VCS MODULE VMD0032

ESTIMATION OF EMISSIONS FROM ACTIVITY-SHIFTING LEAKAGE

Version 1.0

16 November 2012

Sectoral Scope 14

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1 SOURCES

VCS methodology, *VM0015 Methodology for Avoided Unplanned Deforestation*[1]

CDM methodology, *AR-AM 0004 Reforestation or afforestation of land currently under agricultural use*.[2]

2 SUMMARY DESCRIPTION OF THE MODULE

This module provides two possible approaches to the estimation of emissions resulting from activity-shifting to areas outside of the project area, resulting in the emission of GHGs from carbon pools.

3 DEFINITIONS

Agent:	A person or organization undertaking actions which impact the management of carbon pools and emissions.
Leakage Zone:	Zone in which leakage is expected to occur and must therefore be monitored.
Project Area:	The area of land on which the project proponent will undertake project activities.
Reasonably 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 caused by the previous event in the chain with a probability greater than 50%.
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.

4 APPLICABILITY CONDITIONS

None

[1] Available on the VCS website.

[2] Available on the CDM website.

5 PROCEDURES

Introduction:

Only leakage which results in changes in carbon pools or carbon emissions from specific areas outside of the project area are assessed using this module. Thus, for instance, market leakage, where emissions may result from changes in price or other market signals caused by implementation of the project, but where the physical location of the emissions cannot be identified, is not estimated using this module. This module also does not account for emissions from power equipment outside the project area, since those emissions are accounted in the module *VMD0030 Estimation of Emissions from Power Equipment*.

This module provides methods to estimate emissions due to activity-shifting leakage under the project scenario. It is possible that some similar changes (for instance movement of populations to other areas, clearance by local actors of areas outside the project area, etc.) might also have occurred under the baseline scenario, due to causes not associated with the project. In such cases, these changes under the baseline scenario must be projected using the module *VMD0019 Methods to Project Future Conditions*, and deducted from those found using the methods in this module.

This module provides two possible approaches to identifying the amount of project area activity-shifting:

Approach A: Tracking a sample of agents who are undertaking activities within the project area under the baseline scenario, to determine if those activities are shifted to areas outside of the project area under the project scenario.

Approach B: Tracking of changes in land management in an area surrounding the project area (the leakage zone) to see if changes occur in carbon pools which are reasonably attributable to activity-shifting from within the project area.

Approach A is required unless the project proponent can demonstrate that, due to the size of the project or other factors, Approach A is not feasible.

Once the nature and amount of activity-shifting has been determined using one of these two approaches, the amount of GHG emissions associated with this leakage are estimated.

Note that a shift of activity from within the project area to outside of the project area does not necessarily result in leakage. For instance, if cattle are shifted from within the project area to outside of the project area, without any significant change in carbon pools outside of the project area, and emissions from domesticated animals are not included as part of the project area, leakage has probably not occurred. On the other hand, if trees are cleared to provide enhanced pasture for these cattle, or if significant losses of soil carbon are reasonably attributable to the presence of the cattle outside the project area, then leakage has probably occurred.

Step 1: Determine the approach used to identify activity-shifting leakage

Determine whether Approach A or Approach B is to be used to identify and quantify activity-shifting leakage. As noted above, Approach A is required and Approach B is to be used only where the project proponent can demonstrate that, due to the size of the project or other factors.

Step 2: Quantify emissions

Approach A: Tracking of agents

If Approach A was selected in Step 1, activity-shifting leakage must be monitored through sampling the households and communities whose activities have been displaced from land by the project.

Monitoring is undertaken over a 5 year period, as effects arising more than 5 years after the commencement of a project activity are unlikely to meet the standards for being reasonably attributable to the project activity. Thus, under this method, leakage due to conversion of land is not attributable to the project activity if the conversion of land occurs 5 or more years after the shifting of the activity to areas outside the project area. However, where leakage begins during the 5 year period, and is expected to continue (for instance, loss of soil carbon due to overgrazing of areas outside of the project area by cattle displaced from the project area), ongoing monitoring of leakage events identified during the first 5 year period must continue in subsequent monitoring periods.

Under this approach, activity-shifting leakage estimation includes monitoring agents who are undertaking identifiable actions leading to leakage, and conservatively estimating the leakage arising from agents who are not monitored, based on the data generated by the monitoring.

The type and schedule of measures to be taken to prevent leakage must be described in the VCS project description and their implementation monitored.

Leakage due to shifting of agricultural activities can be set as zero ($LK_{conv\text{-}area} = 0$) where activities are shifted to land area with a carbon stock equal to or less than the land from which they are displaced:

$$\mathbf{CS_b \geq CS_{AD}} \quad (16.1)$$

Where:

CS_b = Carbon stock of baseline (t CO_{2eq} ha^{-1})

CS_{AD} = Locally derived carbon stock (including all 5 measurement pools; t CO_{2eq} ha^{-1}) of area of land on which activities shifted.

In such cases, activities are expected to be unlikely to result in further losses of carbon stocks in areas which were at least as degraded as the project area prior to the displacement occurring.

Before project start date, undertake steps A.1 and A.2

Step A.1: Identification of agents and activities

Identify the types of activities occurring both within the project area, and in the surrounding areas, and the types of agents undertaking these activities.

Note that an agent may be an individual, a business or corporation, a family, a cooperative, or any other type of organization where decisions are made by a single person, or collectively or hierarchically by some or all of the members of the organization.

Step A.2: Quantification of agents, activities and landbase

Step A.2-a:
Identify and record the number and identity of agents occupying or undertaking activities on land inside the project area, and determine the amount of land occupied by each agent. Randomly select 10% of the agents (or a minimum of 30) to be sampled for each type of activity undertaken. Where fewer than 30 agents are undertaking activities within the project area, all of them must be tracked.

Step A.2-b:
Identify and estimate the amount of each activity type undertaken by each sampled agent within the project area.

Step A.2-c
Identify and estimate the amount of all land based activities currently undertaken outside the project area by the sampled agents.

One year after project start date, undertake step A.3

Step A.3: Monitoring of agent activities

One year after the project start date, record activities undertaken by the agents outside the project area using the following steps:

Step A.3-a:
Classify sampled agents as either having identifiable or unidentifiable activities outside of the project area. Agents who have moved outside of the province, state, or similar administrative boundary within which the project occurs or who cannot be found are categorized as 'unidentifiable agents'.

Step A.3-b:
For identifiable agents, measure or sample, and estimate the amount of each type of activity that the agent is undertaking both inside and outside of the project area. Measure or sample using the appropriate module for the type of activity being undertaken.

Step A.3-c:
Determine whether an increase in each type of activity outside the project area by each agent has occurred by subtracting the amount of the activity estimated in Step A.2-c from the amount of activity occurring outside the project area estimated in Step A.3-b. Determine whether a decrease in the amount of the activity by the agent within the project area has occurred by subtracting the amount determined for that area in Step A.2-b from the amount determined in Step A.3-b. For any type of activity for which an increase in the amount of the activity outside of the project area by the agent has occurred, and a decrease in that activity by that agent has occurred within the project area, continue to Step A.3-d.

Step A.3-d
For each case where increased activity by an agent outside of the project area is detected, and the agent has reduced the amount of that activity being undertaken within the project area, determine whether or not the activity is having a negative impact on existing carbon pools outside of the project area , or is causing an increase in emissions of non-CO_2 GHGs from the soil or biomass outside the project area , or an increase in non-CO_2 GHGs from enteric fermentation.

Note that as specified in the module *VMD0028 Estimation of Emissions from Domesticated Animals*, where project activities result in a net lower emissions from domesticated animals (ie, emissions from domesticated animals both within and outside the project area), as compared with the baseline, the project proponent can conservatively choose not to account for emissions from domesticated animals under the baseline and project scenarios. In this case, leakage arising from emissions from domesticated animals would also not be accounted.

However, reductions in soil carbon pools in areas outside of the project area resulting from the increased domesticated animal populations would still constitute leakage.

Step A.3-e
For each activity shift causing leakage, locate and map the area impacted by the shifted activity, or quantify the source of the emissions outside of the project area, where it is not area specific (for instance, enteric emissions from cattle outside of the project area).

Step A.3-f:
Determine the nature of the impact caused by the activity-shifting. For instance, activity-shifting might result in decreased woody biomass on an area, decreased soil carbon, increased emissions of CH_4 and N_2O from soils, enteric fermentation, etc.

Step A.3-g:
Utilize the appropriate sampling and calculation modules to conservatively determine the GHG emissions resulting from the activity-shifting leakage. Note that for soil carbon and other similar pools, quantification of the pools at time t=0 in the area affected by the activity-shifting may not exist. However, subsequent monitoring undertaken in Step A.4 will allow estimation of changes between time t=1 and t=5, and changes can be extrapolated backward to time t=0 using appropriate models and assumptions.

Step A.3-h
For sampled agents who are currently unidentifiable, identify the type and amount of activity which they undertook prior to project commencement. Estimate the amount of emissions attributable to them based on extrapolation of the results from the identifiable agents undertaking that activity, proportional to the amount of the activity that they were undertaking. Similarly, in cases where more than 30 agents existed, and not all agents were sampled, extrapolate the results from the sampled agents to the total population of agents proportionally to the amount of the activity undertaken prior to the commencement of the project.

In the case that all of the agents who formerly undertook a particular activity within the project area prior to project commencement (for instance, cattle grazing) are unidentifiable, leakage attributable to those agents must conservatively be calculated based on the assumption that all of the agents continued to undertake the same amount of the activity outside of the project area. Emissions from this displaced activity must be calculated based on the method most likely to be used by people with the economic capacity and skill set of the displaced agents. For example, if smallholders undertaking swidden (slash and burn) agriculture were displaced, the assumption must be that they will continue to undertake swidden agriculture, and the amount of GHGs released by these activities must reflect the soil and vegetation conditions most likely to be found in land which would be available to them.

5 years after project start date, undertake Steps A.4 and A.5

Step A.4: Final monitoring
Repeat Steps A.3-a through A.3-h to determine whether further sources of leakage have arisen, and to quantify the amount of such leakage. For sources of leakage which were identified in Step A.3, Steps A.3-e through A.3-h must be repeated.

Step A.5: Continued impacts of activity shifting
Where leakage sources identified in Steps A.3 or A.4 are expected to continue, project the quantity of leakage expected to occur during each future monitoring period using the module *VMD0019 Methods to Project Future Conditions*.

Approach B: Leakage zone

If the project proponent can demonstrate that, due to the size of the project, or other factors, Approach A is not feasible, the use of this Approach B is appropriate and the following steps must be undertaken:

Before the project start date, undertake Steps B.1 and B.2.

Step B.1: Locate the leakage zone

The leakage zone is an area surrounding the project area, within which leakage is expected to be likely to occur for a given form of leakage.

The project proponent must identify the leakage zone geographically. The project proponent must provide documentation of the reasons for believing that the chosen leakage zone reasonably captures the area within which most of the leakage would be expected to occur.

Step B.2: Prepare the baseline for the variable within the leakage zone

The baseline for the variable(s) which might be impacted by leakage must be projected for the entire area of the leakage zone for the project crediting period using the module *VMD0019 Methods to Project Future Conditions*. Utilization of the module *VMD0019 Methods to Project Future Conditions* must include the use of Step 13 to identify changes in the variable on a location specific basis.

5 years after the project start date, undertake Steps 3.3, 3.4 and 3.5.

Step B.3: Determine the current status of the variable within the leakage zone

The current status of the variable within the leakage zone must be determined using the appropriate methods given in the module relevant to the variable. Where direct sampling of the variable is not possible, remote sensing methods described in Step 7 of the module *VMD0019 Methods to Project Future Conditions* may be used. In this case, remote sensing images should not be more than 1 year old.

Step B.4: Correct the baseline for changes in exogenous factors

When the future values of the variable were projected for the baseline using the module *VMD0019 Methods to Project Future Conditions*, an analysis of the projected future values and impacts of drivers, agents and causes found to be significant was undertaken. Since the analysis of leakage using this approach is undertaken on an ex-post basis, estimates of the actual values of those significant drivers, agents and causes must be ascertained. If those values differ significantly from those used in the ex-ante projections, and that change has occurred as a result of exogenous causes, not as a result of the implementation of the project, the baseline projections of the variable for the leakage zone must be revised based on the estimated actual values of the drivers, agents and causes. For instance, it may have been expected that population in the leakage zone would increase slightly as a result of displacement of a few families from the project area. If in fact the population in the leakage zone has doubled due to immigration of people from another part of the country, the baseline will need to be recalculated to account for the part of the change in population which was not caused by the project activity.

Step B.5: Determine if leakage has occurred

The following decision sequence must be used to determine if leakage has occurred:

Step B.5-a: Reduction of carbon pools, and/or increase in GHG emissions
If the current values of the variable indicate that less carbon exists in carbon pools within the leakage zone, and/or that there has been an increase in GHG emissions, as compared with the amounts that were forecast using the revised baseline for the leakage zone, prepared in Step 3.4 above, continue to Step 3.5.b. If not, no leakage has occurred.

Step B.5-b: Presence of previously unidentified drivers, agents or causes

Determine whether any other exogenous driver, agent or cause, not identified ex-ante, may account for the change in the variable. If the project proponent can demonstrate and document that, with a high degree of probability, such a factor is responsible for the change in the variable, and the consequent reduction in carbon pools and/or increase in GHG emissions within the leakage zone, then no leakage has occurred. If not, then continue to Step 3.5.c. For instance, a change in the world market price for a key agricultural commodity may not have been modeled in the baseline, because it was unlikely that the price change would be large enough to be significant. Since the commencement of the project activity, however, the price of that commodity has tripled, and as a result large areas of land within the leakage zone have been cleared to grow the commodity by large agricultural operators. If the project proponent can demonstrate that all significant change in carbon stocks in the leakage zone is attributable to this change, then it is reasonable to conclude that no significant and attributable leakage has occurred.

Step B.5-c: Plausible causal chain
If the project proponent can demonstrate, with a high degree of probability, that no plausible causal linkage or chain could exist between the actions of the project and the reduction of carbon pools, and/or increase in GHG emissions found, then no accountable leakage has occurred. Otherwise, leakage has occurred.

Step 3: Quantify the change in emissions arising from activity-shifting leakage

If activity-shifting leakage has been found to be reasonably attributable to the project, and significant, using the methods in Approach A or Approach B, then the amount of activity-shifting leakage that has occurred is calculated using the following equation:

$$E_d = Cp_b - Cp_p \quad (16.2)$$

Where:

E_d = The emissions arising from activity-shifting, tCO_2e
Cp_b = The total carbon content of the affected pools under the baseline scenario, as modified in Step 3.4, tCO_2e
Cp_p = The total carbon content of the affected pools under the project scenario, tCO_2e

Carbon content of the pools affected must be estimated or projected using the appropriate modules and methods for that pool, as well as the module *VMD0019 Methods to Project Future Conditions* where projections are required.

6 PARAMETERS

Data Unit / Parameter:	CS_b
Data unit:	$tCO_2e.ha^{-1}$
Description:	Carbon stock of baseline per hectare
Source of data:	Estimated using appropriate modules
Justification of choice of data or description of measurement methods and procedures applied:	
Any comment:	

Data Unit / Parameter:	CS_{AD}
Data unit:	$tCO_2e.ha^{-1}$
Description:	Locally derived carbon stock (including all 5 measurement pools; t CO_{2eq} ha^{-1}) of area of land on which activities shifted
Source of data:	Estimated using appropriate modules
Justification of choice of data or description of measurement methods and procedures applied:	
Any comment:	

Data Unit / Parameter:	E_d
Data unit:	tCO_2e
Description:	Emissions arising from activity-shifting
Source of data:	See formula 15.2
Justification of choice of data or description of measurement methods and procedures applied:	
Any comment:	

Data Unit / Parameter:	Cp_b
Data unit:	tCO_2e
Description:	The total carbon content of the affected pools under the baseline scenario, as modified in Step 3.4
Source of data:	Field survey
Justification of choice of data or description of measurement methods and procedures applied:	The average diameter of the piece of dead wood at the line
Any comment:	

Data Unit / Parameter:	Cp_p
Data unit:	tCO_2e
Description:	The total carbon content of the affected pools under the project scenario
Source of data:	Calculated
Justification of choice of data or description of measurement methods and procedures applied:	
Any comment:	

7 REFERENCES AND OTHER INFORMATION

None

DOCUMENT HISTORY

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