Approved VCS Tool VT0003
Version 1.0
Tool for the Estimation of Uncertainty for IFM Project Activities
Sectoral Scope 14

I. SCOPE, APPLICABILITY AND PARAMETERS

Scope

This tool allows for estimating uncertainty in the estimation of emissions and removals in IFM project activities, i.e. for calculating a precision level and any deduction in credits for lack of precision following project implementation and monitoring, by assessing uncertainty in baseline estimations and in estimations of with-project sequestration, emissions and leakage.

Applicability

This tool shall only be applicable for use under VM0005 VCS Methodology for Improved Forest Management- Low to High Productive Forests, Version 1.0.

This tool focuses on the following sources of uncertainty:

- Uncertainty associated with estimation of stocks in carbon pools and changes in carbon stocks
- Uncertainty in assessment of project emissions

Where an uncertainty value is not known or cannot be simply calculated, then a project proponent must justify that it is using a conservative number and an uncertainty of 0% may be used for this component.

Guidance on uncertainty – a precision target of a 90% confidence interval equal to or less than 10% of the recorded value shall be targeted. This is especially important in terms of project planning for measurement of carbon stocks where sufficient measurement plots should be included to achieve this precision level across the measured stocks.

Required conditions

- Levels of uncertainty must be known for all aspects of baseline and project implementation and monitoring. Uncertainty will generally be known as the ±90% confidence interval expressed as a percentage of the mean.
- Where uncertainty is not known it must be demonstrated that the value used is conservative.

Parameters

This tool provides procedures to determine the following parameter:

Parameter	SI Unit	Description
C_{IFM_ERROR}	%	Total uncertainty for IFM project activity

II. PROCEDURE

Estimated carbon emissions and removals arising from AFOLU activities have uncertainties associated with the measures/estimates of: area or other activity data, carbon stocks, biomass growth rates, expansion factors, and other coefficients. It is assumed that the uncertainties associated with the estimates of the various input data are available, either as default values given in IPCC Guidelines (2006), IPCC GPG-LULUCF (2003), expert judgment[1], or estimates based of sound statistical sampling.

Alternatively, conservative estimates can also be used instead of uncertainties, provided that they are based on verifiable literature sources or expert judgment. In this case the uncertainty is assumed to be zero. However, this tool provides a procedure to combine uncertainty information and conservative estimates resulting in an overall *ex-post* project uncertainty.

Planning to Diminish Uncertainty

It is important that the process of project planning consider uncertainty. Procedures including stratification and the allocation of sufficient measurement plots can help ensure that low uncertainty in carbon stocks results and ultimately full crediting can result.

It is good practice to apply this tool at an early stage to identify the data sources with the highest uncertainty to allow the opportunity to conduct further work to diminish uncertainty.

Part 1 – Uncertainty in Baseline Estimates

Relevant parameters:

$C_{harvest,i}$
$C_{damage,i}$
$C_{DW,i}$
$C_{WP,i}$
$C_{BSLpre,i}$
$C_{BSLpost,i}$
$C_{DWpre,i}$
$C_{tree-exist,i,t}$
$GHG_{BSL-E,t}$

[1] Justification should be supplied for all values derived from expert judgment.

Uncertainty should be expressed as the 90% confidence interval as a percentage of the mean.

$$Uncertainty_{BSL,i} = \frac{\sqrt{\left(U_{BSL,SS1,i} * E_{BSL,SS1,i}\right)^2 + \left(U_{BSL,SS2,i} * E_{BSL,SS2,i}\right)^2 \ldots + \ldots \left(U_{BSL,SSn,i} * E_{BSL,SSn,i}\right)^2}}{E_{BSL,SS1,i} + E_{BSL,SS2,i} \ldots + \ldots E_{BSL,SSn,i}} \quad (1)$$

Where:

$Uncertainty_{BSL,i}$	Percentage uncertainty in the combined carbon stocks and greenhouse gas sources in the baseline case in stratum *i*; %
$U_{BSL,SS,i}$	Percentage uncertainty (expressed as 90% confidence interval as a percentage of the mean where appropriate) for carbon stocks and greenhouse gas sources in the baseline case in stratum *i* (1,2…n represent different carbon pools and/or GHG sources); %
$E_{BSL,SS,i}$	Carbon stock or GHG sources (e.g. trees, down dead wood, etc.) in stratum *i* (1,2…n represent different carbon pools and/or GHG sources) in the baseline case; t CO_2-e
i	1, 2, 3 …M_{BSL} strata in the baseline scenario

To assess uncertainty across combined strata:

$$Uncertainty_{BSL} = \frac{\sqrt{\left(U_{BSL,1} * A_1\right)^2 + \left(U_{BSL,2} * A_2\right)^2 \ldots + \ldots \left(U_{BSL,M_{BSL}} * A_{M_{BSL}}\right)^2}}{A_1 + A_2 \ldots + \ldots A_{M_{BSL}}} \quad (2)$$

Where:

$Uncertainty_{BSL}$	Total uncertainty in baseline scenario; %
$U_{BSL,i}$	Uncertainty in baseline scenario in stratum *i*; %
A_i	Area in stratum *i;*
i	1, 2, 3 …M_{BSL} strata in the baseline scenario

Part 2 – Uncertainty Ex-Post in the With-Project Scenario

Relevant parameters:

$E_{biomassloss,t}$
$\Delta C_{AGB,i,t}$

$\Delta C_{BGB,i,t}$
$\Delta C_{DW,i,t}$
$\Delta C_{WP,i,t}$
$GHG_{WPS\text{-}E,t}$
ΔC_{LK}

$$Uncertainty_{WPS,i} = \frac{\sqrt{\left(U_{WPS,SS1,i} * E_{WPS,SS1,i}\right)^2 + \left(U_{WPS,SS2,i} * E_{WPS,SS2,i}\right)^2 \ldots + \ldots \left(U_{WPS,SSn,i} * E_{WPS,SSn,i}\right)^2}}{E_{WPS,SS1,i} + E_{WPS,SS2,i} \ldots + \ldots E_{WPS,SSn,i}} \quad (3)$$

Where:

$Uncertainty_{WPS,i}$	Uncertainty in the with-project scenario in stratum *i*; %
$U_{WPS,SS,i}$	Percentage uncertainty (expressed as 90% confidence interval as a percentage of the mean where appropriate) for carbon stocks or greenhouse gas sources and leakage emissions in the with-project case in stratum *i* (1,2…n represent different carbon pools and/or GHG sources); %
$E_{WPS,SS,i}$	Carbon stock, GHG sources or leakage emission type (e.g. trees, down dead wood, etc.) in stratum *i* (1,2…n represent different carbon pools and/or GHG sources) in the with-project case; t CO_2-e
i	1, 2, 3 …M_{WPS} strata in the project scenario

To assess uncertainty across combined strata:

$$Uncertainty_{WPS} = \frac{\sqrt{\left(U_{WPS,1} * A_1\right)^2 + \left(U_{WPS,2} * A_2\right)^2 \ldots + \ldots \left(U_{WPS,M_{BSL}} * A_{M_{BSL}}\right)^2}}{A_1 + A_2 \ldots + \ldots A_{M_{BSL}}} \quad (4)$$

Where:

$Uncertainty_{WPS}$	Total uncertainty in project scenario; %
$U_{WPS,i}$	Uncertainty in baseline project in stratum *i*; %
A_i	Area in stratum *i*;
i	1, 2, 3 …M_{WPS} strata in the project scenario

Part 3 – Total Error in IFM Project Activity

$$C_{IFM\_ERROR} = \sqrt{Uncertainty_{BSL}^{2} + Uncertainty_{WPS}^{2}} \quad (5)$$

Where:

C_{IFM_ERROR}	Total uncertainty for IFM project activity; %
$Uncertainty_{BSL}$	Total uncertainty in baseline scenario; %
$Uncertainty_{WPS}$	Total uncertainty in the with-project scenario; %

Part 4 – Implications for Project Accounting

If $C_{IFM\_ERROR} \leq 10\%$ of $\Delta C_{IFM,t}$ then no deduction shall result for uncertainty.

If $C_{IFM\_ERROR} > 10\%$ of $\Delta C_{IFM,t}$ then the modified value for $\Delta C_{IFM,t}$ to account for uncertainty shall be:

$$= \frac{100 - C_{IFM\_ERROR}}{100} * C_{IFM,t} \quad (6)$$

Where:

$\Delta C_{IFM,t}$	Total net GHG emission reductions from the IFM project activity up to year *t*; t CO_2-e
C_{IFM_ERROR}	Total uncertainty for IFM project activity; %

III. DATA AND PARAMETERS MONITORED

Data / parameter:	$E_{BSL,SS}$
Data unit:	t CO_2-e
Used in equations:	1
Description:	Carbon stock or GHG sources (e.g. trees, dead wood, wood products etc.) in the baseline case

Source of data:	The terms denoting significant carbon stocks, GHG sources from Chapter 4 of the methodology (baseline accounting) used to calculate net emission reductions.
Measurement procedures (if any):	
Any comment:	

Data / parameter:	$E_{WPS,SS}$
Data unit:	t CO_2-e
Used in equations:	2
Description:	Carbon stock or GHG sources (e.g. trees, down dead wood, etc.) in the with-project case
Source of data:	The terms denoting significant carbon stocks or GHG sources used in calculating net emission reductions in Chapter 5 of the methodology (project accounting).
Measurement procedures (if any):	
Any comment:	

Data / parameter:	$U_{BSL,SS}$
Data unit:	%
Used in equations:	1
Description:	Percentage uncertainty (expressed as 90% confidence interval as a percentage of the mean where appropriate) for carbon stocks and greenhouse gas sources in the baseline case (1,2…n represent different carbon pools and/or GHG sources)
Source of data:	Calculations arising from field measurement data
Measurement procedures (if any):	*Uncertainty in pools derived from field measurement with 90% confidence interval calculated as the standard error of the averaged plot measurements in each stratum multiplied by the t value for the 90% confidence level.* *For wood products the uncertainty should be the confidence interval around the volume of timber extracted from the forest.* *For emission sources conservative parameters should be used sufficient to allow the uncertainty to be set as zero.*
Any comment:	

Data / parameter:	$U_{WPS,SS}$
Data unit:	%
Used in equations:	3
Description:	Percentage uncertainty (expressed as 90% confidence interval as a percentage of the mean where appropriate) for carbon stocks and greenhouse gas sources in the with-project case (1,2…n represent different carbon pools and/or GHG sources)
Source of data:	Calculations arising from field measurement data
Measurement procedures (if any):	*Uncertainty in pools derived from field measurement with 90% confidence interval calculated as the standard error of the averaged plot measurements in each stratum multiplied by the t value for the 90% confidence level.* *For wood products the uncertainty should be the confidence interval around the volume of timber extracted from the forest.* *For emission sources conservative parameters should be used sufficient to allow the uncertainty to be set as zero.*
Any comment:	

IV. PARAMETERS ORIGINATING IN THE METHODOLOGY

Data / parameter:	ΔC_{IFM}
Data unit:	t CO_2-e
Used in equations:	6
Description:	Total net GHG emission reductions from the IFM project activity up to year t; t CO_2-e
Any comment:	

Data / parameter:	A_i
Data unit:	Ha
Used in equations:	2 and 4
Description:	Area of stratum *i*
Any comment:	