T-VER-P-TOOL-01-06
Estimation of the increase in GHG emissions attributable to displacement of pre-project agricultural activities in forest project activities

Version 01

1. Introduction

This tool is used for estimation of the increase in GHG emissions attributable to displacement of pre-project agricultural activities in forest project activities. This tool can be used to estimate greenhouse gas emissions in both baseline and project scenarios.

2. Relevant Definition

Details appear in Annex 1

3. Characteristics of relevant activities and conditions

This tool is suitable for estimating the release of leakage emissions if project activities invade into new areas such as farming, setting up residency, and other activities by their nature and fall within the scope (Applicability) and conditions of implementation in accordance with the forestry project characteristics and conditions.

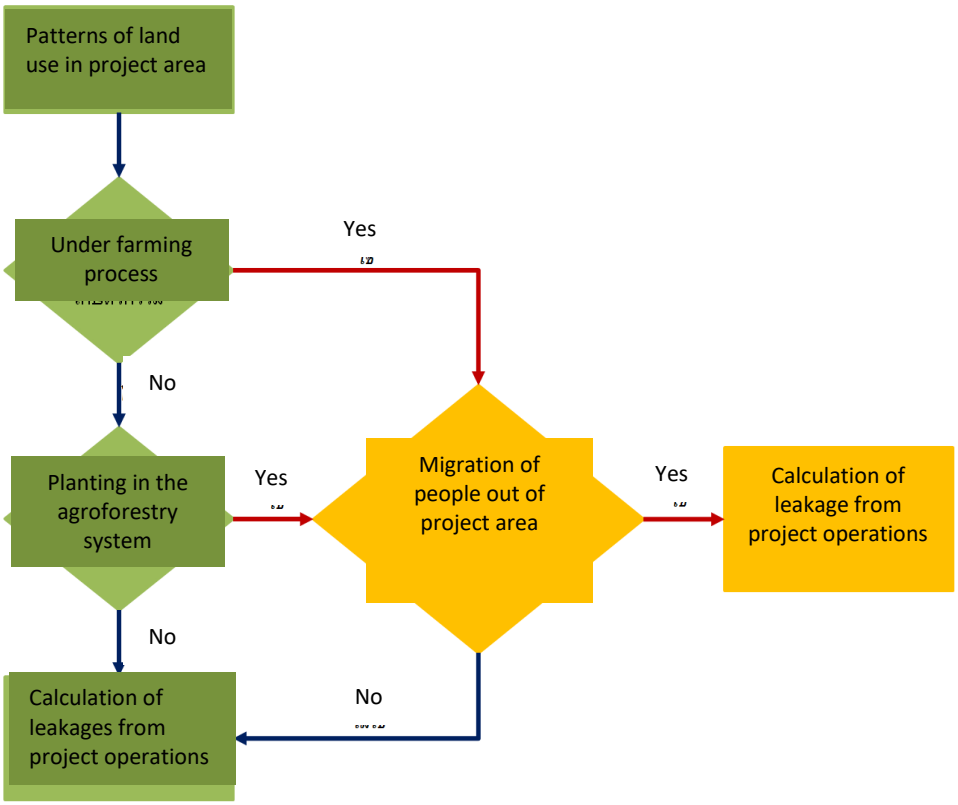
4. Estimation steps

Leakage Emission calculation methods follow the *estimation of the increase in GHG emissions attributable to displacement of pre-project agricultural activities in A/R CDM project activity*).

Leakage emissions caused by the displacement of agricultural activities and invasion into new areas will be calculated from reductions in carbon sequestration in carbon reservoirs affected by project boundary activities:

1) The displacement of agricultural activities alone does not leakage, but if the displacement of agricultural activities leads to higher greenhouse gas emissions compared to those activities in the project area, the leakage emissions must be assessed.
2) Leakage emission causes indirect impacts (such as changes in demand-supply and the price of goods) from project activities in the project scope and are considered insignificant. Therefore, the leakage emission is equivalent to zero.

Steps for leakage emission estimation are as follow:



The leakage emissions can be estimated as per EQUATION (1)-(3):

$$LK_{AGR,t} = \frac{44}{12} \times \left(\Delta C_{BIOMASS,t} + \Delta SOC_{LUC,t}\right) \qquad \textit{EQUATION (1)}$$

$$\Delta C_{BIOMASS,t} = \left[1.1 \times b_{TREE\_ABG} \times (1 + R_{TREE}) + b_{SAP\_ABG} \times (1 + R_{SAP})\right] \times CF \times A_{DISP,t}$$

EQUATION (2)

$$\Delta SOC_{LUC,t} = SOC_{REF} \times (f_{LUP} \times f_{MGP} \times f_{INP} - f_{LUD} \times f_{FGD} \times f_{IND}) \times A_{DISP,t}$$

EQUATION (3)

Where

$LK_{AGR,t}$ = Leakage due to the displacement of agricultural activities from project activities in year t (tons of carbon dioxide equivalent)

$\Delta C_{BIOMASS,t}$ = Changes in carbo outside project boundaries affected by project activities in year t (carbon tons).

		The number 1.1 is a constant used to calculate the total biomass of dead wood and plant waste as a percentage relative to the tree biomass.
CF	=	Carbon fraction of tree biomass
$A_{DISP,t}$	=	Agricultural area arising from the displacement of project activities in year t (rai)
b_{TREE_ABG}	=	Mean above-ground biomass of trees in agricultural areas arising from displacement from project activities (ton of dry weight per rai)
R_{TREE}	=	Root-shoot ratio of tree (no unit)
b_{SAP_ABG}	=	Mean above-ground biomass of sapling in agricultural areas arising from displacement from project activities. (ton dry weight per rai)
R_{SAP}	=	Root-shoot ratio of sapling (no unit)
$\Delta SOC_{LUC,t}$	=	Changes in soil carbon stock caused by changes in land use outside the project before project initiation (tons of carbon). In the event that the value obtained from the assessment is less than 0 (meaning that the area outside the project scope has increased soil carbon accumulation after the project implementation) $\Delta SOC_{LUC,t}$ is 0
SOC_{REF}	=	Carbon accumulated in the soil outside the project area prior to the project commencement (tons of carbon per rai)
f_{LUP}	=	Coefficient of change in carbon stock in soil outside the project area according to land use before project initiation
f_{MGP}	=	Coefficient of change in carbon stock in soil outside the project area according to land management method before project initiation
f_{INP}	=	Coefficient of change in carbon stock in soil outside the project area according to the level of organic matter returned to the soil before the project initiation
f_{LUD}	=	Coefficient of change in carbon stock in soil outside the project area by land use after project activity

f_{MGD} = Coefficient of change in carbon stock in soil outside the project area according to land management method after project activities

f_{IND} = Coefficient of change in carbon stock in soil outside the project area according to the level of organic matter returned to the soil after the project activities.

t = 1, 2, 3, ... year since project initiation

In the event that project activities cause the displacement of activities outside the project areas having different land types, the amount of leakage caused by the change occurred in agricultural land from project activities needs to be calculated separately according to the type of land.

The calculation of carbon stock in soil can be done by using *T-VER-P-TOOL-01-04 Calculation for change in soil organic carbon stocks in forest project activities*

5. Relevant Parameters

5.1 Parameters required monitoring

Parameter	CF
Unit	No unit
Definition	Carbon fraction of tree biomass
Source of Information	OPTION 1 2019 refinement to the 2006 IPCC guidelines for national greenhouse gas inventories: Volume 4 Agriculture, Forestry and Other Land Use OPTION 2 As specified by TGO in the reference manual for the development of the Voluntary Greenhouse Gas Reduction Project according to the standards of Thailand Forestry and Agriculture OPTION 3 Values derived from research published in academic papers that are recognized and identifiable as appropriate for the project area.
REMARK	-

PARAMETER	b_{TREE_ABG}
UNIT	Dry weight ton per rai

DEFINITION	Mean value of aboveground biomass of trees in agricultural areas arising from displacements from project activities.
SOURCE OF INFORMATION	OPTION 1 2019 refinement to the 2006 IPCC guidelines for national greenhouse gas inventories: Volume 4 Agriculture, Forestry and Other Land Use OPTION 2 As specified by TGO in the reference manual for the development of the Voluntary Greenhouse Gas Reduction Project according to the standards of Thailand Forestry and Agriculture OPTION 3 Values derived from research published in academic papers that are recognized and identifiable as appropriate for the project area.
REMARK	

PARAMETER	b_{SAP_ABG}
UNIT	Dry weight ton per rai
DEFINITION	Mean of above-ground biomass of sapling in agricultural areas arising from displacements from project activities.
SOURCE OF INFORMATION	OPTION 1 2019 refinement to the 2006 IPCC guidelines for national greenhouse gas inventories: Volume 4 Agriculture, Forestry and Other Land Use OPTION2 As specified by TGO in the reference manual for the development of the Voluntary Greenhouse Gas Reduction Project according to the standards of Thailand Forestry and Agriculture OPTION3 Values derived from research published in academic papers that are recognized and identifiable as appropriate for the project area.
REMARK	

PARAMETER	R_{TREE}, R_{SAP}
UNIT	Ton dry weight of roots per ton dry weight of plant
DEFINITION	Root-shoot ratio per tree/ sapling
SOURCE OF INFORMATION	OPTION 1 2019 refinement to the 2006 IPCC guidelines for national greenhouse gas inventories: Volume 4 Agriculture, Forestry and Other Land Use

	OPTION2 As specified by TGO in the reference manual for the development of the Voluntary Greenhouse Gas Reduction Project according to the standards of Thailand Forestry and Agriculture OPTION3 Values derived from research published in academic papers that are recognized and identifiable as appropriate for the project area.
REMARK	-

PARAMETER	$SOC_{REF,i}$
UNIT	Tons of carbon per rai
DEFINITION	The amount of carbon stock in the reference soil
SOURCE OF INFORMATION	*T-VER-P-TOOL-01-04 Calculation for change in soil organic carbon stocks in forest project activities*
REMARK	-

PARAMETER	F_{LUP}
UNIT	-
DEFINITION	Coefficient of change in carbon stock in soil outside the project area according to land use type before project initiation
SOURCE OF INFORMATION	*T-VER-P-TOOL-01-04 Calculation for change in soil organic carbon stocks in forest project activities*
REMARK	-

PARAMETER	F_{MGP}
UNIT	-
DEFINITION	Coefficient of change in carbon stock in soil outside the project area according to land management method before project initiation
SOURCE OF INFORMATION	*T-VER-P-TOOL-01-04 Calculation for change in soil organic carbon stocks in forest project activities*
REMARK	-

PARAMETER	F_{INP}
UNIT	-

DEFINITION	Coefficient of change in carbon stock in soil outside the project area according to the level of organic matter returned to the soil before the project initiation
SOURCE OF INFORMATION	*T-VER-P-TOOL-01-04 Calculation for change in soil organic carbon stocks in forest project activities*
REMARK	-

PARAMETER	F_{LUD}
UNIT	-
DEFINITION	Coefficient of change in carbon stock accumulation in soil outside the project area by type of land use after project activity
SOURCE OF INFORMATION	*T-VER-P-TOOL-01-04 Calculation for change in soil organic carbon stocks in forest project activities*
REMARK	-

PARAMETER	F_{MGD}
UNIT	-
DEFINITION	Coefficient of change in carbon stock in soil outside the project area according to land management method after project activities
SOURCE OF INFORMATION	*T-VER-P-TOOL-01-04 Calculation for change in soil organic carbon stocks in forest project activities*
REMARK	-

PARAMETER	F_{IND}
UNIT	-
DEFINITION	Coefficient of change in carbon stock in soil outside the project area according to the level of organic matter returned to the soil after the project activities
SOURCE OF INFORMATION	*T-VER-P-TOOL-01-04 (Calculation for change in soil organic carbon stocks in forest project activities*
REMARK	-

PARAMETER	44/12
UNIT	No unit
Details	Molecular mass of carbon dioxide to carbon used for unit conversion from tons of carbon to tons of carbon dioxide

SOURCE OF INFORMATION	2006 IPCC Guidelines
REMARK	

PARAMETER	1.1
UNIT	No unit
DETAILS	The constant value used to calculate total biomass of dead wood and plant residues as a percentage relative to the tree biomass.
SOURCE OF INFORMATION	AR CDM Tool (A/R CDM) *Estimation of the increase in GHG emissions attributable to displacement of pre-project agricultural activities in A/R CDM project activity*)
REMARK	

5.2 Parameters required monitoring

PARAMETER	$A_{DISP,t}$
UNIT	Rai
DEFINITION	Agricultural areas arising outside the project scope from the displacement of project activities.
SOURCE OF INFORMATION	Monitoring report
Monitoring method	- Area exploration - Use of satellite/aerial imagery
Frequency of monitoring	Following a follow-up assessment cycle for certification
REMARK	

6. References

AR-TOOL15Estimation of the increase in GHG emissions attributable to displacement of pre-project agricultural activities in A/R CDM project activity Version 02.0

Annex

Annex 1 Relevant Definitions

Baseline	Greenhouse gas emissions in business-as-usual case when the project has not yet initiated its activities at all
Leakage emission	Leakage emissions arising from the displacement of agricultural activities to areas outside the project boundaries resulting from forest project activities
Small scale project	Greenhouse gas reduction projects that can reduce or capture greenhouse gases up to 16,000 tons of carbon dioxide equivalent per year.
Large scale project	Greenhouse gas reduction projects that can reduce or capture more than 16,000 tons of carbon dioxide equivalent per year.

Document information

Version	Amendment	Entry into force	Description
01	--	1 March 2023	-