GFOI guidance: Advice on the inclusion of Blue Carbon in Greenhouse Gas Inventories and relationship with REDD+ reporting

Dr Carly Green, GFOI Content Manager

Dr Felicity Thomas, Environmental Accounting Services

Dr Jacob Bukoski, Oregon State University

Dr Catherine Lovelock, Queensland University

Dr Sigit Sasmito, James Cook University

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1. Introduction

Coastal wetlands encompass mangroves, tidal marshes, and seagrasses making them among the most biodiverse environments on the planet. These ecosystems form a critical bridge between land and sea, providing a home for countless species and a wealth of vital ecosystem services. The value of sustainably managing and ensuring the integrity of coastal wetland ecosystems is recognised by the United Nations Framework Convention on Climate Change (UNFCCC) and its Paris Agreement [1].

Blue carbon has become colloquial terminology for referring to the carbon sequestered by and stored within the soil, living biomass above ground (leaves, branches, stems) and below ground (roots), and the non-living biomass (litter and dead wood) of coastal wetlands.

It is important to clarify, the only blue carbon ecosystems currently encompassed by the Intergovernmental Panel on Climate Change (IPCC) methodological guidelines for national inventory reporting are tidal marshes, mangroves, and seagrasses; known collectively as coastal wetlands. While emerging blue carbon ecosystems, including macroalgae (kelp), benthic sediments and mud flats show potential for mitigation, significant scientific uncertainties currently prevent their inclusion in GHG reporting and subsequent accounting, if any [2].

This guidance aims to provide methodological advice to report emissions and removals from coastal wetlands in national greenhouse gas inventories (NGHGI) and further detail regarding REDD+ reporting relevant to coastal wetlands and blue carbon Initiatives. In particular, this guidance aims to detail the first steps required to include coastal wetlands in NGHGIs and highlight successful examples of countries that have included coastal wetlands in their NGHGIs. This guidance draws significantly on the collaborative report *Coastal Wetlands in National Greenhouse Gas Inventories* [1] and relevant IPCC guidelines [3], [4], [5].

2. Inclusion of coastal wetlands in national greenhouse gas inventories

Guidance on coastal wetland ecosystems was not included in the 2006 IPCC Guidelines [3], with the exception of mangroves if they fell within national forest definitions. The 2013 Wetlands Supplement [4] addressed this gap, by providing guidance on the inclusion of coastal wetlands (mangroves, tidal marshes, and seagrasses) within national inventories. The 2013 Wetlands Supplement provided guidance for specific activities within coastal wetlands including guidance for estimating methane (CH4) emissions for re-wetting (rehabilitation of mangroves and tidal marshes) and nitrous oxide (N2O) emissions from aquaculture [4].

Subsequently, guidance for estimating CH4 emissions from wetlands was refined in the 2019 Wetlands Refinement [5] to include estimating CH4 emissions from aquaculture ponds, drains, ditches and canals, which are commonly found in drained coastal wetland ecosystems converted to agriculture, aquaculture, or other land-uses.

Under the UNFCCC reporting requirements, the use of the 2006 IPCC Guidelines is required for all Parties and the use of the 2013 Wetlands Supplement is encouraged for all Parties.

Additionally, if wetlands are a key category, it is further encouraged that wetlands are included in the national inventory using the 2013 Wetlands Supplement [1]. A key category refers to a specific sector or activity that is prioritised within a country's national inventory as its estimate has a significant influence on a country's total GHG net emission and/or its uncertainty. The key category analysis is further explained in the GFOI Methods and Guidance document [6].

3. Use of good practice guidance to develop complete inventories

3.1 Land Categories and Conversions

As described in the GFOI Methods and Guidance document [6], land is subdivided by the IPCC into six main categories, according to their predominant use. The Wetlands category includes land that is covered or saturated by water for all or part of the year (e.g., peatland) and that does not fall into the Forest Land, Cropland, Grassland or Settlements categories.

Mangroves often exist within the indistinct boundary between land and marine ecosystems and as such a country can chose to report mangroves in either Forest land or Wetland categories, where the vegetation meets defined thresholds of these categories. Additionally, not all mangrove classes need to be reported in the same category. Countries can also decide to classify all mangroves as Wetlands even if some classes meet the definition of Forest land.

There may be cases where certain mangrove types within a country have the potential to meet the forest definition while others do not e.g. tall mangroves may meet the forest definition but dwarf mangroves many not. In this case, the country can report mangroves types that meet the forest definition in Forest land and report mangrove types which do not meet the forest definition in the

Wetlands category under a subcategory such as 'scrub mangrove'. Alternatively, a country can choose to specify in its forest definition the conditions for inclusion or exclusion of mangroves.

Furthermore, seagrasses may not fall under typical national land representation rules posing additional challenges for inclusion of these ecosystems. Defining the concept of 'coastal land' and its seaward limits can help countries address land representation challenges.

Where boundaries are indistinct it is good practice to report uncertainty around under- or over-estimates in land transitions [1].

Land category conversion

To manage land category conversions, it is good practice for countries to map the spatial extent of all coastal ecosystems and change in area through time, regardless of whether they are managed or unmanaged. An example of typical land-use conversions that may occur over time in mangrove, and how to represent these transitions in land-use mapping is provided in Table 1. Another element to consider is that total land area may change permanently over time due to sea level rise.

3.2 Stratification

Stratification is the process of disaggregating a land-use category/subcategory (e.g. coastal wetlands) into logical, typically homogeneous, sub-divisions (e.g. activity types, mangrove ecosystems). The process of stratification is further described in the GFOI Methods and Guidance document [6].

Being located in between land and marine environments, coastal wetland ecosystems are naturally stratified in different ways depending on geographical location, climate conditions, floristic and species composition, and level of tidal inundation.

Some factors to consider when defining strata to improve emissions estimates in coastal wetland ecosystems include:

- Variation in soil characteristic (soil depth or type, or sediment grain-size)
- Variation in vegetation characteristics [7]
- Land use including historical, existing, and future (noting the inherent challenges of classifying land use)

Tier 2 approaches are likely to involve a more detailed stratification of management systems, under the respective land-use category compared to Tier 1 approaches if sufficient data are available. Countries should aim to balance strata size and number with desired accuracy, required time, and available resources. Some of the difficulties countries face with stratifying coastal wetlands are highlighted in **Box 1**.

Table 1: Example of Land representation for different activities affecting mangroves.

<table>
<tr><th></th><th>Time 1</th><th>Time 2</th><th>Time 3</th><th>Time 4</th><th>Time 5</th><th>Time 6</th><th>Time 7</th></tr>
<tr><td></td><td>Mangrove</td><td>Converted to degraded mangrove</td><td>Degraded mangrove</td><td>Converted to aquaculture pond (construction)</td><td>Aquaculture pond (use)</td><td>Aquaculture pond (discontinued)</td><td>Regenerating mangrove <20 years (> 20 years see Time 1)</td></tr>
<tr><td></td><td colspan="7">Land Representation</td></tr>
<tr><td>Mangrove meets national forest definition</td><td colspan="3">Forest land remaining Forest land.</td><td>Forest and converted to Wetlands-Flooded land (<20 years)</td><td colspan="2" rowspan="2">Wetlands-Flooded land remaining Wetlands-Flooded land.</td><td>Wetlands-Flooded land converted to Forest land.</td></tr>
<tr><td>Mangrove does not meet national forest definition (e.g. dwarf or scrub mangrove).</td><td colspan="3">Wetlands - Other wetlands remaining Wetlands - Other wetlands.</td><td>Wetlands -Other wetlands converted to Wetlands-Flooded land.</td><td>Wetlands -Flooded land converted to Wetlands- Other wetlands</td></tr>
</table>

3.3 Method

As described in the GFOI Methods and Guidance document [6] a method refers to how emissions and removals of CO_2 are estimated. The stock-difference method requires consistent data collected over two points in time to generate emission/removals. For many countries this data set is unlikely to be available at a national level for carbon pools and gases in coastal wetland ecosystems. It is more likely that Tier 1 default emission factors or national data from smaller one-off research programs are available for application in the gain-loss method. However, as data collection expands overtime and data from multiple time points are collected then countries can aim to transition to the stock-difference method but countries should also be aware of the need for time series consistency when modifying the method applied.

3.4Tiers

The 2013 Wetlands Supplement and the 2019 Refinement follow the IPCC's standard "tiered" guidance to GHG reporting. It includes Tier 1 default GHG emission factors (emissions and removals) for a range of activities. These default factors allow a country to start reporting for emissions and removals on the basis of estimated areas of land-use/land cover and associated changes across time.

The 2013 Wetlands Supplement classifies mangroves and provides their default emissions factors (Tier 1) for tropical wet, tropical dry, and subtropical regions reflecting differences in their above-ground biomass.

Parties with greater resources can build more sophisticated assessments through subsequent Tier 2 and Tier 3 assessments, which requires country-specific data. Any decisions to move to Tier 2 and 3 should be made in the context of cost-effectiveness and key priorities for NGHGI improvements across all sectors.

3.5 Pools and Gases

Coastal wetlands have high carbon stocks in soils (also called sediments), and mangroves may also have high carbon stocks in the above-ground and below-ground biomass, including dead organic matter. These carbon pools are vulnerable to losses and associated carbon dioxide emissions when coastal wetlands are degraded and converted to alternative land-uses (e.g., through extraction and drainage for conversion to agriculture, aquaculture or construction of ports or dredging). Atmospheric removals of carbon occur with biomass accumulation and within soils when coastal wetlands are restored, rehabilitated, and created.

Methane and nitrous oxide are relevant gases to consider for coastal wetlands and flooded land especially related to aquaculture and drainage activities.

Therefore, the most relevant carbon pools and gases are:

- Above-ground biomass

- Dead organic matter
- Below-ground biomass
- Soil carbon stocks in organic and mineral soils
- Methane
- Nitrous Oxide

Which carbon pools and GHGs that countries consider relevant to their inventory is dependent on whether particular land-uses and activities are defined as key categories. In situations where national data is not available it is good practice to apply default values opposed to simply omitting the carbon pool.

3.6 Attribution

As described in the GFOI Methods and Guidance document [6] attribution is the process of associating observed land cover and land cover changes with land use and land use change. Attribution is important in the context of coastal wetlands. Short and long term GHG releases from soil organic carbon can be significantly influenced by the land management applied. Therefore, attributing change agents to the land use change data can improve the accuracy of GHG estimates.

3.7 Time Series Consistency

Adopting the 2013 Wetlands Supplement to include coastal wetlands in NGHGIs will trigger the requirement for the recalculation of results from previous inventories to maintain time series consistency. However, coastal Wetlands are likely to have national activity data gaps, making it challenging to develop a complete and consistent time series analysis. Expert judgement may be used in combination with available datasets to develop a time series [1] following gap filling guidance from the IPCC [5].

4. REDD+ methodological considerations

Inclusion of mangroves in REDD+ is dependent on the national definition of Forest lands which is at the discretion of each country.

Where mangrove areas meet the definition of forest and have been included in REDD+ Forest Reference Levels (FREL/ FRL), countries can report these same mangrove lands under the Forest land category in the NGHGI for consistency, as opposed to the Wetlands category. However, shrub mangroves can remain in the Wetlands category.

Including mangroves in REDD+ reporting may require national emissions factors or carbon stocks and appropriate activity data which is generated in a consistent manner with other land classes (i.e. using the same Approach). Most countries who have included mangroves in their forest definition, and are reporting at least some classes of mangrove in REDD+ reporting, have adopted the gain-loss method, using either Approach 2 or Approach 3 activity data combined with Tier 1/2 carbon-stock change factors.

4.1 Where/how to start

Some countries are beginning to include, or already have included, coastal wetland ecosystems in their national inventories, for example: Australia, United States of America, Canada, Costa Rica, Indonesia and the United Kingdom. These countries are using the 2013 Wetlands Supplement and a mixture of Tier 1 and Tier 2 data, depending on the resources such as funding and expertise available [9]. It is important to note that not all coastal wetland ecosystems have to be included to report the sub-category of Coastal Wetlands, i.e. countries can begin by only including a single wetland ecosystem, such as mangroves, and then proceed to include salt-marshes or seagrass at a later date as data becomes available.

All of these countries mentioned above have also included Blue Carbon in their Nationally Determined Contributions (NDCs) and some may be seeking to use the removals occurring in coastal wetlands to help achieve their NDCs and/or access finance for blue carbon projects.

Some of the key lessons learnt from these countries and others on the challenges of including coastal wetlands in national inventories include [10]:

- The user friendliness of the IPCC worksheets and reporting tables could be improved Coastal Wetlands.
- Activity data can be difficult to obtain.
- Coordination between inventory teams with other government institutions that are responsible for providing data can be challenging.

To address difficulties in data availability a range of global data sources are available that can be used to estimate the distribution of coastal wetlands, assist in the generation of activity data, inform emissions/removals estimates from land-use changes, or support verification or augmentation of national data sources. For example, Global Mangrove Watch and Ramsar provides a summary of important wetland ecosystems for each Party contracted to the Convention on Wetlands.

Global synthesis studies on carbon stocks and/or sequestration rates for mangrove e.g. [11], [12], [13], [14],[15] tidal marsh e.g. [16], and seagrass e.g., [17] can be used to derive Tier 2 national emission factors for activities. There is also progress being made with regards to predictive model estimates to lessen field data requirements for generating Tier 2 emission factors [18].

Global maps of coastal wetland cover [19], and changes [22], drivers of mangrove loss [21], [36] and extent of mangrove degradation [37] can be seen as complementary data sources to national mapping capacity for estimating activity data.

Some global data sources used on their own, in particular the seagrass cover mapping, are likely to be too inaccurate at the national level to use for NGHGI estimates. However, these data sources can be combined with other auxiliary data and expert judgement to provide a starting point for estimating spatial extent [1].

4. Summary of key points

Introduction to Coastal Wetlands and Blue Carbon:

- Coastal wetlands (mangroves, tidal marshes, and seagrasses) are vital ecosystems recognized for their biodiversity and ecosystem services.
- Blue carbon refers to carbon stored in the soil, biomass, and dead organic matter within these ecosystems.
- The UNFCCC and Paris Agreement acknowledge the importance of managing coastal wetlands, however only mangroves, tidal marshes, and seagrasses are currently included in IPCC guidelines for national greenhouse gas inventories (NGHGI).

Inclusion of Coastal Wetlands in NGHGIs:

- The 2006 IPCC Guidelines included limited guidance on wetlands, but the 2013 Wetlands Supplement expanded this to include mangroves, tidal marshes, and seagrasses, which countries are encouraged to use if considering incorporating Wetlands and Blue Carbon into their inventories.
- The 2019 Wetlands Refinement further refined methods for estimating emissions, including CH_4 emissions from aquaculture and other land-use changes.

Good Practice Guidance for Inventories:

- Land Categories and Conversions: Coastal wetlands may fall within multiple land categories; countries can report mangroves in either Forest land or Wetland categories based on defined thresholds.
- Stratification: Subdividing wetland classes into homogeneous strata improves emissions estimates.
- Methodology: Data availability is often limited for mangroves which may necessitate a stepwise approach to inclusion of all wetland categories in National inventories sand REDD+ reporting.

REDD+ Methodological Considerations:

- Inclusion of mangroves in REDD+ depends on national forest definitions.

Starting Points for Including Coastal Wetlands:

- Countries should consider beginning with one ecosystem (e.g., mangroves) and expanding to others as data becomes available.
- Global tools (e.g., Global Mangrove Watch) support required data generation but may need augmentation with local expertise.
- Countries like Australia, the US, Canada, and Indonesia are integrating blue carbon into NGHGIs and leveraging global data sources to improve estimates.

5. Case Studies

5.1 United States

The US has included managed coastal wetlands in its yearly NGHGI since its 2017 submission to the UNFCCC, and time series wetlands data are updated on an annual basis [23].

Land Categories

The land-use categories applied within this extent of managed coastal wetlands include Settlements, Cropland, Grassland, Forest land (dry), Wetlands (both palustrine wetlands and estuarine wetlands), and Other land.

Mangroves are reported under Forest land if they meet the definition of forest. Where these ecosystems do not meet the forest definition, they are considered scrub mangroves and reported as vegetated coastal wetlands (VCW).

Seagrasses are not currently included due to insufficient data on distribution, change through time, and carbon stocks.

Land Conversion

Emissions and removals from coastal wetlands areas are determined for four primary conversion types: vegetated coastal wetlands that remained vegetated coastal wetlands (VCW–VCW); unvegetated open water coastal wetlands that were converted to vegetated coastal wetlands (UOWCW–VCW); land that was converted to vegetated coastal wetlands (L–VCW) and vegetated coastal wetlands that were converted to unvegetated open water coastal wetlands (VCW–UOWCW).

Coastal wetland gain from both restoration and creation of coastal wetlands, and from gradual sea level rise, flooding previously drained low-lying coastal land behind hydrological barriers are captured in the US inventory under L-VCW.

Stratification

Activity data on land-use and land-use change are derived from the National Oceanic and Atmospheric Administration Coastal Change Analysis Program, which uses a combination of satellite imagery, tide station data, and national soil survey databases.

Method, Approaches and Tiers

The United States calculates emissions and removals based upon the stock change method for soil carbon and the gain-loss method for biomass and dead organic matter is applied. A mixture of Approach 1, 2 and 3 is used in the United States NGHGI. United States NGHGI uses a combination of Tier 1 and Tier 2 emissions factors.

Pools and Gases

Estimates of CO_2 emissions and removals, and CH_4 emissions from coastal wetlands are included in the US NGHGI. N_2O emissions from aquaculture are also included.

Above ground and below ground biomass carbon stocks, soil carbon stocks and dead organic matter are included where appropriate.

Attribution

Wetlands are highly connected systems that are affected by indirect human activities, such as upstream water diversions and sediment supply disruptions. This makes attribution of emissions and removals to a specific management practice difficult to include in inventories. The US addressed this challenge of applying the activity-based approach to GHG estimation by considering all coastal wetlands as managed land, and accounting for emissions and removals regardless of the drivers associated with the change [24], [25].

Time Series Consistency

In the 2018 inventory, only soil CO_2 emissions and removals were reported, as soils have been recognised as the largest carbon pool for coastal wetland ecosystems. The following year biomass was added. Methodological recalculations were applied to the entire time series to ensure time-series consistency from 1990 through 2022 [23].

5.2 Australia

Australia introduced mangroves and tidal marshes into their NGHGI in 2015. The majority of the information reflected in this case study is taken from the methods described in the current 2022 Australian National Inventory Report [26].

Land Categories

Land areas with wetland characteristics that meet the definition of forest land, such as mangroves, are reported under the forest land category. Mangrove forests are one of eight native forest types. Tidal marshes comprise of salt tolerant vegetation which do not meet the Australian forest definition and are categorised as Wetlands in the Australian NGHGI. Areas of mixed mangrove and tidal marsh that do not meet the Australian forest definition are known as 'scrub mangrove'.

Australia's inventory team have incorporated seagrass in the NGHGI with a focus on estimating emissions from seagrass associated with dredging. Emission associated with aquaculture activity are also included in the NGHGI. These activities are reported under the Common Reporting Tables submission as Other land but are discussed within the NGHGI under the Wetlands category for transparency and completeness.

Land Conversion

Mangrove forests are bordered by seawater on the lower side and by salt marsh on the higher side. Therefore, it is assumed that any emerging coastal mangrove forest does so on land which was previously tidal marsh or bare tidal flat and is allocated to *wetland converted to forest land.*

Where mangrove forests are cleared for commercial developments, such as marinas, these conversions are categorised as *forest land converted to settlements* within the broader land converted to settlements source category.

Gains and losses of sparse woody vegetation on tidal marshes is considered *wetland remaining wetland.* While dredged seagrass land (vegetation removed) is allocated to the *wetlands converted to other land* category.

Stratification

For stratification of coastal vegetation, a layer is derived from NVIS Version 6.0 MVS (Major Vegetation Subgroups) and an intertidal extent model was used to define the area of mangrove and tidal marsh. The coast of Australia is divided to reflect the predominant bioregions and reflect the key drainage basins that influence mangrove and tidal marsh type, extent, and carbon storage. The generation of a nationwide mangrove, saltmarsh and supratidal forest map will likely result in a change in this stratification process in future.

To stratify seagrass, shapefiles containing details of different seagrass habitat are sourced from State and Territory jurisdictions and the University of Tasmania. These shapefiles are further described in Table A5.6.10.10 of the Australian National Inventory Report 2022 [27].

Method, Approaches and Tiers

Australia uses Approaches 1 and 3 as described in the 2006 IPCC Guidelines for National Greenhouse Gas Inventories (IPCC 2006) to monitor land use, land use change and forestry.

For Wetlands converted to Forest land and Land converted to Wetlands, carbon dioxide emissions and removals are modelled using Full Carbon Accounting Model (FullCAM), a spatially explicit Tier 3 modelling system calibrated, in this model, to mangrove ecosystems around Australia's coastal land area. The FullCAM Wetlands – coastal sub-model was calibrated using a small observational dataset from published literature [28], [29].

However, to estimate CO_2emissions or removals from Wetlands converted to Cropland and Wetlands converted to Grassland Tier 1 IPCC default values are used.

Estimates of emissions or removals from Wetlands remaining Wetlands are reported using a combination of Tier 1 and Tier 2 emissions factors depending on the gas reported.

To estimate emissions from seagrass removal due to capital dredging, a country-specific Tier 2 model is employed relying on scientific literature from different coastal regions [27].

Improvements are planned to the FullCAM Wetlands – coastal sub-model. As mentioned above the updates will include improved spatial inputs for mangrove and tidal marsh extents. Additionally, future use of improved change detection in some vegetation classes may better define areas of scrub mangrove. The model will be further refined with addition of new field data for mangrove and tidal marsh ecosystems, and potential integration of the BlueCAM model [30].

Pools and Gases

Estimates of CO_2 emissions and removals are reported for all Wetland related land use and land use change categories. CH_4 emissions and removals are reported from drainage and rewetting and other management of organic and mineral soils. N_2O emissions from aquaculture are also reported.

FullCAM Wetlands – coastal sub-model is calibrated with data for aboveground biomass, below ground biomass and soil organic carbon. For seagrass only belowground biomass and soil organic carbon is considered.

Attribution

Qualified technical staff use visual image backdrops such as Landsat, Google Earth™, and Sentinel Hub™ to differentiate permanent land use change events from those of temporary forest cover loss events such as harvesting or forest fire.

Time Series Consistency

Time series consistency is ensured by the use of consistent methods and full recalculations in the event of any refinement to methodology.

5.3 Indonesia

Indonesia included mangroves in its first FREL for deforestation and forest degradation in 2016 [31]. Indonesia also includes mangroves in their NGHGI as part of their Biennial Update Report (BUR) and has aligned the reporting in the NGHGI with the FREL [32]. However, in 2022 Indonesia updated their FRL to include enhancement of carbon stocks and all carbon pools [33]. The case study provided below is primarily based on this updated FRL and as it is assumed the Indonesia will use the current FRL to inform their upcoming BUR/Biennial Transparency Report and National Communication (NC).

Land Categories

Indonesia considers all mangrove cover under the Forest Land category. For NGHGI purposes, natural mangrove forests in Indonesia are categorised into primary and secondary forests. Primary mangrove forests are defined as undisturbed mangroves, while secondary mangrove forests are degraded through extraction or other activities.

Seagrass meadows have not yet been included into NGHGI because of the lack of time-series spatial mapping, and limited activity data [34].

Wetlands are reported in the NGHGI but are not delineated into coastal and inland wetlands. In the 2022 FRL, Indonesia considers primary and secondary swamp forests category, where some of these swamp forests areas may be inundated by tidal input and could be categorised as blue carbon ecosystem [35].

Land Conversion

Consistent with other forest types, emissions are calculated from mangrove deforestation (conversion of primary and/or secondary mangrove forests into other land cover categories) and forest degradation (change of primary to secondary mangrove forests).

Stratification

Activity data of mangrove deforestation and degradation are obtained through National Forest Monitoring System – an official repository system based on wall-to-wall land cover maps produced by using Landsat satellite imageries (http://webgis.menlhk.go.id/) [1]

Method, Approaches and Tiers

Indonesia calculates emissions and removals based upon the stock-change method within their FRL.

Approach 2 is used for reporting forest land use conversions.

Indonesia uses a combination of Tier 1 and Tier 2 emissions factors in the FRL. Tier 2 values for the above-ground biomass carbon pool for mangroves are compiled based on the available National Forest Inventory data as well as published field data [1].

Pools and Gases

All five carbon pools, above-ground biomass, below-ground biomass, soil organic carbon (SOC), litter, and dead wood are included in the FRL.

However, SOC is included only in relation to peatland and mangrove emissions due to deforestation, forest degradation, fires and mangrove conversion. Litter and dead wood are included only for non-CO_2 emission estimates from fires.

CO_2 emissions were derived from biomass and soil-related emissions from deforestation, forest degradation, the decomposition of peat and conversion of mangroves. Whereas, CH_4 and N_2O emissions are only calculated from peat fires.

Attribution

The FRL discusses several major drivers of mangrove deforestation which resulted in GHG emissions including conversion to aquaculture, agriculture, and plantations. However, attribution is not addressed specifically within the BUR 3, NC 3, or FRL.

Time Series Consistency

The BUR 3 includes a demonstration of consistency in methodologies used to generate results with FREL assessment methodologies. However, the reference period in the most recent FRL is 2006 to 2020 and includes additional emissions factors, pools, and gases. To remain consistency in the next BUR/BTR and NC the Republic of Indonesia should consider recalculating and reporting their historical emissions in line with the updated FRL.

7. Reviewers

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