PV CLIMATE TOOL CONCEPT NOTE

Estimation of baseline and project soil organic carbon removals in Plan Vivo projects

Version 1.1

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1 Summary

The proposed tool will be integrated into the PV Climate Agriculture and Forestry Carbon Benefit Assessment Methodology (**PM001**)[1] to provide procedures and guidance for estimating changes in soil organic carbon (SOC) stocks in PV Climate project areas under baseline and project scenarios. The tool will not address trace gas emissions of CH_4 and N_2O.

In PV Climate projects, climate benefits are defined as the net increase in carbon stocks and/or net reduction in greenhouse gas (GHG) emissions, each relative to the carbon baseline and attributable to a project intervention. For project interventions that aim to generate net-removal of GHGs, baseline and project scenario removals are estimated following module **PU001**. Project interventions that aim to generate net reductions in GHG emissions must apply **PU002** to estimate baseline and project scenario emissions. Procedures for using in-situ measurements, process-based models validated with in-situ measurements, and (where appropriate) the use of conservative default values, will be provided to determine values for the following parameters that are used to estimate climate benefits following **PM001, PU001** and **PU002**:

$BR_{SO,a,y}$ Net GHG removals in soil organic carbon under the baseline scenario for project area *a* up to year *y* (t CO_2e)

$BE_{SO,a,y}$ Net GHG emissions from soil organic carbon under the baseline scenario for project area *a* up to year *y* (t CO_2e)

$PR_{SO,a,y}$ Net GHG removals in soil organic carbon under the project scenario for project area *a* up to year *y* (t CO_2e)

$PE_{SO,a,y}$ Net GHG emissions from soil organic carbon under the project scenario for project area *a* up to year *y* (t CO_2e)

The proposed tool will be applicable to project interventions in grassland, shrubland, savanna, woodland, forestland and other natural ecosystems where vegetation is grazed by wild and/or domestic herbivores; and to project interventions that either increase the carbon stored in soils, or reduce the rate of loss of SOC through activities such as grazing management, grassland restoration and agricultural land management, noting that different approaches may be better suited to specific ecosystems and activities. Where possible, procedures will also be provided that are applicable to other land cover types and project activities.

2 Relationship to Existing Approaches

PLAN VIVO METHODOLOGIES

The tool will be referenced in relevant sections of the following approved PV Climate Modules:

PU001 Estimation of baseline and project GHG removals by carbon pools in Plan Vivo projects[2]

[1] PM001 Plan Vivo Agriculture and Forestry Project Carbon Benefit Assessment Methodology, Version 1.0. PV Climate Methodology. Available from: https://www.planvivo.org/pm001

[2] PU001 Estimation of Baseline and Project GHG Removals by Carbon Pools in Plan Vivo Projects, Version 1.0. PV Climate Module. Available from: https://www.planvivo.org/pu001

PU002 Estimation of baseline and project GHG emissions from carbon pools in Plan Vivo projects[3]

PU003 Estimation of baseline and project GHG emissions from emission sources in Plan Vivo projects[4]

PU004 Estimation of GHG Emissions from Leakage in Plan Vivo Projects[5]

PU005 Estimation of Uncertainty of Carbon Benefit Estimates in Plan Vivo Projects[6]

The scope of these modules, and additional procedures that will be provided by the proposed tool are summarised below. Where possible the tool will be integrated with approved modules and tools within **PM001**, for example for determining a baseline scenario in **PU001** and **PU002**, and accounting for leakage and uncertainty with **PU004** and **PU005**. If deviations are necessary to maintain the integrity of the SOC procedures, alternative procedures will be developed and integrated into existing modules. Tools that are under development for use of models validated by measurements and for determining whether land is degraded and degrading may also be applied within the proposed tool.[7]

Baseline SOC Removals

PU001 allows the use of the following approaches for estimating baseline removals in SOC:

i. Measurements in matched control areas using an approved tool.
ii. Process-based modelling following the procedures in **PT001**
iii. Assuming removals in soil organic carbon under the baseline scenario are zero for afforestation, reforestation and agroforestry activities that meet the applicability criteria in **AR-ACM003** v2.0 (or **AR-AM0014** v3.0 for mangroves),[8,9] and/or if it can be demonstrated that soil organic carbon stocks are expected to decline under the baseline scenario
iv. Applying a credible and conservative default factor from a published source.

There is no approved tool that currently enables projects to apply a dynamic baseline approach (i.e. approach i). The scope of **PT001** Small-holder Agriculture Monitoring and Baseline Assessment (SHAMBA) Tool is limited to project interventions that involve tree planting, agroforestry or conservation agriculture and to use of the RothC model, so approach ii is not applicable outside of these interventions or with different models. [10] **PT001** also has only limited guidance of validation of model predictions. With approaches iii and iv, there is no guidance for assuming no soil organic carbon removals under the baseline scenario or applying a conservative default value other than for afforestation, reforestation and agroforestry activities.

[3] PU002 Estimation of Baseline and Project GHG Emissions from Carbon Pools in Plan Vivo Projects, Version 1.0. PV Climate Module Available from: https://www.planvivo.org/pu002
[4] PU003 Estimation of baseline and project GHG emissions from emission sources in Plan Vivo projects, Version 1.0. PV Climate Module. Available from: https://www.planvivo.org/pu003
[5] PU004 Estimation of GHG Emissions from Leakage in Plan Vivo Projects, Version 1.0. PV Climate Module. Available from: https://www.planvivo.org/pu004
[6] PU005 Estimation of Uncertainty of Carbon Benefit Estimates in Plan Vivo Projects, Version 1.1. PV Climate Module. Available from: https://www.planvivo.org/pu005
[7] https://www.planvivo.org/Handlers/Download.ashx?IDMF=557917c0-a26a-4800-b2fc-4642844766f4
[8] https://cdm.unfccc.int/methodologies/DB/C9QS5G3CS8FW04MYYXDFOQDPXWM4OE
[9] https://cdm.unfccc.int/methodologies/DB/KMH6O8T6RL3P5XKNBQE2N359QG7KOE
[10] PT001 Smallholder Agriculture Monitoring and Baseline Assessment (SHAMBA) Tool, Version 2.0. PV Climate Tool. Available from: https://www.planvivo.org/pt001

The proposed tool will address these gaps by providing some or all of the following:

- Dynamic baseline procedures for estimating baseline SOC removals in matched control areas;
- Procedures for using process-based modelling of SOC removals under the baseline scenario; and
- Procedures and guidance for conservative estimation of baseline scenario changes in SOC for project activities other than afforestation, reforestation and agroforestry; such as grazing management and grassland restoration.

Expected Project SOC Removals

PU001 allows the use of the following approaches for estimating expected project removals in SOC:

i. Process-based modelling following the procedures in **PT001**
ii. Applying the relevant default factor for afforestation and reforestation activities from **AR-TOOL16** v1.1[11]
iii. Applying a credible and conservative default factor from a published source.

The scope of **PT001** is limited to project interventions that involve tree planting, agroforestry or conservation agriculture and to use of the RothC model so approach i is not applicable outside of these interventions or with different models. With approaches ii and iii, there is no guidance for applying a conservative default value other than for afforestation and reforestation activities.

The proposed tool will address these gaps by providing some or all of the following:

- Procedures for using process-based modelling to estimated expected SOC removals; and
- Procedures and guidance for conservative estimation of expected changes in SOC for project activities other than afforestation and reforestation and agroforestry; such as grazing management and grassland restoration.

Actual Project SOC Removals

PU001 allows the use of the following approaches for estimating actual project removals in SOC:

i. Measurements in project areas following procedures in an approved tool;
ii. Process-based modelling using **PT001**;
iii. Applying the relevant default factor for afforestation and reforestation activities from **AR-TOOL16** v1.1 or **AR-AM0014** v3.0 (for mangroves)
iv. Applying a credible and conservative default factor from a published source.

There is no approved tool that currently enables projects to apply approach i. The scope of **PT001** is limited to project interventions that involve tree planting, agroforestry or conservation agriculture and to use of the RothC model so approach ii is not applicable outside of these interventions or with different models. **PT001** also has only limited guidance of validation of model predictions. With approaches iii and iv, there is no guidance for applying a conservative default value other than for afforestation and reforestation activities.

The proposed tool will address these gaps by providing some or all of the following:

- Procedures for estimating change in soil organic carbon from in-situ measurements, including guidance on sampling and soil analysis;

[11] https://cdm.unfccc.int/methodologies/ARmethodologies/tools/ar-am-tool-16-v1.1.0.pdf/history_view

- Procedures for using process-based modelling validated with in-situ measurements for assessing changes in SOC; and
- Procedures and guidance for conservative estimation of project scenario changes in SOC for project activities other than afforestation and reforestation and agroforestry; such as grazing management and grassland restoration.

Baseline and Project SOC Emissions

PU002 refers to procedures for estimation of baseline and project emissions from soil in forest protection projects in the PV Climate Tool PT002 Estimation of Climate benefits from REDD in community-managed forests,[12] but there are no tools approved by Plan Vivo for estimating baseline emissions from soil under other project interventions.

The approaches described above for estimating baseline SOC removals, may also be applicable for estimation of baseline SOC emissions enabling an extension of the scope of **PU002** beyond forest protection activities.

Sampling Procedures

Where possible, the sampling and soil analysis procedures in the tool will align with established protocols such as the Land Degradation Surveillance Framework (LDSF) – an indicator framework that enables systematic and science-based assessment and monitoring of soil and ecosystem health at scale, which has been applied across a broad range of ecosystems in over 40 countries.[13]

OTHER METHODOLOGIES

In the development of this concept note, the following methodologies and tools approved for use in other GHG programmes were reviewed:

Verified Carbon Standard

VM0032 Methodology for the Adoption of Sustainable Grasslands through Adjustment of Fire and Grazing, v1.0[14]

VM0042 Methodology for Improved Agricultural Land Management, v2.1[15]

Climate Action Reserve

US Soil Enrichment Protocol, v1.1[16]

Social Carbon Standard

SCM0005 Methodology for Regenerative Land Management, v2.0[17]

ACR

[12] PT002 Estimation of Carbon Benefits from REDD in Community Managed Forest, Version 2.0. PV Climate Tool. Available from: https://www.planvivo.org/pt002
[13] https://www.cifor-icraf.org/knowledge/publication/25533/
[14] https://verra.org/methodologies/vm0032-methodology-for-the-adoption-of-sustainable-grasslands-through-adjustment-of-fire-and-grazing-v1-0/
[15] https://verra.org/methodologies/vm0042-improved-agricultural-land-management-v2-1/
[16] https://www.climateactionreserve.org/wp-content/uploads/2022/06/Soil-Enrichment-Protocol-V_1.1-final.pdf
[17] https://www.socialcarbon.org/scm0005

Grazing Land and Livestock Management, v1.0 [INACTIVE][18]

Aspects of these methodologies and guidelines will inform the development of procedures in the proposed tool, with adaptations where appropriate to facilitate implementation in the PV Climate project context.

3 Scope and Applicability

The proposed tool will include procedures for the estimation of expected and actual project SOC emissions or removals. It will therefore be possible to apply the tool to generate fPVCs, rPVCs and vPVCs.

The tool will be applicable globally to estimate baseline and project SOC emissions or removals from project interventions in grassland and cropland that either increase the carbon stored in soils, or reduce the rate of loss of SOC through activities such as grazing management, grassland restoration and agricultural land management. Where possible, procedures will also be provided that are applicable to other land cover types and project activities.

It is expected that the tool will be applied by the following PV Climate projects transitioning to Version 5 of the PV Climate Standard:

- Pastures, Conservation and Climate Action, Mongolia[19]

Grazing management and grassland restoration projects that are currently under development in Kazakhstan, Northern Kenya and elsewhere may also apply the tool, as well as existing and future rangeland management, agricultural land management, agroforestry and forestry projects.

4 Baseline Scenario and Additionality

The proposed tool will applied within **PM001**, so the procedures for describing the baseline scenario and demonstrating additionality will follow **AR-TOOL02**,[20] unless this is not consistent with the procedures developed, in which case an alternative will be provided.

5 Quantification of Carbon Benefits

The proposed tool will be applied within **PM001**, so the procedures for potential and actual leakage emissions will follow **PU004**, procedures for calculation of carbon benefits will follow the equations in **PM001** with the uncertainty adjustment defined following **PU005**, and procedures for trace gas emissions will follow **PU003**. If the procedures developed are not consistent with the procedures in these existing methodology elements, alternatives will either be integrated into the tool or provided through updates to the existing methodology or modules.

An overview of the procedures for estimating the carbon baseline, and expected and actual project emissions and removals, is provided below. Compliance of the proposed procedures with the PV Climate Methodology Requirements[21] is summarised in Table 1.

[18] https://acrcarbon.org/methodology/inactive-grazing-land-and-livestock-management/
[19] https://www.planvivo.org/pastures-conservation-climate-action
[20] AR-TOOL02 Combined tool to identify the baseline scenario and demonstrate additionality in A/R CDM project activities, Version 1.0. CDM Tool. Available from: https://cdm.unfccc.int/methodologies/ARmethodologies/tools/ar-am-tool-02-v1.pdf/history_view
[21] https://www.planvivo.org/pv-climate-documentation

Carbon Baseline

Some or all of the following options for quantifying baseline emissions/removals from SOC will be included in the tool:

- **Dynamic baseline procedures** – involving in-situ measurements of SOC and/or proxy measures in matched control areas.
- **Process-based modelling** – using models parameterised with environmental and activity data that represents the baseline scenario for the project area(s)
- **Conservative defaults** – describing conditions under which it is conservative to assume no change in SOC under the baseline scenario and/or sources from which conservative estimates of changes in SOC can be derived.

Expected Project Emissions/Removals

Some or all of the following options for estimating expected emissions/removals from SOC will be included in the tool:

- **Process-based modelling** – using models parameterised with environmental and activity data that represents the project scenario(s)
- **Conservative defaults** – describing sources from which conservative estimates of changes in SOC can be derived under different environmental conditions and management interventions.

Actual Project Emissions/Removals

Some or all of the following options for estimating actual emissions/removals from SOC will be included in the tool:

- **In-situ measurement** – directly measuring change in SOC in the project area(s) with efficient soil sampling and analysis procedures.
- **Process-based modelling** – using models parameterised with environmental and activity data that represents the project scenario(s) with results validated with in-situ measurements
- **Conservative defaults** – describing sources from which conservative estimates of changes in SOC can be derived under different environmental conditions and management interventions.

Table 1 Justification for compliance with PV Climate Methodology Requirements

Methodology Requirement Type	Summary of Compliance
1.1 Methodology Structure	• The tool will be prepared using the latest template provided by Plan Vivo
1.2 Uncertainty	• When sampling procedures are used uncertainty will be estimated using the Equation 1 in PU005 Section 5.1.1; or an alternative approach for estimating sampling uncertainty at a 90% confidence level • For model-based procedures, the tool will include procedures for estimating model error at a 90% confidence level and reporting this as a percentage of the carbon benefit derived from the SOC pool.
1.3 Quantifying Emissions and Removals	• The tool will only be used to quantify changes in SOC stocks • All procedures will be consistent with international good practices in greenhouse gas accounting.

	• All data, parameters, assumption and calculations will be fully described and justified
1.4 Measurements and Sampling	• All procedures that involve measurements will apply established procedures for sample collection and analysis that minimise measurement error.
1.5 Models, Default Factors and Proxies	• Only publicly available models will be applied, and procedures will include requirements to demonstrate that models have been appropriately calibrated to the project conditions, and to ensure that models are applied in a manner that minimises potential for over-estimation of carbon benefits. • Any default values used will be sourced from reliable peer-reviewed literature that is appropriate to the scope of application. • Proxy values will only be used if there is robust evidence that they are strongly correlated to the parameter they represent.
2.1 Applicability Conditions	• The tool will have global application and the project interventions it can be applied to will be specified • It will be possible to apply the tool to generate fPVCs, rPVCs and vPVCs
2.2 Carbon Pools and Emission Sources	• The tool will be applicable to projects where SOC has been identified as a significant carbon pool following the procedures in **PM001** that require application of **AR-TOOL04**[22]
2.3 Baseline Scenario and Additionality	• The tool will be applied within **PM001**, so the procedures for describing the baseline scenario and demonstrating additionality will follow **AR-TOOL02.**
2.4 Carbon Baseline	• The tool will describe procedures for estimating annualised baseline emissions/removals from SOC, based on the identified baseline scenario • The tool will include procedures for updating carbon baselines where appropriate
2.5 Project Emissions and Removals	• The tool will describe procedures for estimating annual emissions/removals from SOC under the project scenario • The tool will include indicators and procedures for estimating project emissions/removals in each verification period
2.6 Harvesting	• SOC stocks may fluctuate in areas where trees are harvested. The tool will therefore apply an average carbon stock procedure to estimating changes in SOC when there is tree harvesting with even-aged management and cap carbon benefits from changes in SOC at the minimum post harvest carbon benefit when there is partial felling.
2.7 Leakage	• The tool will be applied within **PM001**, so the procedures for accounting for leakage will follow **PU005.**
2.8 Calculation of Carbon Benefits	• Calculation of carbon benefits will follow the procedures in **PM001**.

[22] AR-TOOL04 Tool for testing significance of GHG emissions in A/R CDM project activities, Version 1.0. CDM Tool. Available from:https://cdm.unfccc.int/methodologies/ARmethodologies/tools/ar-amtool-04-v1.pdf/history_view

6 Development Team

The tool will be developed by a consortium of technical service providers with experience in the development and implementation of methodologies for carbon standards:

- **TLLG** supported the Plan Vivo Foundation with the development of Version 5 of the Plan Vivo Standard including the Plan Vivo Methodology Requirements. They also led the development of PM001 and the associated modules and tools and contributed to the VCS Methodology for Avoided Forest Degradation through Fire Management (VM0029).
- **TerraCarbon** developed the VCS Methodology for Improved Agricultural Land Management (VM0042) that includes assessment of changes in soil organic carbon in agricultural land and emission reductions from livestock management and the VCS Methodology for Afforestation, Reforestation and Revegetation (VM0047) that includes procedures for dynamic baseline setting that could potentially be applied to avoided conversion of grasslands.
- **Natural State** is pioneering a range of measurement, reporting and verification (MRV) procedures that integrate remote sensing and ground-based monitoring, to provide a robust and cost-effective way to assess the carbon impact of grassland management projects, including below-ground carbon, as well as measuring the biodiversity and ecosystem benefits.

Individuals involved in the development of the tool will include:

- **Nicholas Berry** (TLLG)- the lead author of PM001 and all the associated modules and tools. A chartered forester with a PhD in Tropical Forest Ecology. He is also the chair of the Plan Vivo Technical Advisory Committee and has been providing technical support to Plan Vivo projects since 2008. He has played a leading role in the last two updates of the Plan Vivo Standard, and development of the Plan Vivo Methodology requirements. He has previously developed methodologies for reduced emissions from deforestation and forest degradation, improved agricultural land management, and grassland management that have been approved by Plan Vivo and VCS.
- **Jaclyn Kachelmeyer** (TerraCarbon) - supports the evaluation, design, and implementation of nature-based carbon projects with a primary focus on agricultural soil projects. Her background includes work in soil health, carbon storage research, and conservation of working lands. Jaclyn holds a Master of Environmental Management from the Yale School of the Environment and a Bachelor of Arts in Geography and International Relations from the University of Texas.
- **Jenny Langan-Farmer** (Natural State) - a land use specialist, with over 15 years of diverse experience as both a practitioner and research scientist evaluating land use impacts and carbon market opportunities. She has specialised expertise in measuring and modelling soil carbon and greenhouse gas emissions from land use and land use change, and experience with environmental and social impact assessment, ecosystem service assessment, and grassland, agroforestry and conservation projects within sub-Saharan Africa. She has supported the early-stage development of carbon methodologies, recent updates to the methodology guidance of the new Plan Vivo Standard and evaluation of VCS methodology approaches for agroforestry projects.

The consortium will also receive input from a methodology development working group comprised of stakeholders with an interest in the development of procedures for the assessment of carbon benefits from SOC in Plan Vivo projects, and scientists from the Centre for International Forestry Research and

World Agroforestry (CIFOR-ICRAF) involved in the development of the Land Degradation Surveillance Framework (LDSF).