AFOLU PROJECT MARKET LEAKAGE: PRODUCTION APPROACH

Public Consultation Document

29 May 2014

Sectoral Scope 14

Table of Contents

1 SOURCES

The following have informed the development of the module:

- VCS JNR Leakage Working Group
- VCS document *AFOLU Requirements*
- VCS document *JNR Requirements*
- VT0004 *JNR Leakage Tool*
- VMD0037 *Global Commodity Leakage Module: Production Approach*
- VCS document *Program Definitions*

2 SUMMARY DESCRIPTION OF THE MODULE

This module estimates the market leakage emissions that are expected to result from AFOLU project activities. The market leakage emissions, expressed as tCO_2e, must be deducted in accordance with the applied methodology.

This module quantifies market leakage based on the amount of leakage mitigation achieved by the project. This is designed to reward projects structured to reduce the amount of production displaced from the project area. Leakage mitigation can be achieved by increasing production within known locations through agricultural intensification, increasing commodity yields, production on marginal lands and decreasing demand for commodities. Any leakage mitigation achieved helps to reduce the amount of production subject to leakage, determined based on a baseline amount of production for the project.

The module uses a number of default values to conservatively estimate how much of the displaced production will be made up elsewhere and how much will require new lands to be brought into production as opposed to being made up for on existing lands. Such leakage is discounted based on the amount of land subject to leakage likely to occur within the country. VCS does not account for leakage occurring outside the host country (ie, international leakage).[1] Leakage emissions factors are then used to convert this land subject to leakage into emissions using primarily defaults and project data. Where the project does not wish to apply the conservative default values they may justify other values.

This module was developed with a working group composed of leading practitioners and experts on REDD+ and has undergone peer review. This module is a modification of the VCS module *VMD0037 Global Commodity Leakage Module: Production Approach*, which was developed with a working group composed of leading practitioners and experts on jurisdictional REDD+ and

[1] This follows the precedent established under the United Nations Framework Climate Change Convention and other GHG programs, is practical, and avoids the political and technical challenges of assessing international leakage and determining attribution.

underwent peer review and public consultation, including review and testing by jurisdictional governments that are applying the VCS JNR framework.[2] This module is particularly relevant for projects nested in a jurisdictional program. This framework can help ensure market leakage at the project-level is determined using parallel procedures as market leakage at the jurisdictional-level. Nested projects may be able to use information in the jurisdictional program description for some of the default values and emissions factors.

3 DEFINITIONS

See the VCS documents *Program Definitions, JNR Requirements* and *AFOLU Requirements,* for further specification on terms and definitions used within this document.

Domestic Market Leakage
Emissions resulting when project activities reduce the production of a commodity, not linked to international markets but sold to domestic or regional markets, causing a change in the supply and market demand equilibrium that leads to increased commodity production elsewhere

Forest Products
Commodities commonly produced on lands that meet the definition of a forest. Typical projects that involve forest products in the baseline scenario include IFM and RED**D** (reducing emissions from degradation).

Forest Projects
In the context of this module, projects where the land use prior to the project start date qualifies as forests. Forest projects include IFM and REDD and WRC projects on forestlands.

Global Commodity Leakage
Emissions resulting when project activities reduce the production of a commodity linked to international markets causing a change in the supply and market demand equilibrium that leads to increased commodity production elsewhere

Non-Forest Products
Commodities commonly produced on lands that do not meet the definition of a forest. Typical projects that involve non-forest products in the baseline scenario include ARR, ALM, RED (reducing emissions from deforestation), and ACoGS.

Non-Forest Projects
In the context of this module, projects where the land use prior to the project start date does not qualify as forests. Non-forest projects include ARR, ALM, ACoGS and WRC projects that do not occur on forest lands.

Relevant Commodity(ies)

[2] VCS JNR Leakage Working Group members can be found at: http://www.v-c-s.org/node/620

A commodity that drives a significant amount of conversion within the project area and/or a commodity that was or would have been produced on more than five percent of the project area in the baseline scenario. Collectively, these commodities are considered relevant commodities and are further classified as either relevant global commodities or relevant domestic commodities

Relevant Domestic Commodity(ies)
A relevant commodity that primarily serves domestic or regional markets (ie, is not linked to international markets). Collectively, these commodities are considered relevant domestic commodities

Relevant Global Commodity(ies)
A relevant commodity that is linked to international markets. Collectively, these commodities are considered relevant global commodities

4 APPLICABILITY CONDITIONS

This module is applicable to projects seeking to estimate a market leakage value.

This module is applicable under the following conditions:

- The project is a REDD, IFM, ARR, ACoGS or WRC project
- The project is a ALM project where there are significant changes in production[3]
- The project affects the production of commodities in the baseline scenario.
- The project is independent of a jurisdictional program or the project is nested within a jurisdictional program that applies a Scenario 1 or Scenario 2 approach (see VCS document *JNR Requirements* for a description of the scenarios).

5 PROCEDURES

5.1 Determination of Relevant Commodities

1.1.1 Identification of Relevant Commodities

AFOLU projects must quantify all significant sources of leakage as described in the VCS document *AFOLU Requirements*. This module provides quantification procedures for market leakage caused by project activities. Market leakage occurs when projects significantly reduce the production of a commodity causing a change in the supply and market demand equilibrium that results in a shift of production elsewhere to make up for the lost supply. Projects must identify all commodities that would have been produced in the baseline scenario. The project must then determine which commodities contribute to a significant amount of baseline emissions within the

[3] In accordance with the VCS document *AFOLU Requirements*, market leakage in ALM projects involving cropland or grassland management activities is likely to be negligible.

project area and classify them as relevant commodities to be used for this analysis. Where the production of a given commodity is determined to be insignificant within the project area, the baseline emissions associated with the production of all such commodities excluded from accounting cannot collectively represent more than 5 percent of total emissions.

Where the project involves baseline land use activities that would not be accounted for in the baseline scenario (eg, afforestation projects where the project area involved livestock grazing in the baseline scenario), relevant commodities must be determined based on the proportion of the project area where such activities occurred in the baseline scenario. Commodities that were or would have been produced on more than five percent of the project area in the baseline scenario must be included as relevant commodities. For example in an ARR project if all of the project area was part of an open pasture system and subject to livestock grazing in the baseline scenario, livestock must be included as a relevant commodity. Only if the project could demonstrate that less than five percent of the project area was subject to livestock grazing could livestock be excluded as a relevant commodity.

In order to distinguish the commodity production related market leakage from production related to activity shifting leakage, project proponents must follow procedures within the applicable methodology. Where the methodology does not provide clear guidance regarding how to distinguish activity shifting leakage from market leakage the following guidance should be applied:

- Production of commodities that supply regional, national or international markets are related to market leakage and must be included in the analysis if they are relevant commodities
- Projects may survey agents of conversion or the households within the project area or baseline reference area to determine what fraction of their production is consumed in the household and should be counted as activity shifting versus what is sold to market and should be accounted as market leakage
- Alternative approaches may be used to provide evidence for distinguishing the commodity production attributable to markets leakage versus activity shifting leakage

1.1.2 Distinguishing Relevant Global Commodities from Relevant Domestic Commodities

Global commodity leakage occurs where the project activities affect the production of relevant global commodities that are linked to international markets, such as agricultural products, forest products (including timber and non-timber forest products) and livestock products. A commodity is considered linked to international markets where a significant amount of the country’s production of that commodity is traded on international commodities markets, given as more than 5 percent of the country’s total production of a given commodity being traded on international commodities markets. Leakage from relevant global commodities is globally distributed and is discounted based on the country’s share of at-risk forest land or grasslands as determined in Section 5.4.

Domestic commodity leakage occurs where the project activities affect the production of relevant domestic commodities that primarily serve domestic or local markets, such as artisanal mining, fuelwood gathering, production of charcoal, and production of other domestically traded forest products (ie, timber and non-timber forest products). Domestic commodities are those that primarily serve domestic or local markets and are not linked to international commodities markets. Leakage from relevant domestic commodities is assumed to occur within the country and is not subject to the deduction from leakage occurring outside the country set out in Section 5.4.

Fuelwood is not considered a relevant global commodity as it is not substantially traded on international commodities markets. Leakage from fuelwood collection must be accounted for as a domestic commodity where fuelwood is sold to markets or through the procedures within the methodology to account for activity shifting leakage.

Where the project only impacts relevant global commodities, proceed to Section 5.4 to determine the domestic share of leakage, *s.* Where the domestic share of leakage is less than five percent, market leakage from the project is *de minimis* and the market leakage emissions can be set as zero. Where the domestic share of leakage is five percent or greater, market leakage should be determined in accordance with the procedures below.

1.1.3 Distinguishing Commodities Based on Baseline Scenario

Commodities must be linked to the baseline scenario for the project in accordance with the procedures within the applicable methodology. Where the project involves multiple project activities, leakage must be assessed separately for each project activity. For example a project that involves reducing emissions from deforestation and degradation must apply this module to quantify the leakage from both the forest products driving forest degradation (eg, timber harvesting with the project area) and the non-forest products driving deforestation (eg, agricultural commodity production that maintains a non-forest land use after the timber has been harvested).

Each relevant commodity must also be specified based on type of land the commodity would be produced on in the baseline scenario (ie, forest product and non-forest product). Projects are also distinguished based on the pre-project land use (ie, forest projects and non-forest projects). A detailed table specifying the project types and commodity types is provided in Appendix 3.

5.2 Amount of Production Subject to Leakage

This section evaluates whether, and to what extent, the project area has experienced a net decline in the amount of commodity production as a result of the project. This analysis must be conducted for, at minimum[4], each relevant commodity *j*, identified using the procedures in Section 5.1. Other commodities that may be substituted for relevant commodities should also be considered. The amount of commodity project subject to leakage is determined by monitoring the

[4] Other commodities that are not relevant or may be substituted for relevant commodities may also be included in this analysis.

amount of increased production of commodities or decreased demand for commodities generated through strategies, policies or measures designed to maintain commodity production (ie, leakage mitigation) as described in Section 5.2.4. This amount of leakage mitigation is then subtracted from the amount of foregone production, which is calculated by applying commodity yields to the area of avoided conversion as described in Section 5.2.3 or the baseline production within the project area, to determine the amount of production subject to leakage in Section 5.2.5.

5.2.1 Proportion of Conversion

For projects that involve avoided conversion (ie, REDD, ACoGS and ALM CGLC), the proportion of conversion from each driver of conversion described in the project description, PD_j, must be estimated. Projects that do not involve conversion and have evidence regarding the amount of production within the project area in the baseline scenario (ie, IFM, ALM and ARR) do not need to estimate the proportion of conversion. Such projects can proceed to Section 5.2.3 to estimate the foregone production.

For all areas where conversion was avoided as reported in the project description or most recent monitoring report, consider what land uses would have occurred, and what commodities would have been produced. At minimum, all relevant commodities identified using the procedures in Section 5.1 must be included in this analysis.

Where livestock from cattle grazing is identified as a relevant commodity, commodity yield data for livestock must be included. However, these data should only be assessed for grazing cattle that contribute to conversion. Commodity yield data on cattle that do not directly contribute to conversion (eg, feedlot-grown cattle which do not directly contribute to conversion) need not be included. Calculate the percentage of the area that would have been used for each relevant global commodity (ie, the proportion of conversion, PD_j). Where the area of each non-forest land use of deforested land is specified in the project description, this may be used to calculate the proportion of conversion for each relevant commodity. Where the specific area of each non-forest land use is unknown or not specified for each relevant commodity, use the existing areas of production for each relevant commodity within the area used to calculate the baseline conversion rate. Where these data are not available, country-wide data may be used to calculate these percentages where it can be justified that such data are representative of the project area. Typically, when calculating the percentage of the area used for each commodity, the total across all commodities will be 100 percent. However, justification may be provided that less than 100 percent of the area is subject to conversion driven by agricultural production (ie, there may be select regions not suitable for agricultural production that are only subject to conversion from timber harvesting).

All lands that would have been deforested must be attributed a non-forest use, unless otherwise justified. Justification may be provided that some of the lands that would have been deforested would not be subject to global commodity production. Identify the proportion of conversion driven by the production of relevant global commodities and the proportion of conversion not driven by the production of relevant global commodities (ie, area where conversion is only driven by subsistence activities or production of domestically traded products). For example, a project proponent may have evidence to show that relevant commodities (eg, soy, corn and livestock production) only drive 50 percent of the conversion within the project area and the remaining 50 percent of conversion is caused by subsistence activities or other activities covered by the procedures to account for activity shifting leakage within the methodology. Where data are not available to support such analysis, conservatively assume that 100 percent of the conversion comes from relevant commodities.

The proportion of conversion attributable to each relevant commodity must be determined. The sum of the proportion of conversion attributable to each relevant commodity must be equal to or greater than the proportion of conversion driven by the production of all relevant commodities. For example, where 50 percent of conversion is driven by the production of global commodities, then the sum of the proportion of conversion across each relevant commodity must be 50 percent or greater than 50 percent (eg, 20 percent may be driven by soy, 20 percent by corn and 10 percent by cattle rangelands). There may be significant overlap between non-forest products driving deforestation (eg, soy, corn, rice or livestock) and forest products driving degradation (eg, saw logs or pulp wood). Such overlap between relevant commodities is accounted for in Section 5.3.2.

Because land uses can overlap, the total proportion of conversion attributable to agricultural commodities may be more than the proportion of conversion of relevant commodities (eg, double cropping systems). Where crops overlap seasonally, it may be appropriate for the total value for the proportion of conversion driven by all such crops to be greater than the proportion of conversion driven by the production of relevant global commodities.

Production of pulpwood and saw logs are expected to overlap. These forest uses are often relevant to degradation. Where the production of forest products is identified as a driver of deforestation, such relevant commodities must be included in the analysis for the market leakage value for deforestation. Where they are identified as drivers of degradation and degradation is being accounted for, they must be included in the analysis for the market leakage value for degradation.

5.2.2 Baseline Commodity Yields

This section calculates the baseline commodity yields for the project area based on an analysis of the historical commodity yields. The baseline commodity yields are used to calculate amounts of forgone production caused by avoiding conversion in Section 5.2.3. The baseline commodity yields must be determined per-hectare for each relevant commodity included in the analysis.

The baseline commodity values must be determined by monitoring commodity yields on lands used to determine post-conversion carbon stocks, or lands used to calculate the baseline conversion rate, if available. Where local data are not available, data may be collected from regional studies conducted according to methods that are publicly available from a recognized, credible source and must be reviewed for publication by an appropriately qualified, independent organization or appropriate peer review group, or be published by a government agency.

The period used to calculate baseline commodity yields is called the "historical reference period." The historical reference period used to calculate baseline commodity yields may be different from the historical reference period used to calculate baseline emissions for the project. The most recent applicable and available data should be used. At least three years of data are required if it is available, and 10 years of data are desirable. Where annual data are not available throughout the relevant period, provide justification that the years in which data are available are representative of such period. Where the project involves production of commodities that are not produced annually but over longer production cycles the historical reference period must be set to include at least one production cycle.

For livestock, units must be expressed as the number of animals produced per hectare per year. Typically this number will have to be calculated by dividing the number of head slaughtered or otherwise sold to market per year in the survey area, divided by the area of pasture in the survey area.

Historical commodity yield data are used to estimate baseline commodity yields. A trend in commodity yields for each relevant global commodity *j* must be applied to the historical commodity yields to calculate baseline commodity yields. The trend must be based on the observed or modeled change in the rate of conversion of lands to commodity production, combined with an observed or default change in the rate of production per hectare. The baseline commodity yields for each relevant global commodity *j* at time *t* is calculated by applying an annual growth rate r_j to the historical commodity yields as set out in equation 1 below.

$$y_{j,t} = \frac{\sum_{h=1}^{H}(\bar{y}_{j,h})}{H} \times \left(1 + r_j\right)^t \qquad (1)$$

Where:

$y_{j,t}$ = Baseline commodity yield for commodity *j* in year *t* (tonnes / ha)
$\bar{y}_{j,h}$ = Commodity yield for commodity *j*, in year *h* of the historical reference period (tonnes / ha)
H = Number of historical reference years
r_j = Growth rate of commodity yields for commodity *j* (percent), or the default value (2.5 percent)
t = Years since project crediting period start date

This module uses a conservative default growth rate of commodities of 2.5 percent, based on peer-reviewed agricultural studies.[5] Apply the default growth rate, or where data on trends in commodity yield within the area accessible to the agents of conversion are available, justify a more accurate project-specific growth rate for commodity *j* based on government approved or peer-reviewed studies on growth trends within the area accessible to the agents of conversion. Where a project-specific growth rate is applied, the growth rate must be calculated using data from the same historical reference period used to develop the project baseline. Where the project is nested in a jurisdictional program, the project may adopt the jurisdiction-specific growth rates validated for the jurisdictional program.

Growth rates may be justified as zero for certain commodities, such as timber commodities, where it can be demonstrated that there has not been increases in commodity yields over time within the country.

5.2.3 Forgone Production

For projects that involve avoided conversion (ie, REDD, ACoGS and ALM CGLC) or where evidence for the amount of production within the project area in the baseline scenario is not available, the amount of foregone production is calculated using the area of avoided conversion achieved by the project, the baseline commodity yield (as calculated in Section 5.2.2) and proportion of conversion (as determined in Section 5.2.3) for each relevant commodity as follows:

$$FP_{j,t} = d_t \times y_{j,t} \times PD_j \qquad (2)$$

Where:

$FP_{j,t}$ = Foregone production for commodity *j* in year *t* (tonnes)

d_t = Area subject to production in year *t* (ha)

$y_{j,t}$ = Baseline commodity yield for commodity *j* in year *t* (tonnes / ha)

PD_j = Proportion of conversion driven by commodity *j* (percent)

Where the project involves avoided conversion, the area subject to production, d_t, includes the total area of conversion prevented as reported in the monitoring report. Where evidence for the amount of production within the project area in the baseline scenario is not available and the project does not involve avoided conversion, the area subject to production, d_t, includes the project area subject to production in the baseline scenario. Such area must be determined in accordance with the justification and evidence used to determine the baseline scenario for the project.

Where evidence is available regarding the amount of production within the project area in the baseline scenario (eg, ARR projects with surveys of livestock or IFM project with harvest records), the amount of foregone production must be determine directly based on the historical

[5] See Appendix 2 for additional background information.

average annual production. This method cannot be applied by REDD, ACoGS or ALM CGLC projects that involve avoided conversion (such projects must apply equation 2). The foregone production where baseline production within the project area is known must be calculated using equation 3 (applying guidance on growth rates provided in Section 5.2.2).

$$FP_{j,t} = \frac{\sum_{h=1}^{H}(\bar{p}_{j,h})}{H} \times (1 + r_j)^t \qquad (3)$$

Where:

$FP_{j,t}$ = Foregone production for commodity *j* in year *t* (tonnes)

$\bar{p}_{j,h}$ = Baseline production within the project area for commodity *j* in year *h* of the historical reference period (tonnes)

H = Number of historical reference years

r_j = Growth rate of commodity yields for commodity *j* (percent), or the default value (2.5 percent)

5.2.4 Leakage Mitigation

AFOLU projects may work to mitigate leakage from project activities using various approaches. Many AFOLU projects will continue to produce commodities within the project area in the project scenario (ie, ARR, IFM, ALM). Such production in the project scenario is referred to here as leakage mitigation activities for the purpose of this module. The production achieved in the project scenario must be documented through the project records.

Activities may be implemented as part of the broader project activities that help prevent commodity displacement in areas beyond the project area. Such activities are also referred to here as leakage mitigation activities. Leakage mitigation activities can avoid leakage by increasing production elsewhere, without associated conversion or degradation, to replace production forgone by the project. Leakage mitigation activities can reduce demand for the forgone goods and services. An example of replacing forgone supply is a program that helps farmers increase crop productivity thereby increasing the total amount of crops produced without increasing the area farmed. An example of reducing demand is an activity that assists local people to convert to efficient cookstoves and allowing the same amount of food to be cooked with substantially less consumption of fuelwood.

Where leakage mitigation activities are implemented, the increase in production or decrease in the production demanded must be monitored and reported. Achievements must be demonstrated through amounts of production increased or consumption decreased, not effort or activity. For example, a project proponent could provide technical assistance to farmers or access to high yielding seeds, and measure increases in crop production on farms that are assisted.

Where leakage mitigation activities have not been implemented, the value for leakage mitigation is zero. At verification, evidence must be provided that leakage mitigation activities have been implemented.

5.2.5 Amount of Production Subject to Leakage

Calculate the amount of production of each type of commodity that is subject to market leakage, net of mitigation. The calculation of the amount of production subject to market leakage depends on whether the production is annual or long term.

Annual Production

For projects that involve annual production, the amount of production subject to market leakage is the amount of foregone production (as calculated in Section 5.2.3), minus the amount of leakage mitigation (as determined in Section 5.2.4). If no leakage mitigation occurs, the potential amount of leakage will be the same as the amount of foregone production calculated in Section 5.2.3.

$$l_{j,t} = FP_{j,t} - LM_{j,t} \quad (4)$$

Where:

$l_{j,t}$ = Amount of production subject to leakage for commodity *j* in year *t* (tonnes)

$FP_{j,t}$ = Forgone production of commodity *j* in year *t* (tonnes)

$LM_{j,t}$ = Leakage mitigation of commodity *j* in year *t* (tonnes)

Where the leakage mitigation requires a transitional period before annual production can be established (eg, the establishment of an oil palm plantation), the amount of production subject to leakage in the years necessary to establish annual production can be set to zero where justification can be provided the same transitional period would have occurred in the baseline scenario. Where annual production was already present in the project area in the baseline scenario the project could not provide such justification. For example, if a REDD project had a baseline scenario where the forest was cleared for palm oil production, the project may be able to justify that the project would not be subject to leakage in the transitional period required to establish the plantation.

Long Term Production

For projects that involve long-term production occurring over production cycles longer than a year, the amount of production subject to market leakage is the amount of foregone production (as calculated in Section 5.2.3), minus the amount of leakage mitigation (as determined in Section 5.2.4). Since leakage mitigation does not occur on an annual basis it must be averaged over the production cycle. Leakage mitigation must be summed from the initial year of the production cycle (PC_i) to the final year of the production cycle (PC_f) and averaged over the entire production cycle (PC).

$$l_{j,t} = FP_{j,t} - \frac{\sum_{t=PC_i}^{PC_f} LM_{j,t}}{PC} \quad (5)$$

Where:

$l_{j,t}$ = Amount of production subject to leakage for commodity *j* in year *t* (tonnes)

$FP_{j,t}$ = Forgone production of commodity *j* in year *t* (tonnes)

$LM_{j,t}$ = Leakage mitigation of commodity *j* in year *t* (tonnes)

PC = Production cycle (years)

Where the production cycle for commodity *j* is longer than the monitoring period (ie, the leakage mitigation has not yet been achieved), the project must provide evidence they are on target to meet the leakage mitigation claimed for the current production cycle. Such evidence includes management records for the project area. For example an IFM extended rotation age (ERA) project may have a 20 year harvest cycle while the first monitoring period is only 5 years. For the first monitoring period this IFM ERA project would need to provide evidence through the timber management plan for the production anticipated within the harvest cycle in order to achieve any leakage mitigation.

Where no leakage mitigation occurs or the project cannot provide evidence they are on target to meet the leakage mitigation claimed for the current production cycle, the potential amount of leakage will be the same as the amount of foregone production calculated in Section 5.2.3.

5.3 Area Subject to Leakage

5.3.1 Area of New Land Brought into Production

Where the amount of production subject to leakage for commodity *j* in year *t* (as calculated in Section 5.2.5) is greater than zero (ie, $l_{j,t} > 0$), estimate the total area of new land brought into production outside the project in year *t* by applying the baseline commodity yields (as calculated in Section 5.2.2) in the following equation:

$$INL_{j,t} = \frac{l_{j,t} \times IS \times NL_j}{y_{j,t}} \quad (6)$$

Where:

$INL_{j,t}$ = Area of new land brought into production in year *t* (ha)

$l_{j,t}$ = Amount of production subject to leakage for commodity *j* in year *t* (tonnes)

IS = 75 percent; Share of leakage resulting in increased supply outside the project area

NL_j = Share of increased supply coming from new land brought into production for commodity *j*; or the default value (40 percent for non-forest products, 100 percent for forest products)

$y_{j,t}$ = Baseline commodity yield for commodity *j* in year *t* (tonnes / ha)

Where the project has used equation 3 to calculate the foregone production, baseline commodity yield for commodity *j* in year *t* must be calculated using equation 7.

$$y_{j,t} = \frac{1}{H} \times \sum_{h=1}^{H} \frac{\bar{p}_{j,h}}{\bar{a}_{j,h}} \times \left(1 + r_j\right)^{t} \quad (7)$$

Where:

$y_{j,t}$ = Baseline commodity yield for commodity *j* in year *t* (tonnes / ha)

$\bar{p}_{j,h}$ = Baseline production within the project area for commodity *j* in year *h* of the historical reference period (tonnes)

$\bar{a}_{j,h}$ = Area of production within the project area for commodity *j* in year *h* of the historical reference period (tonnes)

H = Number of historical reference years

r_j = Growth rate of commodity yields for commodity *j* (percent), or the default value (2.5 percent)

The growth rate must be determined in accordance with the procedures described in Section 5.2.2. A brief summary of the default values and the procedures for applying alternative values is provided below. Appendix 2 contains additional background information regarding how the default values were developed.

<u>Amount of Increased Supply</u>

A fundamental premise of market leakage is that where production is decreased by one unit, then production in other locations will replace some, but not all, of the forgone production. This module uses a conservative default value of 75 percent for *IS* which assumes that 75 percent of the production lost due to the project is made up through increases in supply outside the project.

<u>Amount from New Land Brought into Production</u>

For non-forest products, the increases in supply of these global commodities outside the project area but due to the project may or may not result in bringing new lands into production. Supply increases from bringing new non-forest land into production may result in conversion, while supply increases from agricultural intensification and increases in yields on non-forest lands will not lead to conversion. This module uses a conservative default value of 40 percent for *NL* for non-forest products. This assumes that 40 percent of the increase in supply of non-forest products outside the project is made up through bringing new land into production.

For forest products, the increases in supply of these global commodities outside the project area but due to the project may or may not result in bringing new lands into production. Supply increases from bringing new land into production may result in conversion, while supply increases from agricultural intensification and increases in yields will not lead to conversion. This module uses a conservative default value of 100 percent for *NL* from forest products. This assumes that 100 percent of the increase in supply of forest products outside the project is made up through bringing new land into production.

Where the default value is not applied for *NL*, provide evidence justifying the use of a different value for the percent of supply increase coming from new land brought into production within the country. Such evidence may include government approved or peer reviewed studies of the amount of production increases coming from new land brought into production.

5.3.2 Area Subject to Leakage

The total area subject to leakage as a result of the area of new land brought into production must be calculated across relevant global commodities and relevant domestic commodities. AL_t must be calculated separately for relevant global commodities, $AL_{t,rgc}$, and relevant domestic commodities, $AL_{t,rdc}$. This is calculated slightly differently for forest projects (ie, REDD and IFM) versus non-forest projects (ie, ARR, ALM and ACoGS) as described below.

<u>Forest Projects</u>

Forest projects must calculate the area subject to leakage using equation 8.

$$AL_t = max\left(\sum_{j=1}^{NFP} INL_{j,t}\ ,\sum_{j=1}^{FP} INL_{j,t}\right) \qquad (8)$$

Where:

AL_t = Area subject to leakage in year *t* (ha)
$INL_{j,t}$ = Area of new land brought into production in year *t* (ha)
NFP = Total number of relevant commodities that are non-forest products
FP = Total number of relevant commodities that are forest products

When summing across commodities consider overlaps in the land use to produce different commodities as described below. Where the relevant commodities driving deforestation only include non-forest products, the area of new land brought into production must be summed across all relevant commodities that are non-forest products, *NFP*, to determine the total area subject to leakage. Where both non-forest products and forest products are included as relevant commodities, the area of new land brought into production must be summed across all relevant commodities that are non-forest products, *NFP*, and also summed across all relevant commodities that are forest products, *FP*, to determine the area subject to leakage. The increase in area brought into production from non-forest products and forest products must then be compared and the highest value must be selected as the total area subject to leakage.[6]

Non-Forest Projects

Non-forest projects must calculate the area subject to leakage using equation 9.

$$AL_t = \sum_{j=1}^{T} INL_{j,t} \quad (9)$$

Where:

AL_t = Area subject to leakage in year *t* (ha)
$INL_{j,t}$ = Area of new land brought into production in year *t* (ha)
T = Total number of relevant commodities

For non-forest lands, the area of new land brought into production must be summed across all relevant commodities to determine the total area subject to leakage.

5.4 Domestic Share of Leakage

For relevant global commodities the next step is to estimate how much of this area subject to leakage is likely to occur outside the project area but within the country. UNFCCC policy establishes that countries are only responsible for their own GHG emissions. As such, a project, jurisdiction or country reporting GHG emission reductions or removals does not report emission increases that may occur in other countries as a result of the activities in the reporting country. Relevant global commodities must apply the country's share of global leakage from forests or forests and grasslands, s_f or s_g, to estimate the leakage attributable to their country using the procedures in Section 5.4.3. Such reduction in leakage is not applicable to relevant domestic commodities as all leakage for such commodities are assumed to remain within the country.

The domestic share of leakage is calculated slightly differently if the project land use is forest land versus non-forest lands. Where projects involve multiple project activities, leakage from forest lands and leakage from non-forest lands must be calculated separately, and later in Section 5.5 the two amounts of leakage are combined.

5.4.1 Domestic Share of At-Risk Forests

Where the project is a forest projects that involves reducing deforestation or is a non-forest project, the share of at-risk forests must be calculated based on the historical deforestation and

[6] Production of non-forest products driving deforestation will often overlap in land use with production of forest products driving degradation. Such land may first be deforested for its wood resources then used for agricultural production. Therefore such overlaps must be considered and the land use resulting in the largest area brought into production due to the project must conservatively be selected to determine the area subject to leakage.

forest carbon stocks at risk of deforestation. Where the project is a forest projects that involves reducing degradation or improved forest management the share of at-risk forests must be calculated based on the historical degradation and forest carbon stocks at risk of degradation. Where the project is a forest project that involves reducing both deforestation and degradation, the share of at-risk forests must be calculated as follows:

1) Where the area of new land brought into production from non-forest products ($\sum_{j=1}^{NFP} INL_{j,t}$) is higher, the share of at-risk forests must be based on the historical deforestation and forest carbon stocks at risk of deforestation
2) Where the area of new land brought into production from forest products ($\sum_{j=1}^{FP} INL_{j,t}$) is higher, the share of at-risk forest must be based on the historical degradation and forest carbon stocks at risk of degradation.

Estimate the domestic share of at-risk forests to determine how much of this global deforestation/degradation is likely to occur within the country. The share of at-risk forests can be calculated using one of the following approaches:

1) The percentage of global deforestation/degradation during the historical reference period that occurred in the country, as a proxy for historical at-risk forests (equation 11); or
2) The percentage of global at-risk forest carbon stocks during the historical reference period that are located within the country, as a proxy for future at-risk forests (equation 12).

Conservatively select the metric that yields the highest percentage, as set out in equation 10 (and expanded upon in equations 11 and 12) below:

$$s_f = max(s_d, s_{cs}) \tag{10}$$

$$s_d = \frac{d_d}{g_d} \tag{11}$$

$$s_{cs} = \frac{d_{cs}}{g_{cs}} \tag{12}$$

Where:

s_f = Domestic share of global leakage from forest lands (percent)
s_d = Domestic share of global deforestation/degradation (percent)
s_{cs} = Domestic share of global at-risk forest carbon stocks (percent)
d_d = Area of deforestation/degradation within the country (ha)
g_d = Area of deforestation/degradation globally (ha)
d_{cs} = At-risk forest carbon stocks within the country (tonnes C)
g_{cs} = At-risk forest carbon stocks globally (tonnes C)

5.4.2 Domestic Share of Grassland

Estimate the domestic share of global leakage from grassland, s_g, to determine how much of the global conversion of non-forest land is likely to occur within the country. Where the project applies the default value for share of leakage to forest land (as explained in Section 5.4.3), s_g does not need to be calculated. The share of grasslands must be calculated using the following equation:

$$s_g = \frac{d_g}{g_g} \tag{13}$$

Where:

s_g = Domestic share of global leakage from grasslands (percent)

d_g = Area of grassland within the country (ha)

g_g = Area of grassland globally (ha)

5.4.3 Domestic Share of Global Leakage

Using the domestic share of at-risk forests and at-risk grasslands, calculate the domestic share of global leakage using the following equation:

$$s = \left(LFL \times s_f\right) + \left((1 - LFL) \times s_g\right) \tag{14}$$

Where:

s = Domestic share of global leakage (percent)

LFL = Share of leakage going to forest lands; or the default value of 100 percent[7]

s_f = Domestic share of global leakage from forest lands (percent)

s_g = Domestic share of global leakage from grasslands (percent)

Leakage from project activities may be displaced to both forest and non-forest land. The share of leakage going to forest lands, *LFL*, is used to differentiate between the area subject to leakage that is forest land and the area subject to leakage that is non-forest land. Where data required to calculate the domestic share of global leakage from grasslands, s_g, or the leakage emission factor for non-forest land, LEF_{nf}, (see Section 5.5.2) are unavailable, the default value of 100 percent can be applied to determine *LFL* and s_g and LEF_{nf} do not need to be determined. The default value conservatively assumes that all displaced production will go to forest lands.

Where the area of new land brought into production from forest products ($\sum_{j=1}^{FP} INL_{j,t}$) was higher, as determined using equation 7, the default value for *LFL* must be applied. Forest products are conservatively assumed to always be produced on forest land thus all leakage will be displaced to forest lands.

---

[7] See Appendix 2 for additional background information

Where the default value is not applied for *LFL*, provide evidence to justify a value for the percent of new land brought into production for non-forest products that is forest land within the country. Such evidence may include government approved or peer reviewed studies of the amount of production increases on forest land within the country. Data on the suitability of forest vs non-forest lands within the country for the production of relevant commodities may be used to justify a value for *LFL*. Likewise, data on the recent land use change within the country may be used to justify a value for *LFL*.

Where data is available, proxies for the share of leakage going to forest lands may be justified, such as equation 15. This equation assumes that the area subject to leakage has an equal likelihood of being displaced to any hectare of forest or grassland within the country.[8] Where studies suggest a preferential conversion of forest land within the country this proxy cannot be used.

$$LFL = \frac{d_f}{d_f + d_g} \tag{15}$$

Where:

LFL = Share of leakage going to forest lands (percent)

d_f = Area of forest within the country (ha)

d_g = Area of grassland within the country (ha)

5.4.4 Domestic Area Subject to Leakage

Using the country's share of global leakage, calculate the domestic area subject to leakage:

$$DAL_t = \left(AL_{t,rgc} \times s\right) + AL_{t,rdc} \tag{16}$$

Where:

DAL_t = Domestic area subject to leakage in year *t* for relevant global commodities (ha)

$AL_{t,rgc}$ = Area subject to leakage in year *t* for relevant global commodities (ha)

s = Domestic share of global leakage (percent)

$AL_{t,rdc}$ = Area subject to leakage in year *t* for relevant domestic commodities (ha)

5.5 Leakage Emissions

To convert the domestic area subject to leakage to leakage emissions the project must also determine leakage emission factors for forest lands and, in some cases, non-forest lands. Where the project only involves forest products or the default value is applied for LFL, a leakage emission factor for non-forest land does not need to be determined. The parameters for such

[8] This is a conservative assumption as the country may contain significant forest lands that may not be at risk of being converted for cultivation such as protected areas or managed forests.

leakage emissions factors must be based on the net GHG emission reductions and removals for the project and appropriately reviewed and published data as described below. The leakage emission factors are determined differently for forest projects versus non-forest projects. In some cases projects may require a carbon stock adjustment to be applied if the project area has lower carbon stocks. The procedures for determining where such adjustment factors are necessary are described in the sections and equations below. Additional details regarding the justification of appropriate data sources are provided in the parameters tables in Section 6.

5.5.1 Leakage Emissions Factor for Forest Lands

The leakage emissions factor for forest lands is used to estimate the emissions from displacement of baseline activities to other forests within the country. This emissions factor is determined differently for forest projects (ie, REDD and IFM) versus non-forest projects (ie, ARR, ALM and ACoGS) as described below and illustrated in Figure 1.

Forest Projects

Forest projects must determine the leakage emissions factor for forest lands, $LEF_{f,t}$, by comparing the forest carbon stocks within the project area at the project start date to forest carbon stocks within the country. This comparison ensures a conservative estimation of the change in carbon stock. This comparison is determined differently for forest projects that involve forest products versus forest projects that involve non-forest products as described below.

Where the forest project produces forest products in the baseline scenario (eg, an IFM project which produces timber in the baseline scenario or a REDD project which involves fuelwood production in the baseline scenario) the carbon stocks within the project area at the project start date must be compared to the average carbon stocks in similar forest types within the country. Where the average forest carbon stocks within the project area are higher than similar forest types, $LEF_{f,t}$ must be determined using equation 17. Where the average forest carbon stocks within the project area are lower than similar forest types, $LEF_{f,t}$ must be determined using equation 18). For such projects, the forest carbon stocks of the leakage area, $CS_{LA,f,}$ must be determined using the average carbon stocks of similar forest types within the country.

Where the forest project produces non-forest products in the baseline scenario (eg, a RED project where soy would have been produced in the baseline or a RED project where the baseline involves conversion to rangeland) the carbon stocks within the project area at the project start date must be compared to the average forest carbon stock within the country. Where the average forest carbon stocks within the project area are higher than the national average, $LEF_{f,t}$ must be determined using equation 17. Where the average forest carbon stocks within the project area are lower than the national average, $LEF_{f,t}$ must be determined using equation 18. For such projects, the forest carbon stocks of the leakage area, $CS_{LA,f}$ must be determined using the average forest carbon stocks within the country. Where the project is nested project in a jurisdictional program, $CS_{LA,f}$ must be determined based on larger of the following values; the average forest carbon stocks within the jurisdiction or the average forest carbon stocks within the country.

Forest projects that do not require adjustments for carbon stocks must apply equation

$$LEF_{f,t} = \frac{\Delta GHG_t}{PA} \quad (17)$$

Where:

$LEF_{f,t}$ = Leakage emissions factor for forest lands in the country (tonnes CO_2e / ha)
ΔGHG_t = Net GHG emission reductions and removals for the project (tonnes CO_2e)
PA = Project area (ha)

Forest projects that require adjustments for carbon stocks must apply equation

$$LEF_{f,t} = \frac{\Delta GHG_t}{PA} \times \frac{CS_{LA,f}}{CS_{PA}} \quad (18)$$

Where:

$LEF_{f,t}$ = Leakage emissions factor for forest lands in the country (tonnes CO_2e / ha)
ΔGHG_t = Net GHG emission reductions and removals for the project (tonnes CO_2e)
PA = Project area (ha)
CS_{PA} = Carbon stocks of the project area at the project start date (tonnes C / ha)
$CS_{LA,f}$ = Forest carbon stocks of the leakage area (tonnes C / ha)

<u>Non-Forest Projects</u>

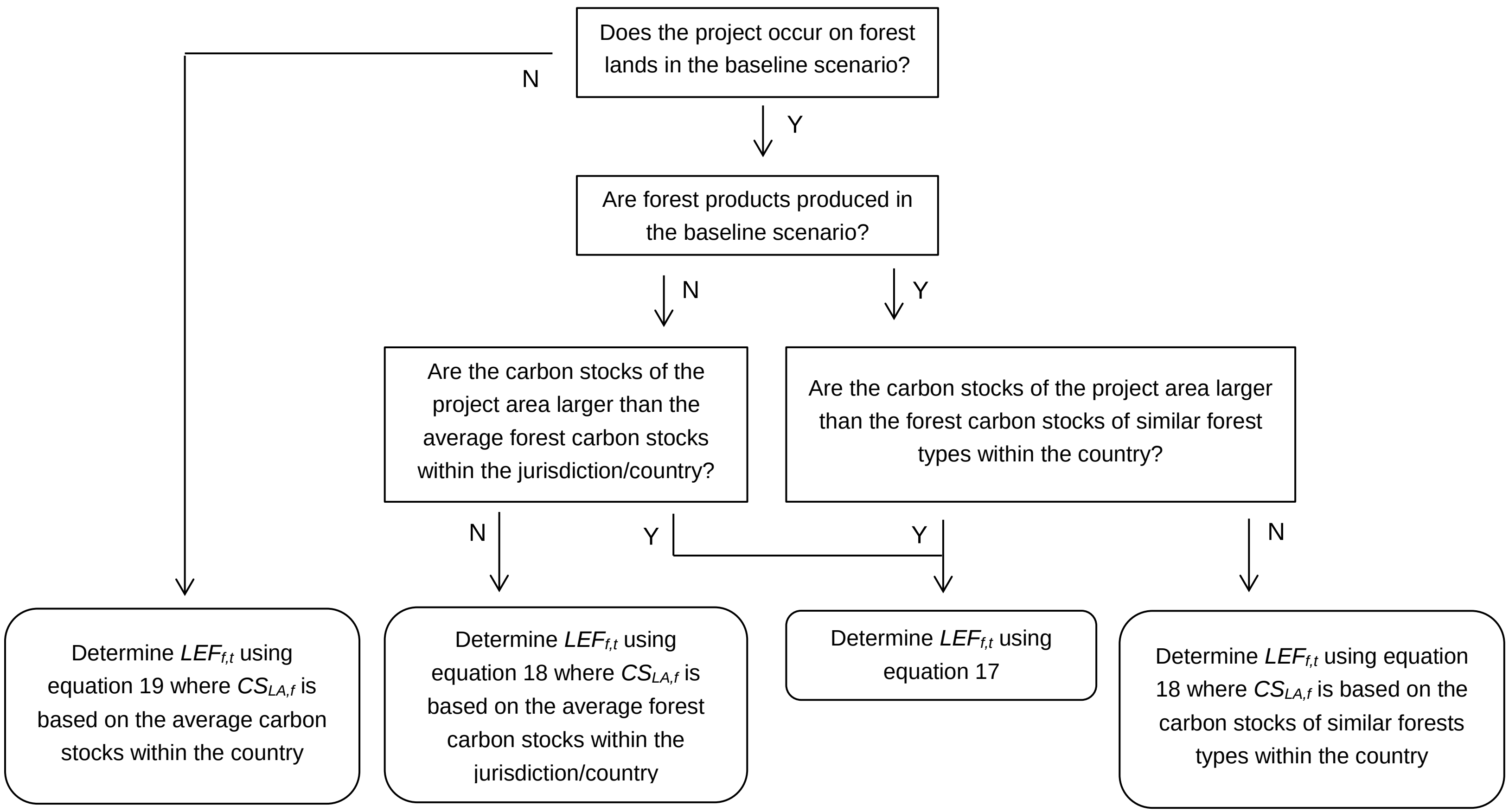
Non-forest projects must determine the leakage emissions factors for forest lands in the country, $LEF_{f,t}$, using the forest carbon stocks of the leakage area, $CS_{LA,f}$. $CS_{LA,f}$ must be determined using the average forest carbon stocks within the country. For a non-forest project, this module conservatively assumes that all carbon in the aboveground biomass pool will be lost in the forested areas where leakage will be displaced to.

$$LEF_{f,t} = CS_{LA,f} \times {}^{44}/_{12} \quad (19)$$

Where:

$LEF_{f,t}$ = Leakage emissions factor for forest lands in the country (tonnes CO_2e / ha)
$CS_{LA,f}$ = Forest carbon stocks of the leakage area (tonnes C / ha)

Figure 1: Decision Tree for Determining the Leakage Emissions Factor for Forest Lands, $LEF_{f,t}$



5.5.2 Leakage Emissions Factor for Non-Forest Lands

The leakage emission factor for non-forest lands is used to estimate the emissions from displacement of baseline activities to other non-forest land within the country. Where the project only involves forest products or the default value is applied for *LFL*, a leakage emission factor for non-forest land does not need to be determined. This emissions factor is determined differently for forest projects versus non-forest projects as described below and illustrated in Figure 2.

Forest Projects

Forest projects must determine the leakage emissions factor for non-forest lands, $LEF_{nf,t}$, using the non-forest carbon stocks of the leakage area, $CS_{LA,nf}$. Projects may apply the default value for $CS_{LA,nf}$ of 72.6 tC / ha. Projects that include soil carbon in the project boundary and are located in countries with significant areas with wetlands (ie, wetlands covering greater than 5 percent of the total land area within the country) cannot apply the default value and must determine a country-specific value. Where the default value is not applied, $CS_{LA,nf}$ must be determined based on a conservative estimate of non-forest carbon stocks from areas with similar land use as the baseline scenario within the country.

$$LEF_{nf,t} = CS_{LA,nf} \times {}^{44}/_{12} \quad (20)$$

Where:

$LEF_{nf,t}$ = Leakage emissions factor for non-forest lands in the country (tonnes CO_2e / ha)

$CS_{LA,nf}$ = Non-forest carbon stocks of the leakage area (tonnes C / ha)

Non-Forest Projects

Non-forest projects must determine the leakage emissions factor for non-forests, $LEF_{nf,t}$, by comparing the non-forest carbon stocks within the project area at the project start date to the non-forest carbon stocks from areas with similar land use as baseline activities within the country. This comparison ensures a conservative estimation of the change in carbon stock. Where the average non-forest carbon stocks within the project area are higher than areas with similar land use as baseline activities, $LEF_{nf,t}$ must be determined using equation 21. Where the average non-forest carbon stocks within the project area are lower than areas with similar land use as baseline activities, $LEF_{nf,t}$ must be determined using equation 22. Projects may apply the default value for $CS_{LA,nf}$ of 72.6 tC / ha. Projects that include soil carbon in the project boundary and are located in countries with significant areas with wetlands (ie, wetlands covering greater than 5 percent of the total land area within the country) cannot apply the default value and must determine a country-specific value. Where the default value is not applied, $CS_{LA,nf}$ must be determined based on a conservative estimate of non-forest carbon stocks from areas with similar land use as the baseline scenario within the country.

Non-forest projects that require adjustments for carbon stocks must apply equation

$$LEF_{nf,t} = \frac{\Delta GHG_t}{PA} \quad (21)$$

Where:

$LEF_{nf,t}$ = Leakage emissions factor for non-forest lands in the country (tonnes CO_2e / ha)

ΔGHG_t = Net GHG emission reductions and removals for the project (tonnes CO_2e)

PA = Project area (ha)

Non-forest projects that require adjustments for carbon stocks must apply equation

$$LEF_{nf,t} = \frac{\Delta GHG_t}{PA} \times \frac{CS_{LA,nf}}{CS_{PA}} \quad (22)$$

Where:

$LEF_{nf,t}$ = Leakage emissions factor for forest lands in the country (tonnes CO_2e / ha)

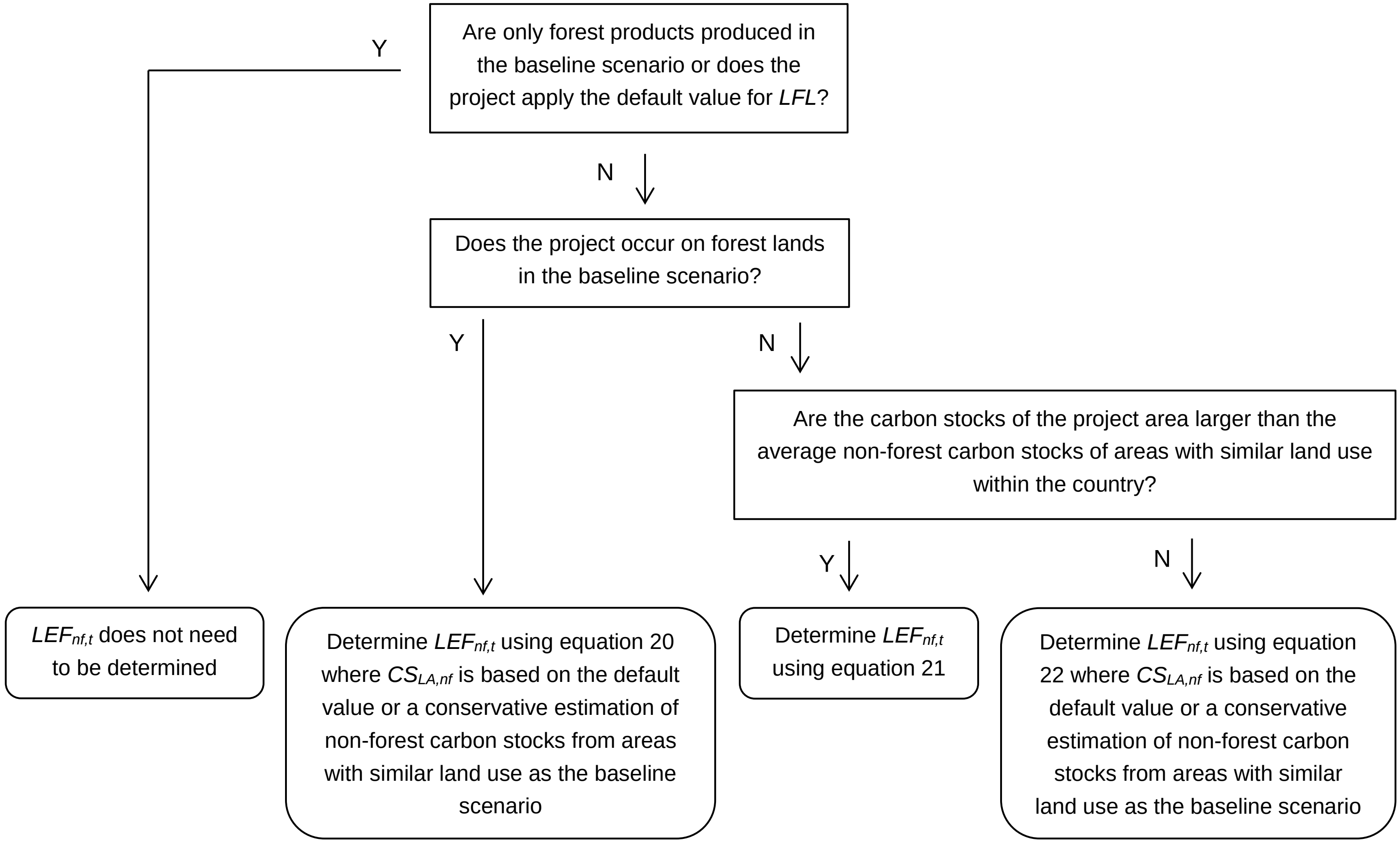
ΔGHG_t = Net GHG emission reductions and removals for the project (tonnes CO_2e)

PA = Project area (ha)

$CS_{LA,nf}$ = Non-forest carbon stocks of the leakage area (tonnes C / ha)

CS_{PA} = Carbon stocks of the project area at the project start date (tonnes C / ha)

Figure 2: Decision Tree for Determining the Leakage Emissions Factor for Non-Forest Lands, $LEF_{nf,t}$



5.5.3 Market Leakage

Calculate the market leakage emissions resulting from the domestic area subject to leakage. This involves calculating the leakage emissions based on the leakage emission factors, as determined in Sections 5.5.1 and 5.5.2, and the share of leakage going to forest lands, as determined in Section 5.4.3. Market leakage emissions can thus be determined using the following equation:

$$ML_t = \left[\left(LFL \times LEF_f\right) + \left((1 - LFL) \times LEF_{nf}\right)\right] \times DAL_t \qquad (23)$$

Where:

ML_t = Market leakage emissions in year *t* (tonnes CO_2e)
LFL = Share of leakage going to forest lands; or the default value of 100 percent
LEF_f = Leakage emissions factor for forest lands in the country (tonnes CO_2e / ha)
LEF_{nf} = Leakage emissions factor for non-forest lands in the country (tonnes CO_2e / ha)
DAL_t = Domestic area subject to leakage in year *t* (ha)

6 PARAMETERS

6.1 Parameters Available at Validation

Data Unit / Parameter	$\bar{y}_{j,h}$
Data unit	Tonnes / hectare
Description	Historical commodity yield within the project for commodity *j* in year *h* of the historical reference period
Equations	1
Source of data	Surveys conducted in the area used to calculate the project baseline or in the project leakage area, or officially published agricultural data, or peer-reviewed studies.
Value to be applied	
Justification of choice of data or description of measurement methods and procedures applied	The data must report on the commodity yield for commodity *j* within the project and be sourced from the same time period used to develop the project baseline. Where direct commodity yield data are not available, it is acceptable to use data on the production in a region that encompasses the project divided by the area of production in that region, for each commodity within the region and justify that such factors are appropriate for the project. Where sub-national data on commodity yields, production and area of production are not available, use country-wide commodity yield data and justify that such data are appropriate.
Purpose of data	Calculation of leakage
Any comment	Where data are not available for every year during the time period used to develop the baseline, provide justification that the years in which data are available are representative of such period or the period to which the factors are being applied. Apply the data from the historical reference period determined at validation until the project crediting period is renewed (ie, where the baseline is updated more frequently than every 10 years, the data from the historical reference period should still be applied until the crediting period is renewed). Apply the data provided at validation throughout the project crediting period to ensure that such historical reference period represents commodity yields likely to have occurred within the project in the absence of the project. Once the crediting period is renewed, use newly calculated data based on an updated historical reference period.

Data Unit / Parameter	H
Data unit	Number
Description	Number of historical reference years
Equations	1, 3 and 7
Source of data	Project description or based on data availability
Value to be applied	
Justification of choice of data or description of measurement methods and procedures applied	The number of historical reference years should include the same number of years in the historical reference period used to develop the project baseline. For projects with annual production, the historical reference period must correspond to the availability of annual production data. Where data are not available for every year during the historical reference period used to develop the project baseline, provide justification that the years for which data are available are representative of such period. Where such justification is provided, the number of historical reference years, *H*, is the number of years for which data has been provided (eg, if the project baseline was developed from 2005 to 2015 but commodity yield data was only available in 2006, 2008, 2010, 2012 and 2014 and this is justified, then the project's number of historical reference years, *H*, is five years). For projects with long term production that does not occur on an annual basis, the historical reference period must correspond to the production cycles. The historical reference period must be set to include at least one production cycle and should include data from multiple historical production cycles where possible.
Purpose of data	Calculation of leakage
Any comment	

Data Unit / Parameter	r_j
Data unit	Percent
Description	Growth rate of commodity yields for commodity *j*
Equations	1, 3 and 7

Source of data	For project-specific growth rates, data from government approved or publicly available peer-reviewed studies on growth trends within or sub-national regions encompassing the project area.
Value to be applied	Default value of 2.5 percent or justify a project-specific growth rate
Justification of choice of data or description of measurement methods and procedures applied:	For background information on the default value see Appendix 2. For project-specific values, data from government approved or publicly available peer-reviewed studies on growth trends for individual commodities within sub-national regions that encompass the project or studies performed within the project area must be used to justify project-specific values for individual commodities. Where this local data are not available, use studies on growth trends for individual commodities within the country and justify that such data are representative of the project.
Purpose of data	Calculation of leakage
Any comment:	

Data Unit / Parameter	PD_j
Data unit	Percent
Description	Proportion of the area of deforestation driven by commodity *j*
Equations	2
Source of data	Analysis of commodities driving the deforestation based on recognized, credible sources reviewed for publication by an appropriately qualified, independent organization or appropriate peer review group, or published by a government agency.
Value to be applied	

Justification of choice of data or description of measurement methods and procedures applied:	Conduct an analysis based on agricultural production or deforestation data from recognized, credible sources reviewed for publication by an appropriately qualified, independent organization or appropriate peer review group, or published by a government agency. Consider the area of land within the area used to develop the project baseline where each relevant global commodity would have been produced. Calculate the proportion of deforestation, based on the percentage of the area within the baseline area, subject to each driver. When available, use data regarding each relevant global commodity. Where sub-national data are not available, use country-wide data to calculate these percentages and justify such data are appropriate. Average the production data over a period covering the most recent 10 years for which data are available or justify a different time period that is representative of trends in production.
Purpose of data	Calculation of leakage
Any comment:	The proportion of deforestation must be calculated for all relevant global commodities driving deforestation. The proportion of degradation must be calculated for all relevant global commodities driving degradation. Where wood products are considered drivers of both degradation and deforestation they must conservatively be included in the analysis for both deforestation and degradation.

Data Unit / Parameter	$\bar{p}_{j,h}$
Data unit	Tonnes / hectare
Description	Historical production within the project area for commodity *j* in year *h* of the historical reference period
Equations	3 and 7
Source of data	Management records from the project area or surveys conducted in the project area
Value to be applied	

Justification of choice of data or description of measurement methods and procedures applied	The data must report on the production of commodity j within the project area and be sourced from the same time period used to develop the project baseline. Evidence must be from historical records within the project area and must reflect the baseline scenario as identified within the methodology.
Purpose of data	Calculation of leakage
Any comment	Where data are not available for every year during the time period used to develop the baseline, provide justification that the years in which data are available are representative of such period or the period to which the factors are being applied. Apply the data from the historical reference period determined at validation until the project crediting period is renewed (ie, where the baseline is updated more frequently than every 10 years, the data from the historical reference period should still be applied until the crediting period is renewed). Apply the data provided at validation throughout the project crediting period to ensure that such historical reference period represents production in the baseline scenario. Once the crediting period is renewed, use newly calculated data based on an updated historical reference period.

Data Unit / Parameter:	IS
Data unit:	Percent
Description:	Share of leakage resulting in increased supply outside the outside the project, caused by displacement from within the project
Equations	6
Source of data:	
Value to be applied	Default value of 75 percent
Justification of choice of data or description of measurement methods and procedures applied:	For background information on the default value see Appendix 2.
Purpose of data	Calculation of leakage
Any comment:	

Data Unit / Parameter:	NL_j
Data unit:	Percent
Description:	Share of increased supply coming from new land brought into production for commodity *j*
Equations	6
Source of data:	For country-specific values, data from government approved or publicly available peer-reviewed studies.
Value to be applied	For non-forest products, default value of 40 percent, for forest products default value of 100 percentor justify a country-specific value
Justification of choice of data or description of measurement methods and procedures applied:	For background information on the default value see Appendix 2. For country-specific values, the data from government approved or publicly available peer-reviewed studies on the share of increased supply coming from new land brought into production within the country must be used to justify a country-specific value. Such studies should distinguish between the increase in supply coming from bringing new land into production and the increase in supply coming from increased commodity yields or agricultural intensification. The same default value may be justified for all non-forest products or for all forest products, however separate values must be justified for forest products versus non-forest products.
Purpose of data	Calculation of leakage
Any comment:	

Data Unit / Parameter	$\bar{a}_{j,h}$
Data unit	Tonnes / hectare
Description	Historical area of production within the project area for commodity *j* in year *h* of the historical reference period
Equations	7
Source of data	Management records from the project area or surveys conducted in the project area
Value to be applied	

Justification of choice of data or description of measurement methods and procedures applied	The data must report on the production of commodity *j* within the project area and be sourced from the same time period used to develop the project baseline. Evidence must be from historical records within the project area and must reflect the baseline scenario as identified within the methodology.
Purpose of data	Calculation of leakage
Any comment	Where data are not available for every year during the time period used to develop the baseline, provide justification that the years in which data are available are representative of such period or the period to which the factors are being applied. Apply the data from the historical reference period determined at validation until the project crediting period is renewed (ie, where the baseline is updated more frequently than every 10 years, the data from the historical reference period should still be applied until the crediting period is renewed). Apply the data provided at validation throughout the project crediting period to ensure that such historical reference period represents the area of production in the baseline scenario. Once the crediting period is renewed, use newly calculated data based on an updated historical reference period.

Data Unit / Parameter	d_d
Data unit	Hectares
Description	Area of deforestation/degradation within the country
Equations	11
Source of data	Data from recognized, credible sources that have been reviewed by an appropriately qualified, independent organization (eg, IPCC, FAO) or appropriate peer review group, or been published by a government agency
Value to be applied	
Justification of choice of data or description of measurement methods and procedures applied	When available, apply nationally monitored or estimated data. The deforestation/degradation data must be sourced from a time period within five years of the project crediting period start date, or justification must be provided for use of older data.
Purpose of data	Calculation of leakage
Any comment	

Data Unit / Parameter	g_d
Data unit	Hectares
Description	Area of deforestation/degradation globally
Equations	11
Source of data	Data from recognized, credible sources that have been reviewed by an appropriately qualified, independent organization (eg, IPCC, FAO) or appropriate peer review group, or been published by a government agency
Value to be applied	
Justification of choice of data or description of measurement methods and procedures applied	Studies on global deforestation/degradation should use comparable methods and definitions to estimate global deforestation/degradation as those used to determine the area of deforestation/degradation within the country.
Purpose of data	Calculation of leakage
Any comment	

Data Unit / Parameter	d_{cs}
Data unit	Tonnes C
Description	At-risk forest carbon stocks within the country
Equations	12
Source of data	Data from recognized, credible sources that have been reviewed by an appropriately qualified, independent organization (eg, IPCC, FAO) or appropriate peer review group, or been published by a government agency
Value to be applied	
Justification of choice of data or description of measurement methods and procedures applied	When available, apply nationally monitored or estimated data. The at-risk forest carbon stocks data must be sourced from a time period within five years of the project crediting period start date, or justification must be provided for use of older data. Where data on at-risk forest carbon stocks is not available, data on the area of at-risk forest land may be used. Where studies regarding at-risk forest carbon stocks or areas are not available, justify the use of proxies such as the tropical forest carbon

	stocks as an indicator of the at-risk forest carbon stocks. The same metric (eg, tonnes C or hectares) or proxy must be used to calculate at-risk forest carbon stocks globally.
Purpose of data	Calculation of leakage
Any comment	

Data Unit / Parameter	g_{cs}
Data unit	Tonnes C
Description	At-risk forest carbon stocks globally
Equations	12
Source of data	Data from recognized, credible sources that have been reviewed by an appropriately qualified, independent organization (eg, IPCC, FAO) or appropriate peer review group, or been published by a government agency
Value to be applied	
Justification of choice of data or description of measurement methods and procedures applied	Studies on global deforestation should use comparable methods and definitions to estimate global at-risk forest carbon stocks as those used to determine the at-risk forest carbon stocks within the country.
Purpose of data	Calculation of leakage
Any comment	

Data Unit / Parameter	d_g
Data unit	Hectares
Description	Area of grassland within the country
Equations	13 and 15
Source of data	Data from recognized, credible sources that have been reviewed by an appropriately qualified, independent organization (eg, IPCC, FAO) or appropriate peer review group, or been published by a government agency Where the default value is applied for the area of grassland globally, data from the “Resources > Land” domain and “Permanent meadows and pasture” item for the country from the FAOSTAT database must be applied.[9] Alternative data sources

[9] (FAO, 2011), http://faostat3.fao.org/faostat-gateway/go/to/download/R/RL/E

	for national grassland areas are FAO Country Pasture Profiles.[10]
Value to be applied	
Justification of choice of data or description of measurement methods and procedures applied	The data must be sourced from a time period within five years of the project crediting period start date, or justification must be provided for use of older data.
Purpose of data	Calculation of leakage
Any comment	Where no data on the area of grasslands within the country is available, NLF can conservatively be assumed to be 100 percent and this value does not need to be determined.

Data Unit / Parameter	g_g
Data unit	Hectares
Description	Area of grassland globally
Equations	13
Source of data	Data from recognized, credible sources that have been reviewed by an appropriately qualified, independent organization (eg, IPCC, FAO) or appropriate peer review group, or been published by a government agency
Value to be applied	3.36 billion ha or the most recent value based on data from the "Resources > Land" domain and "Permanent meadows and pasture" item for all countries from the FAOSTAT database must be applied.[11]
Justification of choice of data or description of measurement methods and procedures applied	The default value must be used where a global dataset is unavailable. Where a value besides the default value is applied, studies on the global area of grasslands must use comparable methods and definitions to estimate the area of grasslands globally as those used to determine the area of grasslands within the country. The data must be sourced from a time period within five years of the project crediting period start date, or justification must be provided for use of older data.
Purpose of data	Calculation of leakage
Any comment	

[10] http://www.fao.org/ag/AGP/AGPC/doc/Counprof/regions/index_all.htm
[11] (FAO, 2011), http://faostat3.fao.org/faostat-gateway/go/to/download/R/RL/E

Data Unit / Parameter:	LFL
Data unit:	Percent
Description:	Share of leakage going to forest lands
Equations	14 and 23
Source of data:	For country-specific values, data from government approved or publicly available peer-reviewed studies
Value to be applied	Default value of 100 percent or justify a country-specific value
Justification of choice of data or description of measurement methods and procedures applied:	For background information on the default value see Appendix 2. For country-specific values, data from government approved or publicly available peer-reviewed studies on the share of leakage going to forest lands within the country must be used to justify a country-specific value. Such studies should distinguish between the new land brought into agricultural production that was previously forest land and such land that was previously non-forest land. Data on the suitability of forest vs non-forest lands within the country for the production of relevant commodities may be used to justify a value for *LFL*. Likewise, data on the recent land use change within the country may be used to justify a value for *LFL*. Proxies may also be used to estimate the share of leakage going to forest lands in accordance with Section 5.4.3.
Purpose of data	Calculation of leakage
Any comment:	

Data Unit / Parameter	d_f
Data unit	Hectares
Description	Area of forest land within the country
Equations	15
Source of data	Data from recognized, credible sources that have been reviewed by an appropriately qualified, independent organization (eg, IPCC, FAO) or appropriate peer review group, or been published by a government agency
Value to be applied	
Justification of choice of data or description of	The data must be sourced from a time period within five years of the project crediting period start date, or justification must be

measurement methods and procedures applied	provided for use of older data.
Purpose of data	Calculation of leakage
Any comment	

Data Unit / Parameter	PA
Data unit	Hectares
Description	Project area
Equations	17, 18, 21 and 22
Source of data	Project description
Value to be applied	
Justification of choice of data or description of measurement methods and procedures applied	The project area must be determined based on the project area subject to the change in carbon stocks. Where this area is not clearly specified the project can conservatively include the entire project area.
Purpose of data	Calculation of leakage
Any comment	

Data Unit / Parameter	$CS_{LA,f}$
Data unit	tonnes C / ha
Description	Forest carbon stocks of the leakage area
Equations	18
Source of data	Recognized, credible sources that have been reviewed by an appropriately qualified, independent organization (eg, IPCC, FAO) or appropriate peer review group, or have been published by a government agency
Value to be applied	
Justification of choice of data or description of measurement methods and procedures applied	$CS_{LA,f}$ must be determined based on the average forest carbon stocks in the jurisdiction/country or on the average forest carbon stocks from similar forests in accordance with the procedures in Section 5.5.1. The forest carbon stock data must include at least all carbon pools included in the project boundary. The forest carbon stocks within the country may be determined based on data from FAO or IPCC, 2006. The data must be sourced from a time period within five years of the project crediting period start date, or where such data is

	unavailable justification must be provided that of older data is representative of current forest carbon stocks within the country.
Purpose of data	Calculation of leakage
Any comment	

Data Unit / Parameter	CS_{PA}
Data unit	tonnes C / ha
Description	Carbon stocks of the project area at the project start date
Equations	18 and 22
Source of data	Project description
Value to be applied	
Justification of choice of data or description of measurement methods and procedures applied	$CS_{PA,f}$ must be determined based on the average carbon stocks per hectare at the project start date within the project area. The carbon stock data must include at least all carbon pools included in the project boundary.
Purpose of data	Calculation of leakage
Any comment	

Data Unit / Parameter	$CS_{LA,nf}$
Data unit	tonnes C / ha
Description	Change in carbon stocks from non-forests in year *t*
Equations	20 and 22
Source of data	Recognized, credible sources that have been reviewed by an appropriately qualified, independent organization (eg, IPCC, FAO) or appropriate peer review group, or have been published by a government agency
Value to be applied	Default value of 72.6 t C / ha which will be lost upon conversion of non-forest land for cultivation. This value must be applied according to the pattern of carbon loss determined for the project to produce an annual value for $CS_{LA,nf}$. Where the default value is not applied country-specific data may be used
Justification of choice of data or description of measurement methods and procedures applied	$CS_{LA,nf}$ must be determined based on the default value, a conservative estimation of the non-forest carbon stocks in the country or the carbon stocks from areas with similar land use in accordance with the procedures in Section 5.5.2. The carbon

	stock data must include at least all carbon pools included in the project boundary. The data must be sourced from a time period within five years of the project crediting period start date, or where such data is unavailable justification must be provided that of older data is representative of current forest carbon stocks within the country.
Purpose of data	Calculation of leakage
Any comment	

6.2 Parameters Monitored

Data Unit / Parameter	d_t
Data unit	Hectares
Description	Area subject to production in year *t*
Equations	2
Source of data	Project monitoring report or project description
Description of measurement methods and procedures to be applied	Where the project involves avoided conversion, the total area of conversion prevented as reported with the monitoring report. Where the project does not involve avoided conversion, the area within the project area subject to production in the baseline scenario in accordance with the justification and evidence used to determine the baseline scenario in the project description.
Frequency of monitoring/recording	Where the project involved avoided conversion, the data may be monitored once at the end of the monitoring period but should be reported on an annual basis. Where the project does not involve avoided conversion the data may be provided once at validation and must be reviewed when the baseline is updated.
QA/QC procedures to be applied	
Purpose of data	Calculation of leakage
Any comment	

Data Unit / Parameter	LM_t
Data unit	Tonnes
Description	Leakage mitigation achieved by the project in year *t* in terms of production of a given commodity

Equations	4 and 5
Source of data	Agricultural production data from leakage mitigation projects implemented by the project or data on the reduction in the production demanded as generated by the project.
Description of measurement methods and procedures to be applied	A project should measure the volume of production through agricultural records.
Frequency of monitoring/recording	The data may be monitored once at the end of the monitoring period but should be reported on an annual basis.
QA/QC procedures to be applied:	
Purpose of data	Calculation of leakage
Any comment	

Data Unit / Parameter	ΔGHG_t
Data unit	tonnes CO_2e/ha
Description	Net GHG emissions reductions and removals for the project in year *t*
Equations	17, 18, 21 and 22
Source of data	Data from the project's monitoring report
Value to be applied	
Description of measurement methods and procedures to be applied	The net GHG emissions reductions and removals for the project include the change in both carbon stocks and GHG emissions in year *t*. ΔGHG_t should not include any other leakage emission accounted for by the project (ie, activity shifting leakage or ecological leakage).
Frequency of monitoring/recording	At each verification event
QA/QC procedures to be applied	
Purpose of data	Calculation of leakage
Any comment	

7 REFERENCES

Alexandratos, N. and Bruinsma, J. 2012. World Agriculture towards 2030/2050: The 2012 Revision. Food and Agricultural Organization Agricultural Development Economics Division. (http://www.fao.org/docrep/016/ap106e/ap106e.pdf)

FAO, 2010. Global Forest Resources Assessment 2010. FAO Forestry Paper 163

FAO, 2011. FAOSTAT database (http://faostat3.fao.org/faostat-gateway/go/to/download/R/RL/E)

FAPRI, 2012. Food and Agricultural Policy Research Institute – Elasticity Database. Iowa State Univeristy. (http://www.fapri.iastate.edu/tools/elasticity.aspx)

Fuglie, K., and Nin-Pratt, A. 2012. 2012 Global Food Policy Report: Agricultural Productivity: A Changing Global Harvest. International Food Policy research Institute.

IPCC, 2006. 2006 IPCC Guidelines for National Greenhouse Gas Inventories. Institute for Global Environmental Strategies (IGES)

Gibbs, H. et al. 2010. Tropical forests were the primary sources of new agricultural land in the 1980s and 1990s. Proceedings of the National Academy of Sciences. 107:38 16,732-16,737.

Murray, B.C., B.A. McCarl, and H. Lee. 2004. Estimating Leakage from Forest Carbon Sequestration Programs. Land Economics 80(1):109-124. (http://ideas.repec.org/p/uwo/uwowop/20043.html)

Roberts, M.J. and Schlenker, W. 2013. Identifying Supply and Demand Elasticities of Agricultural Commodities: Implications for the US Ethanol Mandate. American Economic Review. 103(6): 2265-2295.

APPENDIX 1: DOCUMENT HISTORY

Version	Date	Comment
v1.0	17 April 2014	Released for peer review
v1.1	29 May 2014	Released for public comment

APPENDIX 2: BACKGROUND INFORMATION ON DEFAULT VALUES

Growth Rate

The default value for growth rates of production has been developed based on reports from the International Food Policy Research Institute (IFPRI) and Food and Agriculture Organization (FAO). This default value based on the growth rates of production has been applied within this module to serve as proxy for growth rates in yields. Analysis from the IFPRI indicates that the average agricultural growth rates in developing countries over the past 40 years have remained less than 2.5 percent for each decade with values ranging from 2.08 percent to 2.42 percent (Fuglie and Nin-Pratt, 2012). Reports from FAO confirm that this is a conservative default value for growth rates. They predict that agricultural growth rates within developing countries will decrease in the coming decades with an average value of 1.6 percent for developing countries from 2007 to 2030 and an average value of 0.9 percent for developing countries from 2030 to 2050 (Alexandratos and Bruinsma, 2012). Therefore 2.5 percent has been selected as a conservative default value for commodity production and projects are eligible to justify using regional or country-specific values where such data are relevant and available.

Share of Leakage Resulting in Increased Supply

The default value for the share of leakage resulting in increased supply outside the project was developed using the methods for estimating leakage from Murray, McCall and Lee (2004). This method considers the elasticity of supply and the elasticity of demand to estimate leakage for a given commodity. The analysis for developing the conservative default value used data on elasticity of supply and demand across commodities and countries from peer-reviewed economic studies and the Food and Agricultural Policy Research Institute's Elasticity Database. The elasticity data on agricultural commodities and forest products indicated that no commodities experienced perfectly inelastic supply or demand. Averaging across countries, most commodities losses occurring within the project would result in a 40 to 75 percent increase is supply elsewhere. Therefore 75 percent was selected as a conservative default value.

Share of Increased Supply coming from New Land Brought into Production

The default value for the increased supply coming from new land brought into production was developed based on data and reports from the FAO. Such studies indicate that globally only 10 percent of the increases in agricultural production globally will come from new land being brought into production (Alexandratos and Bruinsma, 2012). Some sub-regions such as Latin America and the Caribbean may experience 40 percent of future supply coming from new land being brought into production. While these studies provide predictions regarding the long-term trends in production other studies on short-term trends result in other conclusions. Roberts and Schlenker (2013) provide evidence that shorter-term price shocks do not follow these longer-term trends and the increase in production is primarily made up by bringing new land into production.

The default value has been developed based on the assumption that projects will have longer-term impacts on commodity markets. Based on the FAO data, 40 percent was selected as a conservative threshold for the default value for non-forest product. Such default value could be updated in the future if AFOLU projects are shown to have shorter-term impacts on commodity markets.

For forest products, the share of increase supply coming from new land brought into production has conservatively been set to a default value of 100 percent. Evidence was not available that globally Such default value could be updated in the future if sufficient evidence is available to suggest a significant amount of the increases in the supply of forest products comes from forests already under production.

However, a lower value may be justified for both forest products and non-forest products where such data are relevant and available as described in Section 5.3.1.

<u>Share of Leakage</u> Going to Forest Lands

The default value for the share of leakage going to forest land was developed based on data and reports from FAO and Gibbs et al (2010). These studies indicate that some countries have significant areas of forested land that are suitable for agricultural production and much of the new land brought into agricultural production in the 1980s and 1990s was forested land. Therefore a default value of 1 was selected to provide the most conservative assumption that all production will be displaced to forest land. However, a lower value may be justified by using country-specific values where such data are relevant and available as described in Section 5.4.3.

APPENDIX 3: SUMMARY OF LEAKAGE FROM RELEVANT AFOLU PROJECT TYPES

Project Type	Baseline Land Use/Drivers	Project Activity	Potential Sources of Market Leakage	Commodity Type	Broad AFOLU Project Activity	Specific AFOLU Project Activity
Forest Project	Conversion of forest to non-forest land use	Reducing emissions from conversion of forest to non-forest	Agricultural crops, livestock, fuelwood or mining driving conversion	Non-Forest Products	REDD (Reducing Emissions from Deforestation and Degradation)	APD (Avoided Planned Deforestation)
						AUD (Avoided Unplanned Deforestation)
	Conversion to different forest system (eg, pulpwood or oil palm plantation) or unmanaged forest degradation with a lower carbon stock	Reducing emissions from forests remaining forests	Plantation agricultural crops, fuel wood, illegal timber or pulpwood driving conversion	Forest Products		AUD**D** (Avoided Unplanned Degradation)
	Managed forest system with a lower carbon stock		Timber or pulpwood produced in the baseline scenario		IFM (Improved Forest Management)	RIL (Reduced Impact Logging)
						LtPF (Logged to Protected Forest)
						ERA (Extended Rotation Age)
		Increasing removals from forests remaining forests				LtHP (Low Productive to High-Productive Forests)

Non-Forest Project	Non-forest land use with a lower carbon stock	Increasing conversion to forests	Agricultural crops or livestock produced in the baseline scenario	Non-Forest Products	ARR (Afforestation, Reforestation and Revegetation)	ARR (Reforestation)
						ARR (Afforestation)
		Increasing removals from non-forests remaining non-forests				ARR (Revegetation)
	Managed grassland with a lower carbon stock or higher emissions	Increasing removals or reducing emissions from non-forests remaining non-forests			ALM (Agricultural Land Management)	IGM (Improved Grassland Management)
	Managed cropland with a lower carbon stock or higher emissions					ICM (Improved Cropland Management)
	Conversion to different grassland, shrubland, or cropland system with a lower carbon stock or higher emissions	Reducing emissions or increasing removals by actively changing management practices				CGLC (Cropland and Grassland Land-use Conversions)
		Reducing emissions by preventing conversion	Agricultural crops, livestock or fuelwood driving conversion		ACoGS (Avoided Conversion of Grasslands or Shrublands)	APC (Avoiding Planned Conversion)
						AUC (Avoiding Unplanned Conversion)