Approved VCS Methodology
VM0021

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Sectoral Scope 14

Soil Carbon Quantification
Methodology

Methodology developed by:

The Earth Partners LLC.

RELATIONSHIP TO APPROVED OR PENDING METHODOLOGIES

To date no similar methodologies have been approved under the VCS Program.

Four related methodologies are currently under development or approved under the VCS Program:

- *ALM Adoption of Sustainable Grassland Management through Adjustment of Fire and Grazing* (methodology under development)- This methodology is limited to activities on uncultivated grasslands where fire is a potential occurrence.

- *Agricultural Land Management – Improved Grassland Management* (methodology under development) – This methodology is dependent on the existence of applicable, tested soil models for determining soil carbon.

- *VM0017 Adoption of Sustainable Agricultural Land Management (SALM)* – This methodology focuses on a specific set of management practices

- *Methodology for Sustainable Grassland Management (SGM)* (methodology under development) – This methodology is specific to sustainable grassland management projects where ongoing degradation is occurring and is expected to continue

- *Calculating Emission Reductions in Rice Management Systems* (methodology under development) – This methodology is specific to reducing emissions from rice cultivation.

All of these existing proposed methodologies focus on specific elements of the ALM continuum. The use of soil carbon prediction models such as Century and DNDC are widely applied in these methodologies. This methodology is much more general, and is designed to be applicable to projects where a wide variety of activities may occur under the baseline or project scenario, such as timber harvesting, and fertilization. Soil carbon is measured in both the baseline and project scenarios and the DNDC model is used only for quantifying the methane and nitrous oxide emissions.

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1   SOURCES

This methodology and its modules have been developed on the accounting principles as set out in: IPCC 2003 Good Practice Guidance for Land Use, Land-Use Change and Forestry.

The modules used in this methodology are:

- *VMD0018 Methods to Determine Stratification*
- *VMD0019 Methods to Project Future Conditions*
- *VMD0020 Methods to Determine the Project Boundary*
- *VMD0021 Estimation of Stocks in the Soil Carbon Pool*
- *VMD0022 Estimation of Carbon Stocks in Living Plant Biomass*
- *VMD0023 Estimation of Carbon Stocks in the Litter Pool*
- *VMD0024 Estimation of Carbon Stocks in the Dead Wood Pool*
- *VMD0025 Estimation of Woody Biomass Harvesting and Utilization*
- *VMD0026 Estimation of Carbon Stocks in the Long Lived Wood Products Pool*
- *VMD0027 Estimation of Domesticated Animal Populations*
- *VMD0028 Estimation of Emissions from Domesticated Animals*
- *VMD0029 Estimation of Emissions of Non-CO_2 GHG from Soils*
- *VMD0030 Estimation of Emissions from Power Equipment*
- *VMD0031 Estimation of Emissions from Biomass Burning*
- *VMD0032 Estimation of Emissions from Activity Shifting Leakage*
- *VMD0033 Estimation of Emissions from Market Leakage*
- *VMD0034 Methods for Developing a Monitoring Plan*
- *VMD0035 Methods to Determine the Net Change in Atmospheric GHG Resulting from Project Activities*

2   SUMMARY DESCRIPTION OF THE METHODOLOGY

This methodology describes methods for quantifying and monitoring changes in carbon accrual in, and emissions from, soils, as well as from other GHG pools and sources which may be impacted by soil focused activities. The methodology is designed based on guidance provided in the IPCC 2003 Good Practice Guidance for Land Use, Land-Use Change and Forestry. This methodology has been designed to be applicable to conservation, ecosystem restoration and agricultural projects, as well as other projects where the management of soils directly, or management of hydrology, fertility and vegetation systems, can affect changes in soils and soil carbon. The methodology is applicable to a range of project activities designed to improve soils, including changes to agricultural practices, grassland and rangeland restorations, soil carbon protection and accrual benefits from reductions in erosion, grassland protection projects, and treatments designed to improve diversity and productivity of grassland and savanna plant communities.

The intention of the developers has been to create a methodology which includes sufficient detail on methods to allow a wide range of project proponents to use the methods during the development of soil carbon projects. However, accurately estimating and projecting the values of the various ecosystem carbon pools does require a significant level of technical ability on the part of the project proponent team. It is therefore expected that in many cases landowners and farmers may need to work with people with

specific technical skills to complete the development of a soil carbon project description (PD) using this methodology.

This methodology provides methods for the quantification of soil carbon, as well as methods for quantifying changes in vegetation and litter pools which can be impacted by project activities, as compared with the baseline scenario.

This methodology does not address projects designed to enhance carbon sequestration in ancient soils (paleosols) that have been buried by more recent soil formations. While the same methods presented here are applicable to characterize the buried substrates, other methods (such as drilling rigs with a deeper boring capacity and split spoon sampling equipment) are beyond the scope of this methodology, which is focused on the extant active soil surfaces and active present day rooting zones soils.

This methodology is focused on addressing the following key variables:
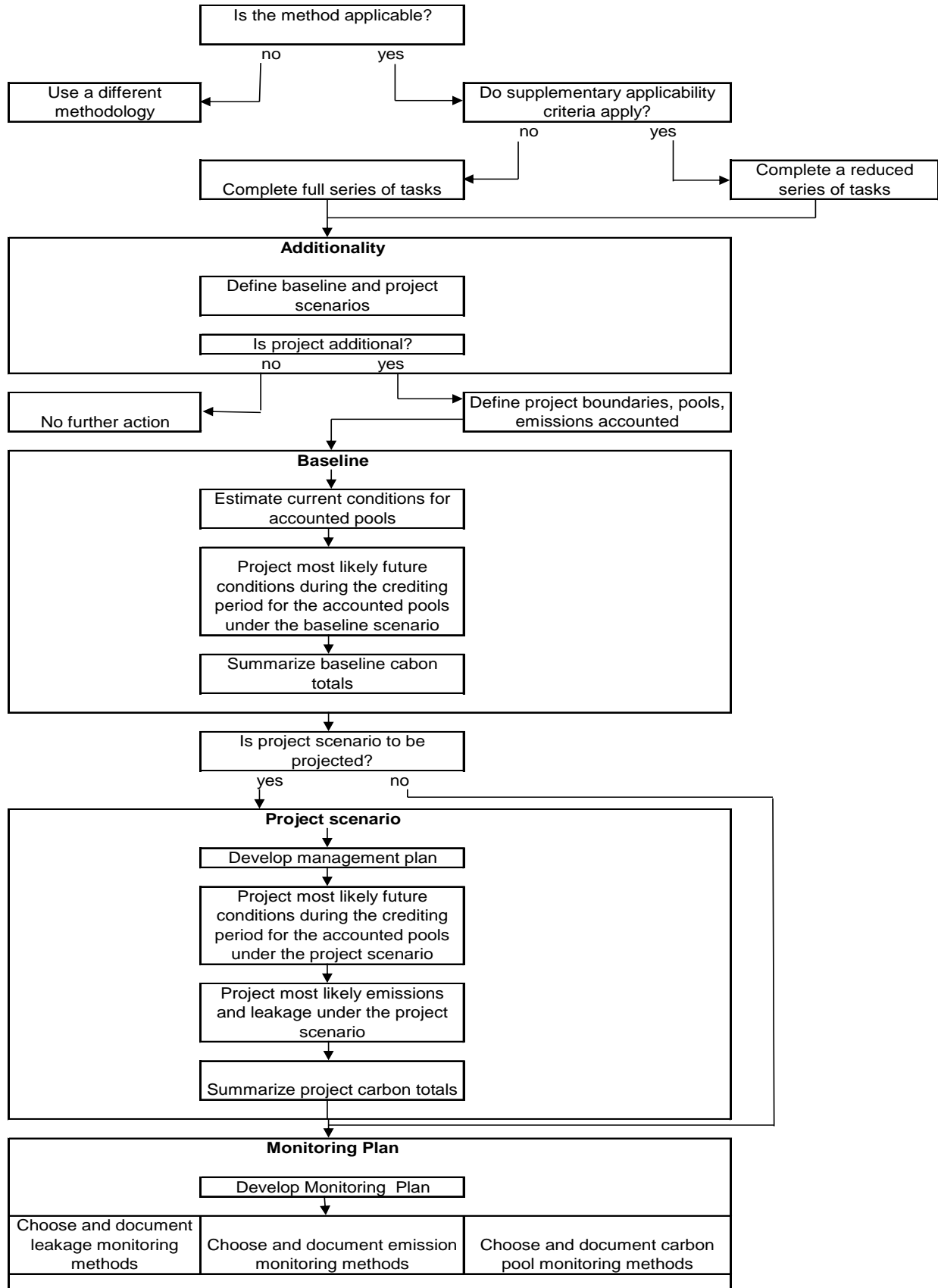
- Estimating the amount of carbon in the soil, litter, and living vegetation pools at the start of the project;

- Monitoring and documenting changes in soil carbon and the other carbon pools over time under the project scenario;

- Projecting changes in soil carbon and other pools under the baseline scenario;

- Estimating emissions of nitrous oxides and methane from soils, and,

- Estimating project leakage.

The methodology has been designed using a modular approach. This methodology document lays out the steps required to fulfill estimation, projection and quantification requirements for projects wishing to register credits under the VCS. The methodology calls on the associated modules for specific techniques and options for estimating or projecting the GHG impacts of changes in specific pools and emissions.

The methodology requires the completion of four main tasks, each of which is comprised of a number of sub-tasks:

1. Task 1: Identification of project boundary, demonstration of additionality and determination of the baseline scenario

2. Task 2: Ex-ante estimation and projection of carbon pools and emissions under the baseline scenario

3. Task 3: Ex-ante estimation and projection of carbon pools and emissions under the project scenario

4. Task 4: Development of a monitoring plan subsequent ex-post monitoring of pools and emissions under the project scenario as well as under the baseline scenario if a monitored baseline is used, and monitoring of leakage.

The overall process used by the methodology is shown in the following methodology map.

Is the method applicable?		
no		yes

Use a different methodology

Do supplementary applicability criteria apply?		
no		yes

Complete full series of tasks

Complete a reduced series of tasks

Additionality

Define baseline and project scenarios

Is project additional?	
no	yes

No further action

Define project boundaries, pools, emissions accounted

Baseline

Estimate current conditions for accounted pools

Project most likely future conditions during the crediting period for the accounted pools under the baseline scenario

Summarize baseline cabon totals

Is project scenario to be projected?	
yes	no

Project scenario

Develop management plan

Project most likely future conditions during the crediting period for the accounted pools under the project scenario

Project most likely emissions and leakage under the project scenario

Summarize project carbon totals

Monitoring Plan

Develop Monitoring Plan

Choose and document leakage monitoring methods	Choose and document emission monitoring methods	Choose and document carbon pool monitoring methods

3   DEFINITIONS

Activity Shifting Leakage: Activities that are moved by local actors from within the project area to outside due to the project, and which result in losses of carbon in pools outside the project area.

Agent: A person or organization undertaking actions which impact the management of carbon pools and emissions.

Baseline: The total amount of carbon within the project area in absence of the project.

Baseline Scenario: The most likely sequence of events and actions which would be expected to occur within the project area in the absence of the project.

Carbon Project: See *VCS Program Definitions* for project.

Conservative: Tending to err on the side of reduced creditable carbon in cases where uncertainty exists as to the correct value of variables, or relationships among variables.

Coarse Fragments: Pieces of rock or cemented soils > 2mm in diameter, and therefore too large to pass through the screen used in the laboratory prior to laboratory analyses.

Directly Attributable: The change or effect occurs as result of a chain of causal events linking the change or effect to an event, or to the actions of an agent. Each of the causal events or conditions in the chain must be primarily and directly caused by the previous event in the chain. Analysis of the linkages in the chain should show that for each one, the previous event is at least 75% responsible for the next event. For this reason, the relationship between an event, or the actions of an agent, and the directly attributable effect, typically consist of not more than a few causal linkages.

Ex-ante: Before the fact. Projection of values or conditions in the future.

Ex-post: After the fact. Estimation of values or conditions in the present or past.

Long Lived Wood Products: Products produced from harvested timber which is expected to persist and to sequester carbon for an extended period of time – typically 100 years, unless there is a specific reason for using a different time period.

Monitoring Event: The time at which monitoring of all of the relevant variables is undertaken, to determine the net change in atmospheric carbon attributable to the project.

Monitoring Period: The time period specified in a monitoring report during which GHG

emission reduction or removals were generated by the project.

Monitoring Plan: Plan in which a monitoring schedule and methods will be documented.

Planned: Changes in the value of the variable are under the control of identified agents who are independent of the project proponent.

Project Area :   The area or areas of land on which the project proponent will undertake the project activities.

Project Crediting Period: See *VCS Program Definitions.*

Project Scenario: The actions and events which are expected to occur as a result of implementing the project.

Significant: A pool or source is significant if it does not meet the criteria for being deemed de minimis. Specific carbon pools and GHG sources, including carbon pools and GHG sources that cause project and leakage emissions, may be deemed de minimis and do not have to be accounted for if together the omitted decrease in carbon stocks (in carbon pools) or increase in GHG emissions (from GHG sources) amounts to less than five percent of the total GHG benefit generated by the project.

Stratification: The division of an area into sub-units (strata) which are relatively homogenous for the value of the variable on which the stratification is based, which are repeatable in the landscape, and could reasonably be expected to be similarly identified and classified by different people.

Stratum (plural strata):   An area of land within which the value of a variable, and the processes leading to change in that variable, are relatively homogenous.

Verification Date: A date, at which an independent verifier audits the results of monitoring.

Woody Biomass: Biomass which exists primarily in the form of lignified tissues, such as that of shrubs and trees. Typically accounting of woody biomass includes the non woody parts (leaves, etc.) of plants which contain woody biomass.

4   APPLICABILITY CONDITIONS

4.1   Mandatory Conditions

All projects using this methodology must meet the following conditions:

    a. Projects must meet the most recent VCS requirements for one of the following three Agricultural Land Management activities:

- Improved Cropland Management (ICM)

- Improved Grassland Management (IGM)

- Cropland and Grassland Land-use Conversions (CGLC)

b. As of the project start date all of the project area consists of grasslands or croplands. Crops may include woody species grown for food products, fuel products or timber, providing that the densities of these crops do not meet the requirements for definition of these lands as forest lands. The project area must not consist of forest, wetlands, or peatlands, as such terms are defined under the VCS.

c. The only baseline activities that could be displaced by the project activities are grazing and fodder production, crop production and timber production.

d. Project activities must not include changes in surface and shallow (<1m) soil water regimes through flood irrigation, drainage or other significant anthropogenic changes in the ground water table.

e. The project activity must not cause a significant change in termite populations, as compared with the baseline scenario.

4.2   Optional Conditions

The following conditions do not need to be met to utilize the methodology. However, each of these conditions allows the simplification of the methodology through the elimination of the requirement for the completion of specific tasks.

a. The activities and agents which have caused the degradation of the croplands, grasslands or rangelands are expected to continue to impact the area in the absence of the project activity. On that basis, it can be demonstrated that the total carbon content of the soil organic and inorganic carbon pools within the project area is highly unlikely to increase under the baseline scenario during the project crediting period.

    Consequence if met: Project proponent may conservatively assume that soil carbon content for all future dates under the baseline scenario shall be accounted as equal to the current soil carbon content, subject to re-assessment at year 10, as required under the VCS rules.

b. Changes in above and below ground living biomass pools within the project area can be shown to be insignificant under either the baseline or project scenarios.

    Consequence if met: Project proponent is not required to complete Tasks 2.4, 2.5, 2.6, 3.3, 3.4, 4.3 and 4.4 of this document.

c. Woody biomass is found within the project area, but amounts of current and projected wood harvest under the baseline and project scenarios are not significant.

    Consequence if met: Project proponent is not required to complete Tasks 2.7, 2.8, 2.9, 3.5, 3.6, 4.5, and 4.6 of this document.

d. GHG emissions from populations of domesticated animals are expected to remain the same or decline under the project scenario as compared with the baseline scenario.

Consequence if met: Project proponent is not required to complete Tasks 2.12, 2.13, 2.14, 3.8, 3.9, 4.8, and 4.9 of this document.

e. No significant change is expected to occur in the amounts or locations of any of the following conditions or activities between the baseline scenario and the project scenario:

- Amount or location of application of organic or inorganic fertilizers.

- Amount or location of domesticated animal grazing and deposition of manure or urine.

- Amount or location of areas subject to flooding, and duration of flooding.

- Amount or location of nitrogen fixing species.

Consequence if met: Project proponent is not required to complete Tasks 2.15, 2.16, 3.10, and 4.12 of this document.

5   PROJECT BOUNDARY

Task 1: Identification of project boundary, demonstration of additionality and determination of the baseline scenario

Task 1.1 Project boundary determination
Requirement: For all projects
Goal: To determine the project boundary for baseline scenario and additionality purposes.
Method: Determine the project boundary using the module *VMD0020 Methods to Determine Project Boundary*

6   PROCEDURE FOR DETERMINING THE BASELINE SCENARIO

Task 1: Identification of project boundary, demonstration of additionality and determination of the baseline scenario (continued)

Task 1.2 Baseline scenario determination

Requirement: Required for all projects.

Goal: To determine the most plausible baseline scenario.

Method: Determine the baseline scenario(s) for the project area using the latest version of the CDM *Combined tool to identify the baseline scenario and demonstrate additionality for A/R CDM project activities.*

The tool has been designed for A/R CDM project activities, but is used for the purposes of this methodology in an ALM context. As such, the following applies:

- Where the tool refers to A/R it must be understood as referring to ALM activities.

- Where the tool refers to forestation, it must be understood as referring to the project agricultural land management activities, and where the tool refers to forest, it must be understood as referring to agricultural land.

- Where the tool refers to CDM, it must be understood as referring to VCS.

- Where the tool refers to tCERs or lCERs, it must be understood as referring to VCUs.

- In case there is a conflict between the CDM tool requirements and the VCS rules, then the VCS rules must be followed.

- Where the tool makes reference to events occurring before or after December 31 1989, it must be understood as referring to events occurring before or after 10 years prior to the project start date.

Use of the tool is subject to the following:

- Applicability conditions: The tool is applicable for all VCS ALM project types that comply with the VCS eligibility rules as set out by AFOLU Requirements v3.2 section 4.2.2, or updated version

- Step 0: Start Date: Must follow most up to date VCS rules.

- Step 1 Point 9: Identify the alternative land management scenario in absence of the VCS ALM project

7   PROCEDURE FOR DEMONSTRATING ADDITIONALITY

Task 1: Identification of project boundary, demonstration of additionality and determination of the baseline scenario (continued)

Task 1.3 Demonstration of additionality

Requirement: Required for all projects

Goal: to determine the additionality of the project.

Method: The project proponent must demonstrate whether or not the proposed project activity is additional using the latest version of the CDM *Combined tool to identify the baseline scenario and demonstrate additionality for A/R CDM project activities*, following the same guidance given in section 6 above, or use the latest version of the VCS *Tool for Demonstration and Assessment of Additionality in VCS AFOLU Project Activities*.

8   QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

8.1   Baseline Emissions

Estimation of the carbon content of current pools, and projection of carbon pools and emissions under the baseline scenario is undertaken using the following the steps:

Task 2: Ex-ante estimation and projection of carbon pools and emissions under the baseline scenario

Task 2.1 Project area stratification for soil carbon

Requirement: Required for all projects.

Goal: To divide the project area into one or more strata within which the existing soil carbon pools and soil carbon dynamics are relatively uniform.

Methods: Use module *VMD0018 Methods to Determine Stratification*, with soil carbon as the relevant variable *X.*

Task 2.2 Estimation of the current carbon content of the soil carbon pool per unit of area, for each stratum

Requirement: Required for all projects.

Goal: To sample the organic and inorganic soil carbon content in each stratum with a sampling intensity sufficient to estimate, at the required levels of statistical precision and accuracy, the amount of soil carbon per unit area.

Methods: Use module *VMD0022 Estimation of Stocks in the Soil Carbon Pool*.

Task 2.3 Projection of the future carbon content of the soil carbon pool per unit of area, for each stratum

Requirement: Required for all projects.

Goal: To project the future organic and inorganic soil carbon content per unit area in each stratum for each projected verification date within the project crediting period under the baseline scenario.

Methods: Use module *VMD0019 Methods to Project Future Conditions*, and *VMD0021 Estimation of Stocks in the Soil Carbon Pool*, unless optional applicability condition (a) (See Section 4) is met.

Task Notes: If optional applicability condition (a) of this methodology is met, soils within the project area are demonstrated to be subject to continued degradation. Therefore, gains in soil carbon under the baseline scenario do not need to be projected. If this applicability condition is met, the methodology allows the project proponent to conservatively assume that the current carbon content of the soils will continue to be the carbon content of the soils throughout the project crediting period under the baseline scenario. In this case, no further work need be done on this task. This approach follows the simplifying precedent set in *CDM AR-AM0001*, now part of the consolidated methodology *CDM AR-ACM0002*.

Task 2.4 Project area stratification for biomass

Requirement: Required for all projects where the difference in total above and below ground biomass carbon between the project scenario and the baseline scenario at any time after the project start date is expected to be significant. Optional for all other projects.

Goal: To divide the project area into one or more strata within which the existing vegetation carbon pools and vegetation dynamics are relatively uniform.

Methods: Use module *VMD0018 Methods to Determine Stratification*, with above and below ground biomass stocks per unit area as the relevant variable *X*.

Task 2.5 Estimation of the carbon content of current aboveground woody and non-woody biomass and below ground living biomass pools

Requirement: Same criteria as Task 2.4.

Goal: To sample the aboveground biomass pools and derive the belowground biomass pool in each stratum with a sampling intensity sufficient to estimate, at the required levels of statistical precision and accuracy, the amount of biomass carbon per unit area.

Methods: Use module *VMD0022 Estimation of Carbon Stocks in Living Plant Biomass*.

Task 2.6 Projection of future biomass pools under the baseline scenario

Requirement: Same criteria as Task 2.4.

Goal: To determine the most likely future changes in total biomass within the project area under the baseline scenario.

Methods: Use module *VMD0019 Methods to Project Future Conditions*, with biomass pools as the relevant variable *X*.

Task 2.7 Estimation of the amount of current wood harvest from within the project area used for production of long lived wood products

Requirement: Required where the harvest of significant amounts of woody biomass currently occurs within the project area, or is expected to occur in the future under the baseline scenario, and some or all of that woody biomass is used for the production of long lived wood products. Optional and not recommended in all other cases.

Goal: To estimate the current amount of woody biomass harvesting taking place within the project area.

Methods: Use module *VMD0025 Estimation of Woody Biomass Harvesting and Utilization*.

Task 2.8 Projection of future wood harvest outputs

Requirement: Same criteria as Task 2.7.

Goal: To project the most probable amount of woody biomass harvesting, and utilization of that harvest for the production of long lived wood products, that is expected to occur under the baseline scenario.

Methods: Use module *VMD0019 Methods to Project Future Conditions*, with wood harvest and utilization for long lived wood products as the relevant variable *X*.

Task 2.9 Long Lived Wood Products

Requirement: Same criteria as Task 2.7.

Goal: To project the amount of carbon which will be sequestered in long lived wood products under the baseline scenario.

Methods: Use module *VMD0026 Estimation of Carbon Stocks in the Long Lived Wood Products Pool*, with the outputs from Tasks 2.7 and 2.8 as the inputs.

Task 2.10 Estimation of current dead wood pools within the project area

Requirement: Required where there are significant amounts of dead wood in the project area at the project start date, and removals of dead wood through utilization, reduced inputs or accelerated burning as part of a management activity are expected to occur under the project scenario. Optional under all other circumstances.

Goal: To estimate the current amount of biomass contained in dead wood pools.

Methods: Use module *VMD0024 Estimation of Carbon Stocks in the Dead Wood Pool*.

Task 2.11 Projection of future dead wood pools within the project area

Requirement: Same as Task 2.10.

Goal: To project the amount of biomass which will be contained in dead wood pools under the baseline scenario.

Methods: Use module *VMD0019 Methods to Project Future Conditions*, with dead wood pools as the relevant variable *X*.

Task 2.12 Estimation of current average domesticated animal populations within the project area

Requirement: Required where GHG emissions from domesticated animal populations within the project area are expected to be significantly greater under the project scenario as compared with the baseline scenario at any time during the project crediting period. Optional under all other circumstances

Goal: To estimate the average current populations of domesticated animals within the project area.

Methods: Use the module *VMD0027 Estimation of Emissions from Domesticated Animals.*

Task 2.13 Projection of future domesticated animal populations under the baseline scenario

Requirement: Same as Task 2.12.

Goal: To project the future populations of domesticated animals under the baseline scenario.

Methods: Use module *VMD0019 Methods to Project Future Conditions*, with domesticated animal populations as the relevant variable *X.*

Task Notes: If at any time within the project crediting period the populations of domesticated animals under the baseline scenario are projected to be greater than those found at the project start date, populations at that time must be accounted as being equal to current levels. Conservatively, this methodology does not account for projected increases in animal populations and resulting emissions under the baseline scenario.

Task 2.14 Estimation of emissions of GHGs from domesticated animals within the project area under the baseline scenario

Requirement: Same as Task 2.11.

Goal: To estimate GHG emissions from current and projected future domesticated animal populations under the baseline scenario.

Methods: Use module *VMD0028 Estimation of Emissions from Domesticated Animals*, with the outputs from Tasks 2.9 and 2.10 as the inputs.

Task 2.15 Estimation of current soil emissions of N_2O or CH_4 from within the project area

Requirement: Required where emissions of N_2O or CH_4 from the soils within the project area are expected to be significantly greater under the project scenario as compared with the baseline scenario at any time within the project crediting period. Optional under all other circumstances.

Goal: To estimate the current emissions of N_2O or CH_4 from within the project area.

Methods: Use module *VMD0029 Emissions of Non-CO_2 GHGs from Soils*.

Task 2.16 Projection of future emissions of N_2O or CH_4 from the soils within the project area

Requirement: Required if at any time within the project crediting period the emissions of N_2O or CH_4 from the soils within the project area under the baseline scenario are projected to be greater than those found under the project scenario. Optional under all other circumstances.

Goal: To project future emissions from soils under the baseline scenario, in the case that these emissions are expected to decline.

Methods: Use module *VMD0019 Methods to Project Future Conditions*, with relevant input variable(s) from the module *VMD0029 Estimation of Emissions of Non CO2 GHG from Soils*, as the relevant

variable(s) *X.* Then, based on the outputs from this module, use the module *VMD0029 Estimation of Emissions of Non-CO$_2$ GHG from Soils* to estimate the projected future emissions.

Task 2.17 Projected emissions from use of power equipment

Requirement: Required for all projects where emissions from power equipment directly attributable to activities within the project area are expected to be significantly greater under the project scenario as compared with the baseline scenario. Not to be used in all other circumstances. Conservatively, this methodology does not account for emission reductions arising from reductions in the use of power equipment under the project scenario as compared with the baseline scenario.

Goal: To project GHG emissions for the monitoring period from the use of power equipment under the baseline scenario. Note that in this methodology emissions of GHGs due to the use of power equipment directly attributable to activities within the project area are all accounted as baseline or project emissions, whether or not the actual emissions occur within the project area.

Methods: Use module *VMD0019 Methods to Project Future Conditions*, with fuel uses in power equipment as the relevant variable(s) *X.* Then, based on the outputs from this module, use the module *VMD0030 Estimation of Emissions from Power Equipment* to estimate the projected future emissions.

Task 2.18 Estimation of current litter pools.

Requirement: Required where significant decreases in litter pools within the project area are expected under the project scenario as compared with the baseline scenario at any time within the project crediting period. Optional under all other circumstances.

Goal: To estimate the carbon content of the litter pool within the project area.

Methods: Use module *VMD0023 Estimation of Carbon Stocks in the Litter Pool.*

Task 2.19 Projection of future litter pools

Requirement: Same as Task 2.18.

Goal: To project emissions from future litter pools under the baseline scenario where these emissions are expected to decline under the baseline scenario.

Methods: Use module *VMD0019 Methods to Project Future Conditions*, with relevant input variable(s) from the module *VMD0023 Estimation of Carbon Stocks in the Litter Pool*, as the relevant variable(s) *X.*

Task Notes: If at any time in the project crediting period the litter pools within the project area under the baseline scenario are projected to be less than those at the project start date, litter pools for that time period must be accounted as being equal to levels at the project start date. Conservatively, this methodology does not account for projected decreases in litter pools under the baseline scenario.

Task 2.20 Summation of estimates and projections under the baseline scenario

Requirement: Required for all projects.

Goal: To sum current and future carbon sequestration and emissions under the baseline scenario.

Methods: Use module: *VMD0035 Methods to Determine the Net Change in Atmospheric GHG Resulting from Project Activities*.

8.2   Project Emissions

Task 3: (A) Ex-Ante Projection of GHG Pools and Emissions In the Project Scenario (Project Emissions)

Estimation of the carbon content of current pools and projection of carbon pools and emissions under the project scenario is undertaken using the following the steps:

Task 3.1 Ex-ante soil restratification

Requirement: Required for all projects.

Goal: To divide the project area into one or more strata within which the projected soil carbon pools and soil carbon dynamics are expected to be relatively uniform under the project scenario, given the stratification determined in Task 2.1, and the proposed treatment under the project scenario.

Methods: Use module *VMD0018 Methods to Determine Stratification*, with soil carbon as the relevant variable *X*.

Task 3.2 Projection of treatment impacts per stratum, and effects on soil C pools

Requirement: Required for all projects.

Goal: To project, for the time within the project crediting period, the changes in soil carbon pools which are expected to occur in each stratum within the project area, given the planned treatments for the stratum.

Methods: Use module *VMD0019 Methods to Project Future Conditions*, with soil carbon as the relevant variable *X*, and module *VMD0021 Estimation of Stocks in the Soil Carbon Pool.*

Task 3.3 Ex-ante biomass re-stratification

Requirement: Required for all projects where significant decreases in living biomass pools are expected to occur under the project scenario, as compared with the baseline scenario. Optional in all other circumstances.

Goal: To divide the project area into one or more strata within which treatments are expected to result in living vegetation carbon pools and living vegetation dynamics which are relatively uniform for the full project crediting period.

Methods: Use module *VMD0018 Methods to Determine Stratification*, with living biomass as the relevant variable *X.*

Task 3.4 Projection of future aboveground woody and non-woody and below ground living biomass pools under the project scenario

Requirement: Same as Task 3.3.

Goal: To project for the monitoring period the aboveground woody and non-woody biomass and belowground living biomass pools in each stratum based on expected treatment regimes, and to estimate the amount of living biomass carbon per unit area based on those projections.

Methods: Use module *VMD0019 Methods to Project Future Conditions*, with live biomass as the relevant variable *X* and the module *VMD0022 Estimation of Carbon Stocks in Living Plant Biomass*.

Task 3.5 Projection of future wood harvest outputs under the project scenario

Requirement: Required for all projects where the harvest of woody biomass within the project area is expected to be significantly lower under the project scenario as compared with the baseline scenario at any time within the project crediting period and some or all of that woody biomass is used for the production of long lived wood products. Optional but recommended in the case that harvests of woody biomass under the project scenario are expected to be significantly greater than those under the baseline scenario. Optional, but not recommended, where no significant wood harvest takes place under either the baseline or project scenario, or where no significant change in levels of wood harvest are expected under the project scenario as compared with the baseline scenario.

Goal: To project for the monitoring period the amount of woody biomass harvesting which is expected to take place within the project area under the project scenario, and the percentage of that harvest which is expected to be used for the production of long lived wood products.

Methods: Use module *VMD0019 Methods to Project Future Conditions*, with wood harvest and wood utilization as the relevant variable *X.*

Task 3.6 Projection of C sequestration in long lived wood products

Requirement: Same as Task 3.5.

Goal: To estimate the amount of carbon which will be sequestered in long lived wood products under the project scenario, based on the projections prepared in Task 3.5.

Methods: Use module *VMD0026 Estimation of Carbon Stocks in the Long Lived Wood Products Pool*, with the outputs from Task 3.5 as the inputs.

Task 3.7 Projection of future dead wood pools within the project area under the project scenario

Requirement: Required where significant amounts of dead wood are found on the site at the project start date, and removals of dead wood through utilization, reduced inputs, or accelerated burning as part of a management activity, are expected to occur under the project scenario. Optional in all other circumstances.

Goal: To estimate the amount of biomass which will be sequestered in dead wood pools under the project scenario.

Methods: Use the module *VMD0019 Methods to Project Future Conditions*, with dead wood pools as the relevant variable *X.*

Task 3.8 Projection of future domesticated animal populations under the project scenario

Requirement: Required where increases in the emissions of GHGs from domesticated animal populations are expected under the project scenario as compared with the baseline scenario. Not to be used in all other circumstances. Conservatively, this methodology does not account for projected decreases in emissions from domesticated animals under the project scenario as compared with the baseline scenario.

Goal: To project the future populations of domesticated animals for the monitoring period under the project scenario.

Methods: Use module *VMD0019 Methods to Project Future Conditions*, with domesticated animal populations as the relevant variable *X.*

Task 3.9 Estimation of emissions of GHGs from domesticated animals within the project area under the project scenario

Requirement: Same as Task 2.10.

Goal: To estimate the emissions of GHGs from the current and projected future populations of domesticated animals under the project scenario the monitoring period based on the projections prepared in Task 3.7.

Methods: Use module *VMD0027 Estimation of Emissions From Domesticated Animals*, with the outputs from Task 3.7 as the inputs.

Task 3.10 Projection of future emissions of N_2O or CH_4 from the soils within the project area

Requirement: Required where significant increases in the emissions of N_2O or CH_4 from the soils within the project area are expected under the project scenario as compared with the baseline scenario. Optional under all other circumstances.

Goal: To estimate future emissions from soils under the project scenario, in the case that these emissions are expected to increase.

Methods: Use module *VMD0019 Methods to Project Future Conditions*, with relevant input variable(s) from the module *VMD0029 Estimation of Emissions of Non CO2 GHG From Soils*, as the relevant variable(s) *X.* Then, based on the outputs from this module, use the module *VMD0029 Estimation of Emissions of Non CO$_2$ GHG from Soils*, to estimate the projected future emissions.

Task 3.11 Projected emissions from use of power equipment

Requirement: Required for all projects where emissions from power equipment directly attributable to activities within the project area are expected to be *significantly* greater under the project scenario as compared with the baseline scenario. Not for use in all other circumstances. Conservatively, this methodology does not account for emission reductions arising from reductions in the use of power equipment under the project scenario as compared with the baseline scenario.

Goal: To estimate GHG emissions for the monitoring period from the use of power equipment under the project scenario. Note that in this methodology emissions of GHGs due to the use of power equipment directly attributable to the project are all accounted for as a project emissions, whether or not they occur within the project boundary.

Methods: Use module *VMD0019 Methods to Project Future Conditions*, with fuel use in power equipment as the relevant variable(s) *X.* Then, based on the outputs from this module, use the module *VMD0030 Estimation of Emissions from Power Equipment*, to estimate the projected future emissions.

Task 3.12 Projection of future litter pools

Requirement: Required where *significant* decreases in the carbon content of the litter carbon pool are expected under the project scenario as compared with the baseline scenario. Optional under all other circumstances.

Goal: To estimate future litter pools under the project scenario.

Methods: Use module *VMD0019 Methods to Project Future Conditions*, with litter carbon pools as the relevant variable *X.*

Task 3.13 Projection of biomass consumption by fire

Requirement: Required where *significant* burning is expected to be used for management of the project area under the project scenario. Optional but not recommended otherwise.

Goal: To project the future amounts of biomass consumed by fire during the project crediting period under the project scenario.

Methods: Use module *VMD0019 Methods to Project Future Conditions*, with biomass consumed by fire as the relevant variable *X.*

Task Notes: This step shall be done twice if biomass burning is to be done both within the project area, and outside of the project area as a consequence of displacement leakage. In that case, the results will be used for separate calculations during Task 3.16.

Task 3.14 Projection of non CO₂ emissions from burning

Requirement: Same as Task 3.13.

Goal: To estimate emissions of non CO2 GHGs from burning of biomass.

Methods: Use module *VMD0029 Estimation of Emissions of Non CO2 GHG from Soils.*

Task Notes: This step shall be done twice if biomass burning is done both within the project area, and outside of the project area as a consequence of activity shifting leakage. In that case, the results will be reported and accounted separately during Task 3.13 above.

Task 3.15 Summation of ex-ante estimates and projections under the project scenario

Requirement: Required for all projects.

Goal: To sum current and future carbon sequestration and emissions under the project scenario.

Methods: Use module *VMD0035 Methods to Determine the Net Change in Atmospheric GHG Resulting from Project Activities*, setting leakage variables to 0, as these will be accounted for in section 8.3 below.

Task 4: (A) Ex-Post Accounting of GHG Pools and Emissions (Project Emissions)

Ex-post accounting of GHG pools and emissions must be undertaken prior to each verification event, and at least once every 5 years during the project crediting period. Note that where leakage mitigation measures include tree planting, agricultural intensification, fertilization, fodder production, and/or other measures to enhance cropland and/or grazing land areas, then any significant increase in GHG emissions associated with these activities must be accounted for using the relevant module, whether or not they occur within the project area, unless they are deemed not significant, or can otherwise be conservatively excluded.

Task 4.1 Ex-post soil re-stratification

Requirement: Required for all projects.

Goal: To divide the project area into one or more strata within which the soil carbon pools and soil carbon dynamics are relatively uniform at the time of sampling.

Methods: Use module *VMD0018 Methods to Determine Stratification*, with soil carbon as the relevant variable *X.*

Task 4.2 Estimation of the carbon content of current soil carbon pools per unit of area, for each stratum

Requirement: Required for all projects.

Goal: To sample the organic and inorganic soil carbon content in each stratum with a sampling intensity sufficient to allow estimation, at the required levels of statistical precision and accuracy, of the amount of soil carbon per unit area.

Methods: Use module *VMD0021 Estimation of Stocks in the Soil Carbon Pool.*

Task 4.3 Ex-post living biomass re-stratification

Requirement: Required for all projects where the aboveground woody and non-woody biomass and belowground living biomass carbon under the project scenario is found to be significantly less than that projected under the baseline scenarios at any time after the project start date. Optional under all other circumstances. Typically completion of this task will be required where the project area before the project start date contains more than scattered woody vegetation, and where the project activities include clearance, site preparation, burning or other activities likely to eliminate woody vegetation, or alternatively to enhance the recruitment of woody vegetation.

Goal: To divide the project area into one or more strata within which the vegetation carbon pools at the end of the project crediting period are relatively uniform.

Methods: Use module *VMD0018 Methods to Determine Stratification*, with above- and belowground living biomass stocks per unit area as the relevant variable *X.*

Task 4.4 Estimation of the carbon content of aboveground woody and non-woody and below ground living biomass pools

Requirement: Same as Task 4.3.

Goal: To sample the aboveground woody and non-woody biomass and below ground living biomass pools in each stratum to a sampling intensity sufficient to allow estimation to the required levels of statistical precision and accuracy of the amount of living biomass carbon per unit area.

Methods: Use module *VMD0022 Estimation of Carbon Stocks in Living Plant Biomass.*

Task 4.5 Estimation of the amount of wood harvest from within the project area used for production of long lived wood products

Requirement: Required for all projects where the harvest of woody biomass within the project area is expected to be *significantly* lower under the project scenario as compared with the baseline scenario at any time within the project crediting period, and some or all of that woody biomass is used for the production of long lived wood products. Optional but recommended in the case that harvests of woody biomass under the project scenario are expected to be significantly greater than those under the baseline scenario. Optional but not recommended in the case where no significant wood harvest takes place under

either the baseline or project scenario, or where no significant change in levels of wood harvest are expected under the project scenario, as compared with the baseline scenario.

Goal: To estimate the amount of woody biomass harvesting taking place within the project area during a monitoring period.

Methods: Use module *VMD0025 Estimation of Woody Biomass Harvesting and Utilization.*

Task 4.6 Long Lived Wood Products

Requirement: Same criteria as Task 4.5.

Goal: To project amount of carbon which will be sequestered in long lived wood products derived from harvesting from within the project area during the monitoring period.

Methods: Use module *VMD0026 Estimation of Carbon Stocks in the Long Lived Wood Products Pool*, with the outputs from Task 4.5 as the inputs.

Task 4.7 Estimation of dead wood pools within the project area

Requirement: Required where dead wood is found on the site at the project start date, and *significant* removals of dead wood through utilization, reduced inputs, or accelerated burning as part of a management activity, are expected to occur under the project scenario. Optional under all other circumstances.

Goal: To estimate the current amount of biomass contained in dead wood pools.

Methods: Use module *VMD0024 Estimation of Carbon Stocks in the Dead Wood Pool.*

Task 4.8 Estimation of current average domesticated animal populations within the project area

Requirement: Required where increases in emissions from domesticated animals within the project area could occur in the project scenario as compared with the baseline scenario, due either to increases in populations or changes in feeding practices., Optional under all other circumstances.

Goal: To estimate the average current populations of domesticated animals within the project area during the monitoring period.

Methods: Use module *VMD0028 Estimation of Emissions from Domesticated Animals.*

Task 4.9 Estimation of emissions of GHGs from domesticated animals within the project area

Requirement: Required where increases in emissions from domesticated animals within the project area could occur in the project scenario as compared with the baselines scenario, due either to increases in populations or changes in feeding practices. Not for use under all other circumstances, to conservatively ensure that crediting for reductions in emissions from domesticated animals does not occur.

Goal: To estimate the emissions of GHGs from the current populations of domesticated animals during the monitoring period.

Methods: Use module *VMD0028 Estimation of Emissions from Domesticated Animals*, with the outputs from Task 4.8 as inputs.

Task 4.10 Estimation of emissions from use of power equipment

Requirement: Required for all projects where emissions from power equipment directly attributable to activities within the project area could be *significantly* greater under the project scenario as compared with the baseline scenario. Not for use in all other circumstances. Conservatively, this methodology does not account for emission reductions arising from reductions in the use of power equipment under the project scenario as compared with the baseline scenario.

Goal: To estimate GHG emissions from the use of power equipment under the project scenario during the monitoring period.

Methods: Use module *VMD0030 Estimation of Emissions from Power Equipment*.

Task notes: Under this methodology emissions of GHGs due to the use of power equipment directly attributable to the project are all accounted as a project emission, whether or not they occur within the project boundary.

Task 4.11 Estimation of non CO_2 emissions from burning

Requirement: Required where *significant* burning has been used for management of the project area under the project scenario. Optional but not recommended under all other circumstances.

Goal: To estimate emissions of non CO_2 GHGs from burning of biomass.

Methods: Use module *VMD0031 Estimation of Emissions from Biomass Burning*.

Task notes: This step must be done twice if biomass burning is done both within the project area and outside of the project area as a consequence of displacement leakage. In that case, the results will be reported and accounted separately during Task 4.15 and/or Task 4.16.

Task 4.12 Monitoring and estimation of soil emissions of N_2O or CH_4 from within the project area

Requirement: Required where *significant* increases in the emissions of N_2O or CH_4 from the soils within the project area are expected under the project scenario as compared with the baseline scenario. Optional under all other circumstances.

Goal: To estimate the emissions of N_2O or CH_4 from within the project area.

Methods: Use module *VMD0029 Estimation of Emissions of Non CO_2 GHG from Soils*.

Task notes: These estimations are expected to be based on the same models as those used during the ex-ante project study, unless improvements in models have occurred in the interim. In either case, values of variables used in the models must be updated to reflect actual conditions which have occurred during the monitoring period. If an updated model is used, and if modeling of baseline emissions was done as part of the baseline study, that modeling must be redone using the improved models.

Task 4.13 Estimation of current litter pools.

Requirement: Required where *significant* decreases in the carbon content of the litter pool are expected under the project scenario as compared with the baseline scenario. Optional under all other circumstances.

Goal: To estimate the carbon content of the litter pool within the project area.

Methods: Use module *VMD0023 Estimation of Carbon Stocks in the Litter Pool*.

Task 4.14 Summation of estimates of GHG fluxes under the project scenario

Requirement: Required for all projects.

Goal: To sum carbon sequestration and emission impacts directly attributable to the project activity based on the monitoring undertaken during the monitoring period.

Methods: Use module *VMD0035 Methods to Determine the Net Change in Atmospheric GHG Resulting from Project Activities*, setting leakage variables to 0, as these will be accounted in section 8.3 below.

8.3   Leakage

Under the VCS rules GHG pools and emissions affected by leakage are projected both ex-ante and accounted ex-post. Note that projects must not account for positive leakage (ie, where GHG emissions decrease, or removals increase, outside the project area due to project activities).

Task 3: (B) Ex-Ante Projection of GHG Pools and Emissions in the Project Scenario (Leakage)

Task 3.16 Projection of leakage due to displacement of grazing, fodder and agricultural production

Requirement: Required for projects where domesticated animal grazing or fodder or agricultural production occurred within the project area at the project start date, and where these activities are projected to decline within the project area due to project activities.

Goal: To project of future emissions from agricultural production, domesticated animals or fodder production displaced under the project scenario.

Methods: Use module *VMD0019 Methods to Project Future Conditions*, with displacement of domesticated animals or agricultural production as the relevant variable(s) *X.* Then, based on the outputs

from this module, use module *VMD0032 Estimation of Emissions from Activity Shifting Leakage*, to estimate the impacts. Depending on the results from the module *VMD0032 Estimation of Emissions From Activity Shifting Leakage*, calculations of emissions may require the use of other modules.

Task 3.17 Projection of leakage due to displacement of wood harvesting

Requirement: Required for projects where displacement of wood harvest to areas outside of the project boundary is projected to occur.

Goal: To project future emissions from wood harvest displaced under the project scenario. Projection includes the reductions in emissions from these displaced wood harvest activities where they are expected to result in the production of long lived wood products.

Methods: Use module *VMD0019 Methods to Project Future Conditions*, with displacement of wood harvest as the relevant variable(s) *X.* Then, based on the outputs from this module, use module *VMD0032 Estimation of Emissions from Activity Shifting Leakage*, to estimate the impacts. Depending on the results from module *VMD0032 Estimation of Emissions from Activity Shifting Leakage*, calculations of emissions may require the use of other modules.

Task notes: Where wood harvesting occurs outside of the project boundary as a result of activity shifting leakage, and where that wood harvesting results in the production of long lived wood products, module *VMD0026 Estimation of Carbon Stocks in the Long Lived Wood Products Pool* must be used to estimate the amounts of carbon stored in wood products resulting from the wood harvesting.

Task 3.18 Projection of market leakage

Requirement: Required for projects where reductions in the production of wood, animals or agricultural products within the project area are expected under the project scenario as compared with the baseline scenario, and where Tasks 3.16 and 3.17 do not find that direct displacement of these activities to identifiable areas outside the project area fully replaces the production lost within the project area.

Goal: To project leakage caused by increases in prices or demand for products resulting from reduced production of these products within the project area under the project scenario.

Methods: Use module *VMD0033 Estimation of Emissions from Market Leakage*.

Task 4: (B) Ex-Post Accounting of Leakage from GHG Pools and Emissions (Leakage)

Task 4.15 Monitoring and estimation of emissions from grazing, fodder and agricultural production displacement

Requirement: Required for projects where domesticated animal grazing or fodder or agricultural production occurred within the project area at the project start date, and where these activities have declined within the project area due to project activities.

Goal: Estimation of emissions from domesticated animals or fodder production displaced as a result of project activities during the crediting period.

Methods: Use module *VMD0032 Estimation of Emissions from Activity Shifting Leakage*, to estimate the impacts. Depending on the results from the module, calculations of emissions may require the use of other modules.

Task 4.16 Monitoring and estimation of emissions from wood harvest displacement

Requirement: Required for projects where wood harvest occurred within the project area at the project start date, and where total wood harvest from the project area over the monitoring period will decline as compared with that projected under the baseline scenario.

Goal: Estimation of emissions from wood harvesting displaced as a result of project activities during the crediting period.

Methods: Use module *VMD0032 Estimation of Emissions from Activity Shifting Leakage*, to estimate the impacts. Depending on the results from the, calculations of emissions may require the use of other modules. Where displaced wood harvesting results in the production of long lived wood products, module *VMD0026 Estimation of Carbon Stocks in the Long Lived Wood Products Pool*, must also be used.

Task 4.17 Estimation of market leakage

Requirement: Required for projects where reductions in the production of wood, animals, or agricultural products within the project area have occurred under the project scenario, as compared with the baseline scenario, and where Tasks 4.15 and 4.16 do not find that direct displacement of these activities to identifiable areas outside the project area fully replaces the production lost within the project area.

Goal: To estimate leakage caused by increases in prices or demand for products resulting from reduced production of these products within the project area under the project scenario.

Methods: Use module *VMD0033 Estimation of Emissions from Market Leakage*.

Task notes: If market leakage has been projected in Task 3, and if the input conditions remain the same ex-post as those predicted ex-ante, the projections completed in Task 3.14 may be used to satisfy the requirements of this task.

8.4   Summary of GHG Emission Reduction and/or Removals

Task 4: Ex-Post Accounting of GHG Pools and Emissions (Net Emissions Reductions and/or Removals)

Task 4.18 Calculation *of GHG emission reductions and/or removals*

Requirement: Required for all projects.

Goal: To summarize net greenhouse gas benefit of project activity.

Methods: Use module *VMD0035 Methods to Determine the Net Change in Atmospheric GHG Resulting from Project Activities*.

Task notes: Net changes in atmospheric GHG at t=z can only be calculated ex-post.

9 MONITORING

9.1 Data and Parameters Available at Validation

Data and parameters available at validation are given in the modules associated with this methodology.

9.2 Data and Parameters Monitored

Data and parameters available at validation are given in the modules associated with this methodology.

9.3 Description of the Monitoring Plan

The monitoring plan must be prepared using module *VMD0034 Methods for Developing a Monitoring Plan*. This module includes specifications on quality assurance and quality control that must be followed during development of the project description and other project documents.

10 REFERENCES AND OTHER INFORMATION

Specific references are given in the modules associated with this methodology.

DOCUMENT HISTORY

Version	Date	Comment
v1.0	16 Nov 2012	Initial version released