PLAN VIVO CLIMATE MODULE

PU004

Estimation of GHG emissions from leakage in Plan Vivo projects

Version 1.0
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Contents

1 Summary

This module is part of the Plan Vivo Agriculture and Forestry Carbon Benefit Assessment Methodologies (**PM001**). It can be used to provide values for the following parameters:

$LE_{CP,a,y}$ Net GHG emissions due to carbon pool leakage from project area *a* up to year *y* (t CO_2e)

$LE_{ES,a,y}$ Net GHG emissions due to emission source leakage from project area *a* up to year *y* (t CO_2e)

$LD_{CP,a}$ Leakage discount factor for carbon pools in project area *a*

$LD_{ES,a}$ Leakage discount factor for emission sources in project area *a*

2 Sources

This module includes procedures from the following modules and tools:

PU003 Estimation of Baseline and Project GHG Emissions from Emission Sources in Plan Vivo Projects, Version 1.0.

AR-TOOL04 Tool for testing significance of GHG emissions in A/R CDM project activities, Version 1.0.

AR-TOOL15 Estimation of the increase in GHG emissions attributable to displacement of pre-project agricultural activities in A/R CDM project activity, Version 2.0

3 Definitions

Definitions used in this module follow the latest version of the PV Climate Glossary and **PM001**.

4 Applicability Conditions

This module is applicable to all Plan Vivo project interventions that have a risk of activity shifting or market leakage.

5 Procedures

Procedures in **AR-TOOL04** v1.0 can be used to demonstrate the significance of potential leakage emissions. If there is potential for significant leakage emissions, two options are available to account for leakage. Projects can either estimate leakage emissions based on expected and observed activity displacement (see Section 5.1) or apply a conservative leakage discount factor (see Section 5.2).

5.1 Leakage estimation

Leakage emissions can be estimated from expected and observed activity displacement with one or more of the following approaches, depending on the type(s) of leakage that could occur and have potential to be significant:

i. Following the procedures in **AR-TOOL15** v2.0 to estimate leakage from displacement of pre-project agricultural activities (see Section 5.1.1)
ii. Following the procedures in **PT002** v2.0 to estimate leakage from displacement of deforestation and degradation (see Section 5.1.2)
iii. Following the procedures in **PU003** v1.0 to estimate any increase in GHG emissions from emission sources outside the project area that results from project activities

5.1.1 Leakage from agricultural displacement

Carbon pool leakage from displacement of pre-project agricultural activities can be estimated following the procedures in **AR-TOOL15** v2.0 and calculated with Equation 1.

Calculation of carbon pool leakage emissions from displacement of agricultural activity

$$LE_{CP,a,y} = \sum_{t=1}^{y} LK_{AGRIC,t}$$

Equation 1

Where:

$LE_{CP,a,y}$ Net GHG emissions due to carbon pool leakage from project area *a* up to year *y* (t CO$_2$e)

$LK_{AGRIC,t}$ Leakage emission due to the displacement of agricultural activities in year *t* (t CO$_2$e from **AR-TOOL15** v2.0)

5.1.2 Leakage from displacement of deforestation and forest degradation

Leakage from displacement of deforestation and forest degradation in community forest REDD projects can be estimated following the procedures in **PT002** v2.0. Following this approach expected leakage emissions are calculated with Equation 2, and actual leakage emissions are calculated with Equation 3. Expected leakage emissions are used for estimating expected leakage, and actual leakage emissions are used for verification of leakage.

Calculation of expected leakage emissions from displacement of deforestation and forest degradation

$$LE_{CP,a,y} = \sum_{VP} E_{LK,VP}$$

Equation 2

Where:

$LE_{CP,a,y}$ Net GHG emissions due to carbon pool leakage from project area *a* up to year *y* (t CO$_2$e)

$E_{LK,VP}$ Leakage emissions expected to result from displacement of deforestation and degradation during verification period *VP* (t CO$_2$e; from **PT002** v2.0)

Calculation of actual leakage emissions from displacement of deforestation and forest degradation

$$LE_{CP,a,y} = \sum_{VP} AE_{LK,VP}$$

Equation 3

Where:

$LE_{CP,a,y}$ Net GHG emissions due to carbon pool leakage from project area *a* up to year *y* (t CO$_2$e)

$AE_{LK,VP}$ Maximum potential leakage emissions that could have occurred as a result of displacement of deforestation and degradation during verification period *VP* (t CO_2e; from **PT002** v2.0)

5.2   Leakage discount factor

To determine a conservative leakage discount factor for each project area, potential leakage emissions are estimated, and used to calculate a leakage discount factor.

5.2.1   Estimation of potential leakage emissions

Potential activity shifting and market leakage from carbon pools and emission sources are estimated for each project area with Equation 4 and Equation 5 respectively.

Calculation of potential carbon pool leakage emissions

$$pLE_{CP,a} = \sum_{p} Arp_p \cdot Prp_p \cdot \Delta C_{a,p}$$

Equation 4

Where:

$pLE_{CP,a}$ Potential net GHG emissions from carbon pools caused by activity shifting and/or market leakage from project area *a* (t CO_2e)

Arp_p Extent of the project area that will experience reduced use, production or harvesting of wood, animals, agricultural crops or non-timber forest products *p* as a result of project activities (ha)

Prp_p Reduction in production (or use, income etc.) within the part of the project area that will experience reduced use, production or harvesting of wood, animals, agricultural crops or non-timber forest products *p* as a result of project activities; expressed as a proportion of production (or use, income etc.) expected under the baseline scenario.

$\Delta C_{a,p}$ Potential reduction in carbon stocks per hectare from all eligible carbon pools that could occur as a result of displacement of use, production or harvesting of wood, animals, agricultural crops or non-timber forest products *p* from project area *a* (t CO_2e/ha).

Calculation of potential emission source leakage emissions

$$pLE_{ES,a} = \sum_{p} Arp_p \cdot Prp_p \cdot \Delta E_{a,p}$$

Equation 5

Where:

$pLE_{ES,a}$ Potential net GHG emissions from emission sources caused by activity shifting and/or activity shifting leakage from project area *a* (t CO_2e)

Arp_p Extent of the project area that will experience reduced use, production or harvesting of wood, animals, agricultural crops or non-timber forest products *p* as a result of project activities (ha)

Prp_p Reduction in production (or use, income etc.) within the part of the project area that will experience reduced use, production or harvesting of wood, animals,

agricultural crops or non-timber forest products *p* as a result of project activities; expressed as a proportion of production (or use, income etc.) expected under the baseline scenario.

$\Delta E_{a,p}$ Potential increase in emissions from all eligible emission sources per hectare of displaced use, production or harvesting that could occur as a result of displacement of use, production or harvesting of wood, animals, agricultural crops or non-timber forest products *p* from project area *a* (t CO_2e/ha).

5.2.2   Calculation of leakage discount factor

Leakage discount factors that account for potential activity shifting and market leakage emissions from carbon pools are calculated with Equation 6 for projects that result in net GHG emission removals, and Equation 7 for projects that generate net GHG emission reductions.

Calculation of leakage discount factor for carbon pool leakage in removal projects

$$LD_{CP,a} = \frac{pLE_{CP,a}}{PR_{a,t} + BR_{a,t}}$$

Equation 6

Calculation of leakage discount factor for carbon pool leakage in emission reduction projects

$$LD_{CP,a} = \frac{pLE_{CP,a}}{BE_{CP,a,t} - PE_{CP,a,t}}$$

Equation 7

Where:

$LD_{CP,a}$ Leakage discount factor for carbon pools in project area *a*

$pLE_{CP,a}$ Potential net GHG emissions from carbon pools caused by activity shifting and/or market leakage from project area *a* (t CO_2e; see Equation 4)

$PR_{a,t}$ Expected total net GHG removals under the project scenario for project area *a* (t CO_2e; see **PM001**)

$BR_{a,t}$ Total net GHG removals under the baseline scenario for project area *a* (t CO_2e; see **PM001**)

$BE_{CP,a,t}$ Expected total net GHG emissions from carbon pools under the baseline scenario for project area *a* (t CO_2e; see **PM001**)

$PE_{CP,a,t}$ Total net GHG emissions from carbon pools under the project scenario for project area *a* (t CO_2e; see **PM001**)

Leakage discount factor for potential activity shifting and market leakage emissions from emission sources is calculated with Equation 8.

Calculation of leakage discount factor for emission source leakage

$$LD_{ES,a} = \frac{pLE_{ES,a}}{BE_{ES,a,t} - PE_{ES,a,t}}$$

Equation 8

Where:

$LD_{ES,a}$ Leakage discount factor for emission sources in project area a

$pLE_{ES,a}$ Potential net GHG emissions from emission sources caused by activity shifting and/or activity shifting leakage from project area a (t CO_2e; see Equation 5)

$BE_{ES,a,t}$ Net GHG emissions from emission sources under the baseline scenario for project area a up to year y (t CO_2e; see **PM001**)

$PE_{ES,a,t}$ Net GHG emissions from emission sources under the project scenario for project area a up to year y (t CO_2e; see **PM001**)

6 Parameters

Data/Parameter	$LK_{AGRIC,t}$
Units	t CO_2e
Description	Leakage emission due to the displacement of agricultural activities in year t
Equations	Equation 1, Equation 6
Source	See **AR-TOOL15**
Value	N/A
Justification of choice of data or description of measurement methods and procedures applied	See **AR-TOOL15**
Purpose of Data	Calculation of leakage emissions
Comments	N/A

Data/Parameter	$E_{LK,VP}$
Units	t CO_2e
Description	Leakage emissions expected to result from displacement of deforestation and degradation during verification period VP
Equations	Equation 2
Source	See **PT002**
Value	N/A
Justification of choice of data or description of measurement methods and procedures applied	See **PT002**
Purpose of Data	Calculation of expected leakage emissions
Comments	N/A

Data/Parameter	$AE_{LK,VP}$
Units	t CO_2e
Description	Maximum potential leakage emissions that could have occurred as a result of displacement of deforestation and degradation during verification period VP
Equations	Equation 3
Source	See **PT002**
Value	N/A

Justification of choice of data or description of measurement methods and procedures applied	See **PT002**
Purpose of Data	Calculation of actual leakage emissions
Comments	N/A

Data/Parameter	Arp_p
Units	ha
Description	Extent of the project area that will experience reduced use, production or harvesting of wood, animals, agricultural crops or non-timber forest products p as a result of project activities
Equations	Equation 4, Equation 5
Source	Estimated for each product or activity in the project area under the baseline scenario through biophysical or participatory mapping, or surveys of project participants.
Value	N/A
Justification of choice of data or description of measurement methods and procedures applied	The methods used for estimating the extent of the project area used for a particular activity must be described and justified in the PDD.
Purpose of Data	Estimating potential leakage emissions.
Comments	N/A

Data/Parameter	Prp_p
Units	Unitless
Description	Reduction in production (or use, income etc.) within the part of the project area that will experience reduced use, production or harvesting of wood, animals, agricultural crops or non-timber forest products p as a result of project activities; expressed as a proportion of production (or use, income etc.) expected under the baseline scenario.
Equations	Equation 4, Equation 5
Source	Estimated for each product or activity in the project area under the baseline scenario based on records or reports of past and/or expected future use, production and harvesting in the project area, and expected impacts of the project activity.
Value	N/A
Justification of choice of data or description of measurement methods and procedures applied	Evidence and/or justification for baseline and project scenario use, production and harvesting estimates must be provided in the PDD. These estimates must be consistent with the project's baseline scenario and theory of change.
Purpose of Data	Estimating potential leakage emissions.
Comments	N/A

Data/Parameter	$\Delta C_{a,p}$
Units	t CO_2e/ha

Description	Potential reduction in carbon stocks per hectare from all eligible carbon pools that could occur as a result of displacement of use, production or harvesting of wood, animals, agricultural crops or non-timber forest products p from project area a.
Equations	Equation 4
Source	Estimated for each product or activity in the project area under the baseline scenario based on potential impact of displacement on all eligible carbon pools. If the area(s) potentially affected by displacement are not known a 'worst case' scenario should be assumed e.g. that displacement will affect the land cover type with highest potential reductions in carbon stocks as a result of the displaced production or activity.
Value	N/A
Justification of choice of data or description of measurement methods and procedures applied	Potential carbon stock reductions for each potentially displaced product or activity must be described and justified in the PDD.
Purpose of Data	Estimating potential leakage emissions.
Comments	N/A

Data/Parameter	$\Delta E_{a,p}$
Units	t CO_2e/ha
Description	Potential increase in emissions from all eligible carbon pools per hectare of displaced use, production or harvesting that could occur as a result of displacement of use, production or harvesting of wood, animals, agricultural crops or non-timber forest products p from project area a.
Equations	Equation 5
Source	Estimated for each product or activity in the project area under the baseline scenario based on potential impact of displacement on all eligible emission sources. If the area(s) potentially affected by displacement are not known, a 'worst case' scenario should be assumed e.g. that displacement will affect the land cover type with highest potential increases in emissions stocks as a result of the displaced production or activity.
Value	N/A
Justification of choice of data or description of measurement methods and procedures applied	Potential increases in emissions from emission sources for each potentially displaced product or activity must be described and justified in the PDD.
Purpose of Data	Estimating potential leakage emissions.
Comments	N/A

Data/Parameter	$PR_{a,t}$
Units	t CO_2e
Description	Expected total net GHG removals under the project scenario for project area a
Equations	Equation 6
Source	See **PM001**

Value	N/A
Justification of choice of data or description of measurement methods and procedures applied	See **PM001**
Purpose of Data	Calculation of leakage discount factor
Comments	N/A

Data/Parameter	$BR_{a,t}$
Units	t CO_2e
Description	Total net GHG removals under the baseline scenario for project area a
Equations	Equation 6
Source	See **PM001**
Value	N/A
Justification of choice of data or description of measurement methods and procedures applied	See **PM001**
Purpose of Data	Calculation of leakage discount factor
Comments	N/A

Data/Parameter	$BE_{CP,a,t}$
Units	t CO_2e
Description	Expected total net GHG emissions from carbon pools under the baseline scenario for project area a
Equations	Equation 7
Source	See **PM001**
Value	N/A
Justification of choice of data or description of measurement methods and procedures applied	See **PM001**
Purpose of Data	Calculation of leakage discount factor
Comments	N/A

Data/Parameter	$PE_{CP,a,t}$
Units	t CO_2e
Description	Total net GHG emissions from carbon pools under the project scenario for project area a
Equations	Equation 7
Source	See **PM001**
Value	N/A
Justification of choice of data or description of measurement methods and procedures applied	See **PM001**
Purpose of Data	Calculation of leakage discount factor

Comments	N/A

Data/Parameter	$BE_{ES,a,t}$
Units	t CO_2e
Description	Net GHG emissions from emission sources under the baseline scenario for project area a up to year y
Equations	Equation 8
Source	See **PM001**
Value	N/A
Justification of choice of data or description of measurement methods and procedures applied	See **PM001**
Purpose of Data	Calculation of leakage discount factor
Comments	

Data/Parameter	$PE_{ES,a,t}$
Units	t CO_2e
Description	Net GHG emissions from emission sources under the project scenario for project area a up to year y
Equations	Equation 8
Source	See **PM001**
Value	N/A
Justification of choice of data or description of measurement methods and procedures applied	See **PM001**
Purpose of Data	Calculation of leakage discount factor
Comments	N/A

7   References

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

AR-TOOL15 Estimation of the increase in GHG emissions attributable to displacement of pre-project agricultural activities in A/R CDM project activity, Version 2.0. CDM Tool. Available from: https://cdm.unfccc.int/methodologies/ARmethodologies/tools/ar-am-tool-15-v2.0.pdf/history_view

PM001 Agriculture and Forestry Carbon Benefit Assessment Methodology, Version 1.0. PV Climate Methodology. Available from: https://www.planvivo.org/pv-climate-documentation

PU003 Estimation of Baseline and Project GHG Emissions from Emission Sources in Plan Vivo Projects, Version 1.0. PV Climate Module. Available from: https://www.planvivo.org/pv-climate-documentation

PT002 Estimation of Carbon Benefits from REDD in Community Managed Forest, Version 2.0. PV Climate Tool. Available from: https://www.planvivo.org/pv-climate-documentation