# 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

องค์การบริหารจัดการก๊าซเรือนกระจก (องค์การมหาชน) (อบก.)

**Thailand Greenhouse Gas Management Organization (Public Organization) (TGO)**

## 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 e*stimation 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:
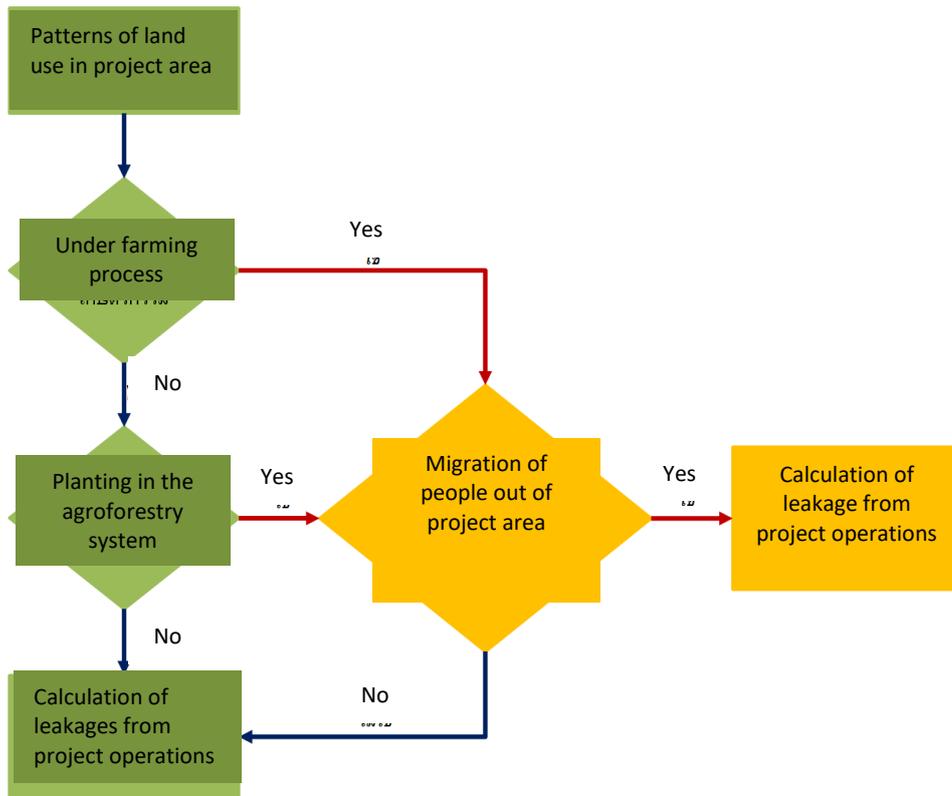


The leakage emissions can be estimated as per EQUATION (1)-(3):

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

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

$$\text{EQUATION (2)}$$

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

$$\text{EQUATION (3)}$$

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 carbon stock in carbo outside project boundaries affected by project activities in year t (carbon tons).

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|  |  |  |
|---|---|---|
|  | | 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 |

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$f_{MGD}$     =     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 |

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| | |
|---|---|
| | 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<br><br>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<br>- 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

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# 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 | - |