Guidance note on application of IPCC guidelines for subcategories and carbon pools where changes take place over a longer time period

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Guidance note[1] on application of IPCC guidelines for subcategories and carbon pools where changes take place over a longer time period

ISFL Emission Reductions (ER) Program Requirements of the BioCarbon Fund ISFL

1 Background

The ISFL ER Program Requirements build on the IPCC Guidelines for National Greenhouse Gas Inventories and other relevant UNFCCC documents and decisions. In this context, the ISFL ER Program Requirements distinguish between

- *Reporting of AFOLU related Emissions and Removals for the Program Area (ISFL Reporting).* This supports the design of the ISFL ER program and is the basis for identifying important subcategories. Reporting under the ISFL requires compilation of existing data from the National Greenhouse Gas Inventory or similar processes that are appropriate for the jurisdiction being proposed for ISFL. In applying the IPCC guidelines, the emphasis is on completeness of the inventory and using available data. This means that the inventory may be based on IPCC Tier 1 and/or Tier 2 methods;
- *The accounting of the emission reductions from the subcategories that are eligible to receive result-based payments under the ISFL by comparing monitored Emissions and Removals with a baseline (ISFL Accounting)*. For the subcategories that are included in the ISFL accounting scope, the Emissions Baseline and the monitoring of emissions and removals shall be done using at minimum IPCC Tier 2 methods and data.

The IPCC Guidelines for National Greenhouse Gas Inventories are developed to enable the compilation of repeated national inventories and not necessarily for the comparison of emissions against an Emissions Baseline as is required for ISFL Accounting. One area where this becomes clear is emissions and removals that take place over a longer time period.

In the IPCC guidelines, after a change in land use, it is good practice to assume is that the carbons stocks in the relevant area change from one steady value (associated with the land use before the land use change) to another steady value (associated with the land use after the land use change) over a period of at least 20 years with the emissions and removals being spread over the whole transition period. This means that in a particular year, GHG emission and removals associated with land use are not just the result of the land use changes occurring in that year but also of emission and removals resulting from land use changes that occurred in previous years (for the purpose of this guidance we will refer to these emissions and removals resulting from land use changes in previous years as “legacy emission/removals”).

Applying the IPCC guidelines in full while considering the legacy emissions/removals mentioned above would have important consequences for both ISFL Reporting and ISFL Accounting:

- For both ISFL Reporting and ISFL Accounting, full implementation of the IPCC guidelines would require long time series of data (often going back 20 year) to properly estimate legacy emissions/removals. A lack of historical data in developing countries makes the quantification of legacy emissions/removals challenging;

[1] In accordance with the ISFL Process Requirements, guidance notes provide supplemental advice or instruction on the ISFL Requirements. A guidance note describes acceptable methods of satisfying requirements.

- For ISFL Accounting, applying the IPCC Guidelines including legacy emissions/removals would mean that the emissions and removals occurring during the Baseline Period and the ISFL ERPA Phase would not just be the result of the emissions and removals occurring during the Baseline Period and the ISFL ERPA Phase but would also include legacy emission and removals from land use changes that occurred outside these two periods of interest.

The purpose of this note is therefore to provide guidance to ISFL ER Programs and other users of the ISFL ER Program Requirements on the application of the IPCC guidelines in the context of the BioCF ISFL. This guidance is applicable to the ISFL ER Program Requirements only and applies to the following subcategories, pools and gases:

- Changes in the Soil Organic Carbon pool in mineral soils associated with conversion of forest land to other land
- Change in biomass carbon stocks (above-ground biomass and below-ground biomass) for Land converted to forest land
- Changes in carbon stocks in dead organic matter
- Change in biomass carbon stocks (above-ground biomass and below-ground biomass) for forest land converted to Cropland or Grassland
- Emissions from organic soils associated to drainage of forestland converted to other land and forestland remaining forestland

2 Changes in the Soil Organic Carbon pool in mineral soils associated with conversion of Forest Land to other land categories

2.1 ISFL Reporting

For the purpose of ISFL Reporting, estimation of changes in the Soil Organic Carbon (SOC) pool in mineral soils associated with conversion of Forest Land to other land categories will be calculated for the inventory period following Equation 2.25 from the 2006 IPCC Guidelines, Volume 4, Chapter 2. It is not required[2] to estimate legacy emission and removals from land use changes before the inventory period and the Soil Organic Carbon pool in forests shall be assumed to be in equilibrium at the beginning of the inventory period. Default Tier 1 data may be used unless better data are available through the national GHG inventory or other existing data sets.

2.2 ISFL Accounting

For ISFL Accounting, the same Equation 2.25 from the 2006 IPCC Guidelines, Volume 4, Chapter 2 will be used using the Tier 2 method. Since the ISFL ER Program Requirements in paragraph 4.2.3 require Approach 2 or 3 for Activity Data Collection, formulation B from box 2.1 in the same IPCC chapter will be applied to replace Equation 2.25. For comparing the monitored Emissions and Removals with an estimated baseline, the following approach will be taken:

[2] Programs may voluntarily choose to include legacy emission and removals from land use changes occurring before the inventory period if the country, through multiple subsequent GHG inventories, has developed a time series of data on land use change which allows the country to track land use change from before the inventory period using Approach 2 or Approach 3

- Calculation of the emission reductions shall be based on comparing the emissions and removals estimated with activity data for the Baseline Period and the ISFL ERPA Phase, including the legacy emissions/removals from the land use changes in these two periods. It is therefore not necessary to have a longer time series of data to estimate legacy emission and removals from land use changes before these two periods.
- Determination of the Emissions Baseline shall assume that the average annual rate of conversion from Forest Land to other land categories (in ha/year) during the Baseline Period would have applied during the ISFL ERPA Phase and emissions and removals are calculated accordingly.
- The Soil Organic Carbon pool in Forest Land shall be assumed to be in equilibrium at the beginning of the Baseline Period.
- The assumed equilibrium for each non-forest subcategory shall be conservatively determined and justified. It shall be assumed that the Soil organic C stock change during the transition to a new equilibrium SOC occurs in a linear fashion over a period of 20 years.
- Under Tier 2, ER Programs shall apply Equation 2.25 from the 2006 IPCC Guidelines, Volume 4, Chapter 2. Since the ISFL ER Program Requirements requires IPCC Approach 2 or 3 for Activity Data collection, formulation B from box 2.1 of that same chapter will be applied.
- The land units used in the equation will represent the different subcategories from the land use change analysis and the different inventory periods used in determining the Emissions Baseline and for monitoring. For example, if conversions of Forest Land to other land categories in the Baseline Period was analyzed using different smaller time periods (for example to determine deforestation from 2005-2015, land use changes were analyzed for the periods 2005-2010, 2011-2012 and 2013-2015), conversions in each time period would be a separate land unit. For the monitoring period, separate land units shall be created for conversions in each year of the monitoring period (see example in box 1 below).
- It shall be assumed that the land unit remains in the same subcategory for the whole ERPA Phase (so for example if during the ERPA Term, Forest Land is converted first to Cropland and later to Grassland, the second conversion will be considered from the start of the following ERPA Phase after which the conversion occurred).

BOX 1: Example calculation of changes in the Soil Organic Carbon pool in mineral soils associated with conversion of Forest Land to other land categories

This example is based on box 2.2 from the 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 4, Chapter 2

This simplified example shows the basis for determining the Emissions Baseline and estimating emissions from changes in the SOC pool resulting from associated with conversion of Forest Land to other land categories. This simplified example is using the following simplified assumptions:

- The country has a single soil type, with a SOC_{Ref} value of 77 tonnes C ha^{-1} corresponding to forest vegetation
- All forest land is converted to cropland. The SOC_{Ref} value for cropland is 67 tonnes C ha^{-1}. It is assumed that the change in Soil Organic Carbon during the transition to a new equilibrium SOC occur in a linear fashion over a period of 20 years (0.5 t C ha^{-1} $year^{-1}$).

- At the start of the Baseline Period the total forest area is 1,000,000 ha.
- There is a 10-year Baseline Period (2006-2015). The average rate of conversion from Forest Land to Cropland in the Baseline Period is 8,000 ha/year.
- In the period 2016-2018, an additional 21,000 ha were converted from Forest Land to Cropland (so on average 7,000 ha/year).
- The first monitoring period is 2019-2020 during which 12,000 ha were converted from Forest Land to Cropland. The second monitoring period is 2021-2022. In this period also 12,000 ha were converted from Forest Land to Cropland.

In accordance with the approach provided in the 2006 IPCC Guidelines and following the guidance above, the example above leads to the following land use change matrix for determining the Emissions Baseline for emissions from SOC. In accordance with the guidance, it is assumed that the average annual rate of conversion from Forest Land to Cropland during the Reference Period (8,000 ha/year) would have applied during the ERPA Phase and separate land units are created for each year. The land units are based on the classes forest-remaining-forest and Forest Land to Cropland with separate land units created for the different inventory periods.

		Ha of land use unit in:				
		2005	**2015**	**2018**	**2020**	**2022**
Land unit 1	**Conversion of Forest Land to Cropland during 2006-2015**	-	80,000	80,000	80,000	80,000
Land unit 2	**Conversion of Forest Land to Cropland during 2016-2018**	-	-	21,000	21,000	21,000
Land unit 3	**Emissions Baseline projected conversion of Forest Land to Cropland 2019**	-	-	-	8,000	8,000
Land unit 4	**Emissions Baseline projected conversion of Forest Land to Cropland 2020**	-	-	-	8,000	8,000
Land unit 5	**Emissions Baseline projected conversion of Forest Land to Cropland 2021**	-	-	-	-	8,000
Land unit 6	**Emissions Baseline projected conversion of Forest Land to Cropland 2022**	-	-	-	-	8,000
Land unit 7	**Forest Land remaining Forest Land**	1,000,000	920,000	899,000	883,000	867,000
Total area		**1,000,000**	**1,000,000**	**1,000,000**	**1,000,000**	**1,000,000**

Using the assumed changes in SOC over 20 years, the SOC value for each land unit in a particular year would be:

		SOC /ha of land use unit in:				
		2005	**2015**	**2018**	**2020**	**2022**
Land unit 1	**Conversion of Forest Land to Cropland during 2006-2015**	-	72	70.5	69.5	68.5

Land unit 2	**Conversion of Forest Land to Cropland during 2016-2018**	-	-	75.5	74.5	73.5
Land unit 3	**Conversion of Forest Land to Cropland during 2019**	-	-	-	76.0	75
Land unit 4	**Conversion of Forest Land to Cropland during 2020**	-	-	-	76.5	75.5
Land unit 5	**Conversion of Forest Land to Cropland during 2021**	-	-	-	-	76
Land unit 6	**Conversion of Forest Land to Cropland during 2022**	-	-	-	-	76.5
Land unit 7	**Forest Land remaining Forest Land**	77	77	77	77	77

Multiplying the two tables above leads to the following results for the application in Equation 2.25 to the Emissions Baseline

		SOC for land use unit in:				
		2005	**2015**	**2018**	**2020**	**2022**
Land unit 1	**Conversion of Forest Land to Cropland during 2006-2015**	-	5,760,000	5,640,000	5,560,000	5,480,000
Land unit 2	**Conversion of Forest Land to Cropland during 2016-2018**	-	-	1,585,500	1,564,500	1,543,500
Land unit 3	**Reference level projected conversion of Forest Land to Cropland during 2019**	-	-	-	608,000	600,000
Land unit 4	**Reference level projected conversion of Forest Land to Cropland during 2020**	-	-	-	612,000	604,000
Land unit 5	**Reference level projected conversion of Forest Land to Cropland during 2021**	-	-	-	-	608,000
Land unit 6	**Reference level projected conversion of Forest Land to Cropland during 2022**	-	-	-	-	612,000
Land unit 7	**Forest Land remaining Forest Land**	77,000,000	70,840,000	69,223,000	67,991,000	66,759,000
Total SOC		**77,000,000**	**76,600,000**	**76,448,500**	**76,335,500**	**76,206,500**

Applying the IPCC approach, changes in the Soil Organic Carbon pool are calculated as $SOC_0 - SOC_{(0-T)}$. This means that the changes in the Soil Organic Carbon pool associated with conversion of Forest Land to Cropland for the Emissions Baseline of the first monitoring period (2019-2020), are '*total SOC* for 2020' (SOC_0) – '*total SOC* for 2018' ($SOC_{(0-T)}$) = 113,000 t C. For the second monitoring period (2021-2022), these are '*total SOC* for 2022' (SOC_0) – '*total SOC* for 2020' ($SOC_{(0-T)}$) = 129,000 t C.

For calculating the Emission Reductions, the changes in the Soil Organic Carbon pool under the Emissions Baseline need to be compared with actual changes in the Soil Organic Carbon pool. In this example, the monitored conversion of Forest Land to Cropland during 2019-2020 and 2021-2022 is 12,000 ha (6,000

ha/year). This results in the following land use change matrix which shows changes (in red) in land units 3,4, 5, 6 and 7 compared to the same matrix for the Reference Level

		Ha of land use unit in:				
		2005	**2015**	**2018**	**2020**	**2022**
Land unit 1	**Conversion of Forest Land to Cropland during 2006-2015**	-	80,000	80,000	80,000	80,000
Land unit 2	**Conversion of Forest Land to Cropland during 2016-2018**	-	-	21,000	21,000	21,000
Land unit 3	**Actual conversion of Forest Land to Cropland during 2019**	-	-	-	6,000	6,000
Land unit 4	**Actual conversion of Forest Land to Cropland during 2020**	-	-	-	6,000	6,000
Land unit 5	**Actual conversion of Forest Land to Cropland during 2021**	-	-	-	-	6,000
Land unit 6	**Actual conversion of Forest Land to Cropland during 2022**	-	-	-	-	6,000
Land unit 7	**Forest Land remaining Forest Land**	1,000,000	920,000	899,000	887,000	875,000
Total area		**1,000,000**	**1,000,000**	**1,000,000**	**1,000,000**	**1,000,000**

Multiplying this with the table containing the SOC/ha values leads to the following results

		SOC for land use unit in:				
		2005	**2015**	**2018**	**2020**	**2022**
Land unit 1	**Conversion of Forest Land to Cropland during 2006-2015**	-	5,760,000	5,640,000	5,560,000	5,480,000
Land unit 2	**Conversion of Forest Land to Cropland during 2016-2018**	-	-	1,585,500	1,564,500	1,543,500
Land unit 3	**Actual conversion of Forest Land to Cropland during 2019**	-	-	-	456,000	450,000
Land unit 4	**Actual conversion of Forest Land to Cropland during 2020**	-	-	-	459,000	453,000
Land unit 5	**Actual conversion of Forest Land to Cropland during 2021**	-	-	-	-	456,000
Land unit 6	**Actual conversion of Forest Land to Cropland during 2022**	-	-	-	-	459,000
Land unit 7	**Forest Land remaining Forest Land**	77,000,000	70,840,000	69,223,000	68,299,000	67,375,000
Total SOC		**77,000,000**	**76,600,000**	**76,448,500**	**76,338,500**	**76,216,500**

So the changes in the Soil Organic Carbon pool associated with the actual monitored conversion of Forest Land to Cropland in the first monitoring period (2019-2020), are '*total SOC* for 2020' (SOC_0) – '*total SOC* for 2018' ($SOC_{(0-T)}$) = 110,000 t C. For the second monitoring period (2021-2022) this is '*total SOC* for 2022' (SOC_0) – '*total SOC* for 2020' ($SOC_{(0-T)}$) = 122,000 t C.

The emission reductions from the SOC pool is calculated as the difference between the Emissions Baseline and the monitored changes. For the first monitoring period (2018-2019) the difference between the changes in the Soil Organic in the Emissions Baseline and the actual emissions is 113,000 – 110,000 = 3,000 t C (or

11,000 t CO_2). For the second monitoring period (2021-2022), this is 129,000 – 122,000 = 7,000 t C (or 25,667 t CO_2). The difference between the two periods is the result of the legacy emissions.

3 Change in biomass carbon stocks (above-ground biomass and below-ground biomass) for land converted to forest land

Following the IPCC guidelines, this section to any conversion to forest (corresponding to the definition of forest adopted by the country) from other land-uses, through afforestation and reforestation, either by natural or artificial regeneration (including plantations).

3.1 ISFL Reporting

For the purpose of ISFL Reporting, estimation of changes in the biomass carbon stocks for Land converted to forest land shall be calculated for the inventory period following section 4.3.1 from the 2006 IPCC Guidelines, Volume 4, Chapter 4.

3.2 ISFL Accounting

For the purpose of ISFL Accounting, ISFL ER Programs shall apply section 4.3 from the 2006 IPCC Guidelines, Volume 4, Chapter 4 considering the general guidance provided below (including guidance provided in box 2 in the form of an example):

- Following section 4.5 of the ISFL ER Program Requirements, data will be collected on: i) average carbon stocks of forestland; and ii) average carbon stocks in non-forest land. Where applicable, stratification will be used to consider the impact of climate, biome or forest type, species mix, management practices, etc and create homogenous sub-categories.
- The net annual CO_2 removals shall be calculated using equations 2.15 and 2.16 from the 2006 IPCC Guidelines, Volume 4, Chapter 2. These equations shall be simplified by assuming that during the conversion from non-forest to forest, carbon stocks will go from average carbon stocks in non-forest to average carbon stocks in forests during a period of time. This calculation shall consider the maximum carbon stocks in different forest types and it shall be ensured that the estimated forests carbon stocks will not continue growing beyond this maximum value. A conservative default period of 20 years is suggested for the forest to grow from the carbon stock levels of non-forest to the level of biomass, stable soil and litter pools of the average forest. Alternative periods may be used but shall be justified and this justification shall also consider the maximum carbon stocks in different forest types.
- Following equation 2.16 from the IPCC Guidelines, ISFL ER Programs shall track the area converted to forest land in a certain year ($\Delta A_{TO\_OTHERSi}$) using an IPCC Approach 3 during the Baseline Period and during the ERPA Phase (i.e. since the start of the first monitoring period to the end of the applicable monitoring/reporting period).
- Using the outcome of equation 2.15 and 2.16, the ISFL ER Program shall determine the changes in the total carbon stocks in biomass (removals) during a monitoring period as the sum of the total carbon stocks in biomass of all land units. It shall be assumed that the average annual rate of conversion to forest land during the Reference Period would have applied during the Crediting Period. The emission

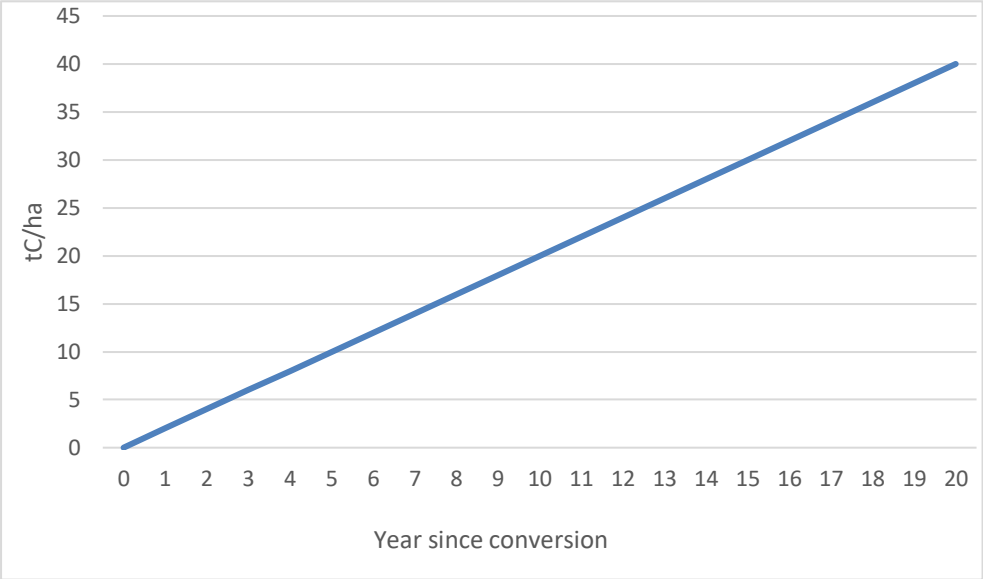
reductions are calculated as the difference between the expected removals under the Emissions Baseline and the actual removals

BOX 2: Example calculation of changes in above- and below ground biomass for land converted to forest plantations

This simplified example shows the basis for determining the contribution of the above-ground biomass and below-ground biomass in the conversion of non-forest to forest. This simplified example based on the conversion of non-forest to forest with one forest type.

The example is using the following assumptions:

- The average carbon stocks (aboveground and belowground) of forestland is 44 tonnes C/ha and average carbon stocks in non-forest land is 4 tonnes C/ha.
- The annual increase in carbon stocks in total biomass (aboveground and belowground) due to net growth is (44 – 4) / 20 = 2 tonnes C ha^{-1} yr^{-1}
- This means that for one ha, the total carbon stocks in biomass over time look like this:



- There is a 10-year Baseline Period (2006-2015). During the Baseline Period it is known that a total of 2,250 ha were planted, average rate of planting in the Baseline Period was therefore 225 ha / year.
- The first monitoring period is 2019-2020. In 2019, 500 ha were restored, in 2020 600 ha were restored.
- The second monitoring period is 2021-2022. The monitoring system shows that the areas restored in 2019 and 2020 have not changed. Again, in 2021, 500 ha were restored, in 2022 600 ha were restored.

The table below shows the estimation of the total carbon stocks in the land units under the Emissions Baseline for the two monitoring periods. Following the guidance, land units have been created to track the area converted to forest land in a certain year during the ERPA Phase. In accordance with the guidance above, for determining the Emissions Baseline it is assumed that the average annual rate during the Baseline Period (225 ha / year) would have applied during the ERPA Phase. The Emissions Baseline removals are calculated by

multiplying the area of land planted with the tonnes of C/ha in the curve above leading to a value of carbon stocks in biomass in a particular year. These are then added up across all land units.

		Ha/year	Total carbon stocks in biomass in:				
			2018	2019	2020	2021	2022
Land unit 1	**Emissions Baseline projected conversion from other land to forest in 2019**	225	0	450	900	1,350	1,800
Land unit 2	**Emissions Baseline projected conversion from other land to forest in 2020**	225	0	0	450	900	1,350
Land unit 3	**Emissions Baseline projected conversion from other land to forest in 2021**	225	0	0	0	450	900
Land unit 4	**Emissions Baseline projected conversion from other land to forest in 2022**	225	0	0	0	0	450
Total carbon stocks			**0**	**450**	**1,350**	**2,700**	**4,500**

The removals are estimated as the 'total carbon stocks in biomass at the end of the monitoring period' - 'total carbon stocks in biomass at the beginning of the monitoring period. This means that the removals under the Emissions Baseline for the first monitoring period (2019-2020) is the 'total carbon stocks for 2020' – 'total carbon stocks for 2018' = 1,350 t C. The removals under the Emissions Baseline for the second monitoring period (2021-2022) is the 'total carbon stocks for 2022' – 'total carbon stocks for 2020' = 3,150 t C.

The actual regeneration was 500 ha (2019), 600 ha (2020), 500 ha (2021) and 600 ha (2022). Using the same calculations, this leads to the following table

		Ha/year	Total carbon stocks in biomass in:				
			2018	2019	2020	2021	2022
Land unit 1	**Actual conversion from other land to forest during 2019**	500	0	1,000	2,000	3,000	4,000
Land unit 2	**Actual conversion from other land to forest during 2020**	600	0		1,200	2,400	3,600
Land unit 3	**Actual conversion from other land to forest in 2021**	500	0			1,000	2,000
Land unit 4	**Actual conversion from other land to forest in 2022**	600	0	0	3,300		1,200
Total carbon stocks			**0**	**1,000**	**3,200**	**6,400**	**10,800**

Therefore, the actual removals for the first monitoring period is 'is the total carbon stocks for 2020' – 'total carbon stocks for 2018' = 3,200 t C. The actual removals for the second monitoring period (2021-2022) is the 'total carbon stocks for 2022' – 'total carbon stocks for 2020' = 7,600 t C.

The emission reductions from Land converted to forest land is estimated as the difference between the removals in the Emissions Baseline and the actual removals. For the first monitoring period (2018-2019) the difference between Emissions Baseline and the actual removals is 3,200 – 1,350 = 1,850 t C (or 6,783 t CO_2). For the second monitoring period (2021-2022), this is 7,600 - 3,150 = 4,450 t C (or 16,317 t CO_2). The difference between the two periods is the result of the legacy removals from regeneration occurring in the first monitoring period and affecting the second monitoring period.

4 Changes in carbon stocks in dead organic matter

Overall, it is recognized that when it comes to carbon stock changes in dead organic matter (dead wood and litter), the ISFL ER program Requirements create some challenges.

Paragraph 4.2.2 of the ISFL ER Program Requirements states that subcategories are considered to meet Tier 2 if all the significant pools and gasses are estimated using Tier 2 methods and data. Significant here refers to (i) the individual pools or gases that make up at least 25% of the absolute level of the total GHG Emissions and Removals in the subcategory, and (ii) the pools and gases that, when listed in the relative magnitude of contribution to the Emissions of the overall subcategory, contribute to 60% of the cumulative Emissions. However, in most countries the best available data only allows for Tier 1 estimations. Under Tier 1, the assumption for both dead wood and litter pools for all land-use categories is that their stocks are not changing over time if the land remains within the same land-use category. Similarly, when it comes to conversions of one land use to another, Tier 1 methods assume that litter and dead wood pools are zero in all non-forest categories and therefore transitions between non-forest categories involve no carbon stock changes in these two pools. This means that under Tier 1, the dead organic matter pool does not lead to emissions and removals and therefore would always be considered an insignificant pool under paragraph 4.2.2 of the ISFL ER Program Requirements.

Therefore, unless the country where the ISFL ER Program is located is already using Tier 2 methods for estimating changes in carbon stocks in dead organic matter, ISFL ER Programs may exclude the changes in carbon stocks in dead organic matter from both the ISFL Reporting and ISFL Accounting for subcategories that involve land remaining within the same land-use category (including forest remaining forest) or subcategories that represent transitions between non-forest categories.

Changes in carbon stocks in dead organic matter shall only be considered for subcategories involving lands converted from Forest Land to any other land-use category (carbon losses) and for lands converted to Forest Land (carbon gains) in accordance with the guidance below. When considering dead organic matter for these subcategories, paragraph 4.2.2 of the ISFL ER Program Requirements shall still be applied to determine the significance of this pool.

4.1 ISFL Reporting

Unless the country where the ISFL ER Program is located is already using Tier 2 methods for estimating changes in carbon stocks in dead organic matter, ISFL ER Programs may use the Tier 1 assumption that carbon stocks in

dead wood and litter pools in non-forest land are zero. It is not required[3] to estimate legacy emission and removals from land use changes before the inventory period.

For lands converted to Forest Land during the inventory period, ISFL ER Programs may apply equation 2.23 from the IPCC Guidelines for National Greenhouse Gas Inventories, Volume 4, Chapter 2 to estimate the changes in carbon stocks in dead organic matter during the inventory period. In applying this equation, it may be assumed that carbon in dead organic matter pools increases linearly to the value of mature forests over a specified time period (default = 20 years which is the default value provided in Section 2.3.2.2 of the IPCC Guidelines for National Greenhouse Gas Inventories, Volume 4, Chapter 2).

For lands converted from Forest Land to any other land-use category during the inventory period, the assumption may be made that carbon in dead organic matter pools is lost in year 1 .

For both conversions, default Tier 1 data may be used for carbon in dead organic matter pools in mature forests unless better data are available through the national GHG inventory or other existing data sets.

4.2 ISFL Accounting

If emission or removals from dead organic matter pools are significant under paragraph 4.2.2 of the ISFL ER Program Requirements, ISFL ER programs shall determine these using equation 2.23 from the IPCC Guidelines for National Greenhouse Gas Inventories, Volume 4, Chapter. As indicated in the IPCC Guidelines, the use of Tier 2 assumes that C_o in equation 2.23 represents the dead wood or litter carbon stocks immediately after the land-use conversion where C_o will transit to C_n over the transition period. In accordance with the ISFL ER Program Requirements, if insufficient data are available on dead wood or litter carbon stocks immediately after the land-use conversion, the pool will be included in the time bound plan to increase the Completeness of the scope of accounting (paragraph 3.2.4 and 4.3.12-4.3.14 of the ISFL ER Program Requirements).

For comparing the monitored Emissions and Removals with an estimated baseline, the following approach will be taken for both 'lands converted to Forest Land' and 'lands converted from Forest Land to any other land-use' categories:

- Calculation of the emission reductions shall be based on comparing the emission and removals estimated with activity data for the Baseline Period and the ERPA Phase. It is therefore not necessary to have a longer time series of data to estimate legacy emission and removals from land use changes before these two periods
- Determination of the Emissions Baseline shall assume that the average annual rate of conversion during the Baseline Period would have applied during the ERPA Phase and emission and removals are calculated accordingly
- Litter and dead wood pools are assumed zero in all non-forest categories
- Dead organic matter in Forest Land shall be assumed to have the value of mature forests at the beginning of the Baseline Period

[3] Programs may voluntarily choose to use a longer time series of data starting before the inventory period if this time series is part of their national GHG inventory process (ie the country has done multiple GHG inventories which has allowed the country to track land use change over time using Approach 2 or Approach 3)

- Transitions shall be in line with the IPCC guidelines for Tier 2. This means that ISFL ER Programs first account for the immediate effects of the land-use conversion in the year of the event. Transitions involving an increase in carbon stocks in dead organic matter pools can assume a linear transition using a default period of 20 years. Alternative periods may be used but should be justified in the ERPD.
- Following equation 2.16 from the IPCC Guidelines, ER Programs shall track the area converted to forest land in a certain year ($\Delta A_{TO\_OTHERSi}$) using an IPCC Approach 3 during the Baseline Period and during ERPA Phase (i.e. since the start of the first monitoring period to the end of the applicable ERPA Phase).
- For determination of the emissions from carbon stocks in dead organic matter in the Emissions Baseline, it shall be assumed that the average annual rate of conversion to forest land during the Baseline Period would have applied during the ISFL ERPA Phase. The emission reductions are calculated as the difference between the expected emissions or removals under the Emissions Baseline and the actual emission or removals (see the example from box 3)

BOX 3: Example calculation of changes in dead organic matter pools for land converted to forest plantations

This simplified example shows the basis for determining the contribution of the dead organic matter pools in case of conversion of non-forest to forest. This simplified example based on the conversion of non-forest to forest with one forest type.

The example is using the following assumptions:

- In accordance with the guidance, carbon stocks in litter and dead wood pools are assumed to be zero in all non-forest categories
- The average carbon stocks in dead organic matter pools of forestland is 5 tonnes C/ha.
- Based on the example value above of 5 tonnes C/ha and the guidance provided (carbon stocks in DOM in non-forest categories is assumed zero and a 20 year transition period for increases in carbon stocks), the annual increase in carbon in the dead organic matter pools is (5 – 0) / 20 = 0.25 tonnes C ha^{-1} yr^{-1}
- There is a 10-year Baseline Period (2006-2015). During the Baseline Period it is known that a total of 2,000 ha was planted, average rate of planting in the Baseline Period was therefore 200 ha / year.
- The first monitoring period is 2019-2020. In 2019, 500 ha were planted, in 2020 600 ha were planted.
- The second monitoring period is 2021-2022. The monitoring system shows that the areas planted in 2019 and 2020 have not changed. Again, in 2021, 500 ha were plantedd, in 2022 600 ha were planted.

The table below shows the estimation of the total carbon stocks in the dead organic matter pools in the land units under the Emissions Baseline for the two monitoring periods. Following the guidance, land units have been created to track the area converted to forest land in a certain year during the ERPA Phase. In accordance with the guidance above, for determining the Emissions Baseline it is assumed that the average annual rate during the Baseline Period (200 ha / year) would have applied during the ERPA Phase. The Emissions Baseline removals are calculated by multiplying the area of land planted with the tonnes of C/ha estimated using the annual increase in carbon stocks in the dead organic matter pools of 0.25 tonnes C ha^{-1} yr^{-1}. This leads to a value of carbon in dead organic matter pools in a particular year. These are then added up across all land units.

		Total carbon in dead organic matter pools in:				
	Ha/year	**2018**	**2019**	**2020**	**2021**	**2022**

Land unit 1	**Emissions Baseline projected conversion from other land to forest in 2019**	200	0	50	100	150	200
Land unit 2	**Emissions Baseline projected conversion from other land to forest in 2020**	200	0	0	50	100	150
Land unit 3	**Emissions Baseline projected conversion from other land to forest in 2021**	200	0	0	0	50	100
Land unit 4	**Emissions Baseline projected conversion from other land to forest in 2022**	200	0	0	0	0	50
Total carbon in dead organic matter pools			**0**	**50**	**150**	**300**	**500**

The removals are estimated as the 'total carbon in dead organic matter pools at the end of the monitoring period' - 'total carbon in dead organic matter pools at the beginning of the monitoring period. This means that the removals under the Emissions Baseline for the first monitoring period (2019-2020) is the 'total carbon in dead organic matter pools for 2020' – 'total carbon in dead organic matter pools for 2018' = 150 t C. The removals under the Emissions Baseline for the second monitoring period (2021-2022) is the 'total carbon in dead organic matter pools for 2022' – 'total carbon in dead organic matter pools for 2020' = 350 t C.

The actual regeneration was 500 ha (2019), 600 ha (2020), 500 ha (2021) and 600 ha (2022). Using the same calculations, this leads to the following table

			Total carbon in dead organic matter pools in:				
		Ha/year	**2018**	**2019**	**2020**	**2021**	**2022**
Land unit 1	**Actual conversion from other land to forest during 2019**	500	0	125	250	375	500
Land unit 2	**Actual conversion from other land to forest during 2020**	600	0	0	150	300	450
Land unit 3	**Actual conversion from other land to forest in 2021**	500	0	0	0	125	250
Land unit 4	**Actual conversion from other land to forest in 2022**	600	0	0	0	0	150
Total carbon in dead organic matter pools			**0**	**125**	**400**	**800**	**1,350**

Therefore, the actual removals from carbon in dead organic matter pools for the first monitoring period is 'total carbon in dead organic matter pools for 2020' – 'total carbon in dead organic matter pools for 2018' = 400 t C. The actual removals for the second monitoring period (2021-2022) is the 'total carbon in dead organic matter pools for 2022' – 'total carbon in dead organic matter pools for 2020' = 950 t C.

The emission reductions from changes in carbon in dead organic matter pools in land converted to forest land is estimated as the difference between the removals in the Emissions Baseline and the actual removals. For the first monitoring period (2018-2019) the difference between Emissions Baseline and the actual removals is 400 -– 150 = 250 t C (or 916 t CO_2). For the second monitoring period (2021-2022), this is 950 -– 350 = 600 t C

(or 2,200 t CO_2). The difference between the two periods is the result of the legacy removals from regeneration occurring in the first monitoring period and affecting the second monitoring period.

5 Change in biomass carbon stocks (above-ground biomass and below-ground biomass) for forest land converted to Cropland or Grassland

Under the IPCC Guidelines, conversions from Forest Land to Cropland or Grassland take a similar approach:

- For lands converted to grassland the Guidelines define a two-phase approach. Phase 1 is estimated at the year of conversion and involves the abrupt change in biomass associated with the land-use change. The second phase accounts for gradual biomass loss and gain during a transition period to a new steady-state system.
- Similarly, for conversions to Cropland, it is assumed that the dominant vegetation is removed entirely leading to emissions, resulting in near zero amounts of carbon remaining in biomass (in Tier 1). Some type of cropping system, especially those with perennial woody biomass, increase the amount of carbon stored in biomass again leading to accumulations and losses in subsequent years. Moreover, for these conversions it is assumed that no biomass loss from belowground biomass occur as a result of these conversions, i.e. forest does not contain belowground biomass.
- For conversions from Forest Land to Cropland or Grassland , the IPCC Guidelines indicate that under Tier 2 it is good practice, if possible, to develop and use a disturbance matrix that provides the proportion of the carbon remaining in that pool, and the proportions transferred to other pools (e.g. biomass to deadwood or soil).

ISFL ER Programs in countries that have done multiple GHG inventories which has enabled the country to track land use change over time using Approach 2 or Approach 3 may apply this approach if they also have reliable data that allows for estimations of accumulations and losses in the subsequent years using either the Gain-Loss Method (Equation 2.7 in Chapter 2) or the Stock-Difference Method (Equation 2.8 in Chapter2).

All other ISFL ER Programs, both for ISFL Reporting and ISFL Accounting, shall assume that in the year of conversion, the biomass carbon stocks (including both aboveground and belowground biomass) go instantly from the average biomass carbon stocks in forest to the average biomass carbons stocks in the new steady state system. ISFL ER Programs are also not required to assume transfer of carbon stocks between pools based on a disturbance matrix. Within the context of the ISFL (with ISFL ERPA Phases that are shorter than the 20-year transition period) this may be considered as conservative since it leads to lower emissions in the year of conversion.

6 Emissions from organic soils associated to drainage of forestland converted to other land and forestland remaining forestland

This guidance is restricted to inland soils only and the assumption is that under the Emissions Baseline, forest land would be converted to other land use or would be degraded, and the organic soils would be drained. This section does not address rewetting of soils drained before the start of the Baseline Period during either the

Baseline Period or the ERPA Phase. If ISFL ER Programs would like to propose this as one of their activities, the principles of this guidance would still apply but the exact application would need to be considered on a case-by-case basis.

This guidance addresses the on-site CO2-C emissions/removals from drained organic soils. Off-site CO2 emissions and non-CO2 emissions may be estimated provided the provisions in Chapter 2 from the Wetlands Supplement are followed or may be conservatively neglected.

6.1 ISFL Reporting

Unless the country where the ISFL ER Program is located is already using Tier 2 methods for estimating changes in carbon stocks in dead organic matter, ISFL ER Programs may apply Tier 1 approaches as provided in the 2006 IPCC Guidelines for National Greenhouse Gas Inventories (including the 2019 Refinement) and Chapter 2 and Chapter 3 of the 2013 Supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Wetlands ("Wetlands Supplement"). It is not required[4] to estimate legacy emission and removals from land use changes before the inventory period.

6.2 ISFL Accounting

ISFL ER Programs shall follow the approach provided in the 2006 IPCC Guidelines for National Greenhouse Gas Inventories (including the 2019 Refinement) and Chapter 2 and Chapter 3 of the 2013 Supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Wetlands ("Wetlands Supplement") considering the general guidance provided below (including guidance provided in box 4 in the form of an example).

- For the Emissions Baseline, ISFL ER Programs shall follow the approach provided in Chapter 2 of the 2013 Supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Wetlands ("Wetlands Supplement"). The annual on-site CO_2-C emissions/removals from drained organic soils in the Emissions Baseline be calculated using equation 2.3 from the Wetland Supplement and the guidance provided in this note (including guidance provided in box 4 in the form of an example).
- The actual emissions shall be determined using the approach provided in Chapter 3 of the Wetlands Supplement. The annual on-site CO_2-C emissions/removals from drained organic soils in the Emissions Baseline shall be calculated using equation 3.4 and the guidance provided in this note (see box 3 for an example). Off-site CO2 emissions and non-CO2 emissions may be estimated provided the provisions in Chapter 3 from the Wetlands Supplement are followed or may be conservatively neglected.
- ISFL ER Programs shall develop relevant EFs for the use in these equations.
- Rewetting is the deliberate action of raising the water table on drained soils to re-establish water saturated conditions, e.g. by blocking drainage ditches or disabling pumping facilities. If the ISFL ER Program claims Emission Reductions from rewetting it shall have in place an IPCC Approach 3 for conversion from forest land to other land and forestland-remaining-forestland to enable full tracking of lands since the start of the Baseline Period to the end of the applicable monitoring period/ERPA Phase.

[4] Programs may voluntarily choose to use a longer time series of data starting before the inventory period if this time series is part of their national GHG inventory process (ie the country has done multiple GHG inventories which has allowed the country to track land use change over time using Approach 2 or Approach 3)

- Similar to the guidance on the other topics above, land units will be created to represent the different inventory periods used in setting the Emissions Baseline and for monitoring
- Emission reductions may be generated by a lowering of the rates of conversion from forest land to other land and preventing a decrease in carbon stocks in forestland remaining forestland, or the lowering of legacy emissions from forest land previously drained.

BOX 4: Example calculation of emission reductions from rewetting of organic soils on land that was previously converted from forestland to another land use (only on-site CO_2 emissions)

This simplified example shows the basis for setting Emissions Baselines and estimating actual emissions for forest land converted to other land resulting in emissions from drainage of organic soils and loss in carbons stocks through the actual conversion. This simplified example is using the following assumptions:

- At the start of the Baseline Period the total forest area is 100,000 ha which is all peatland. There is a 10-year Reference Period (2006-2015). The average conversion of forest land in the Baseline Period is 1,000 ha / year for a total of 10,000 ha.
- After the conversion, the peat is drained and the land is converted to oil palm plantations. The emission factor for the annual on-site CO_2-C emissions/removals is 10 tonnes CO_2-C ha^{-1} yr^{-1} .
- In the period 2016-2018, an additional 2,400 ha were converted according to the monitoring system.
- The projected conversion of forest land during the ERPA Phase is 1,000 ha/year in accordance with the average rate during the Baseline Period.
- The first monitoring period is 2019-2020 during which 600 ha of forest land was converted in 2019 and 800 ha was converted in 2020. During the monitoring period, 25% of the area converted during 2006-2015 is rewetted.
- The second monitoring period 2021-2022. The same happens as the first monitoring so 600 ha of forest land is converted in 2021 and 800 ha is converted in 2022. During the monitoring period, another 25% of the area converted during 2006-2015 is rewetted.
- For this example, it is assumed that the emission factor for rewetted soils is 0 (ISFL ER Programs shall apply Tier 2 EFs for accounting)

In accordance with the approach provided in the IPCC 2006 guidelines and following the guidance above, the example above leads to the following projected emissions under the Emissions Baseline:

		Ha	EF (t CO_2-C ha^{-1} yr^{-1})	Emissions			
				2019	2020	2021	2022
Land unit 1	**Conversion of forestland during 2006-2015**	10,000	10	100,000	100,000	100,000	100,000
Land unit 2	**Conversion of forestland during 2016-2018**	2,400	10	24,000	24,000	24,000	24,000
Land unit 3	**Emissions Baseline projected conversion of forestland during 2019**	1,000	10	10,000	10,000	10,000	10,000
Land unit 4	**Emissions Baseline projected conversion of forestland during 2020**	1,000	10	-	10,000	10,000	10,000
Land unit 5	**Emissions Baseline projected conversion of forestland during 2021**	1,000	10	-	-	10,000	10,000

Land unit 6	**Emissions Baseline projected conversion of forestland during 2022**	1,000	10	-	-	-	10,000
Total emissions from this subcategory				**134,000**	**144,00**	**154,000**	**164,000**

The total Emissions Baseline emissions for the first monitoring period (2019-2020) is the sum of the total emissions over the two years, so 134,000 + 144,000 = 278,000 t C. For the second monitoring period (2021-2022), the sum of the emissions over the two years is 318,000 t C.

Similar to the example in the other sections, the actual measured conversion of forestland is used to determine the emission during the monitoring periods for land units 3-6. In addition, part of the area converted during 2006-2015 is rewetted (25% in 2019 and 25% in 2021). Combining this with the emission factors leads to the following table where land unit 1 is divided in subunits to reflect the rewetting.

		Ha	EF ($t\ C\ ha^{-1}\ yr^{-1}$)	Emissions			
				2019	**2020**	**2021**	**2022**
Land unit 1A	**Conversion of forestland during 2006-2015 – not rewetted**	5,000	10	50,000	50,000	50,000	50,000
Land unit 1B	**Conversion of forestland during 2006-2015 – rewetted in 2019**	2,500	0	0	0	0	0
Land unit 1C	**Conversion of forestland during 2006-2015 – rewetted in 2021**	2,500	0 or 10	25,000	25,000	0	0
Land unit 2	**Conversion of forestland during 2016-2018**	2,400	10	24,000	24,000	24,000	24,000
Land unit 3	**Actual conversion of forestland during 2019**	600	10	6,000	6,000	6,000	6,000
Land unit 4	**Actual conversion of forestland during 2020**	800	10		8,000	8,000	8,000
Land unit 5	**Actual conversion of forestland during 2021**	600	10			6,000	6,000
Land unit 6	**Actual conversion of forestland during 2022**	800	10				8,000
Actual emissions				**105,000**	**113,000**	**94,000**	**102,000**

The actual emissions for the first monitoring period (2019-2020) is the sum of the total emissions over the two years, so 105,000 + 113,000 = 218,000 t C. For the second monitoring period (2021-2022), the sum of the emissions over the two years is 196,000 t C.

The emission reductions from the program are therefore the difference between the expected Emissions Baseline emissions for the monitoring period – actual emission from the monitoring period.

- For the first monitoring period (2019-2020) this is 278,000 – 218,000 = 60,000 t C (or 220,000 t CO_2).
- For the second monitoring period (2021-2022), the emission reductions are 318,000 – 196,00 = 122,000 t C (or 447,333 t CO_2)

Document history

Version	Date	Notes
1.0	March 2021	Initial version adopted by ISFL Contributors.