I. INTRODUCTION AND HOW TO USE THIS METHODOLOGY

1.1 Purpose

This document serves as a technical guide for project proponents participating in the Malaysia Forest Carbon Offset (FCO) program. It provides a structured framework for quantifying and implementing projects that aim to remove, reduce or avoid Greenhouse Gas (GHG) emissions. This FCO methodology supports a range of project types. It enables project proponents to:

a. Assess project eligibility
b. Define project boundary
c. Establish baseline scenarios
d. Quantify GHG reductions, and
e. Monitor project performances.

This FCO methodology is designed to be adaptable and can be used in conjunction with other FCO methodologies depending on project-specific needs.

Project proponents may reference the Theory of Change framework, which maps how interventions are expected to deliver emission reductions and co-benefits by identifying causal pathways, assumptions, and risks[1] to inform project design. Proponents may refer to *Theory of Change UNDAF Companion Guidance* by United Nations Development Group or other relevant frameworks developed by intergovernmental organisations, NGOs and NPOs, or jurisdictional authorities to guide the development of a project-specific Theory of Change.

1.2 Core FCO Methodologies

The FCO program currently supports four key FCO methodologies which is as illustrated in Section IX. Annex:

a. **Afforestation, Reforestation, and Restoration (ARR):** Focuses on forest establishment or restoration on degraded lands to boost carbon sequestration.
b. **Improved Forest Management (IFM):** Enhances carbon stocks in production forests through sustainable practices like reduced impact logging and longer rotation cycles.
c. **Reducing Emissions from Deforestation and Degradation (REDD):** Aims to prevent deforestation and degradation in all forest types.
d. **Wetland Ecosystems (WE):** Activities on wetland ecosystems including restoration, vegetation establishment, deforestation and degradation prevention as well as rewetting.

Additional methodologies may be incorporated in the future.

1.3 How to Use this Methodology

This FCO Methodology guides project proponents to assess and implement activities under the FCO framework. The process begins with a spatial and historical assessment of the land:

a. **Current Land Assessment:** Evaluate the present condition of the land using maps and satellite imagery.
b. **Historical Land Use:** Determine the land's previous state to establish a baseline.

[1] Theory of Change UNDAF Companion Guidance, United Nations Development Group, 2017

c. **Condition Classification:** Compare current and historical states to classify the land as either intact or disturbed.

Based on this classification, project proponents can identify suitable intervention types:

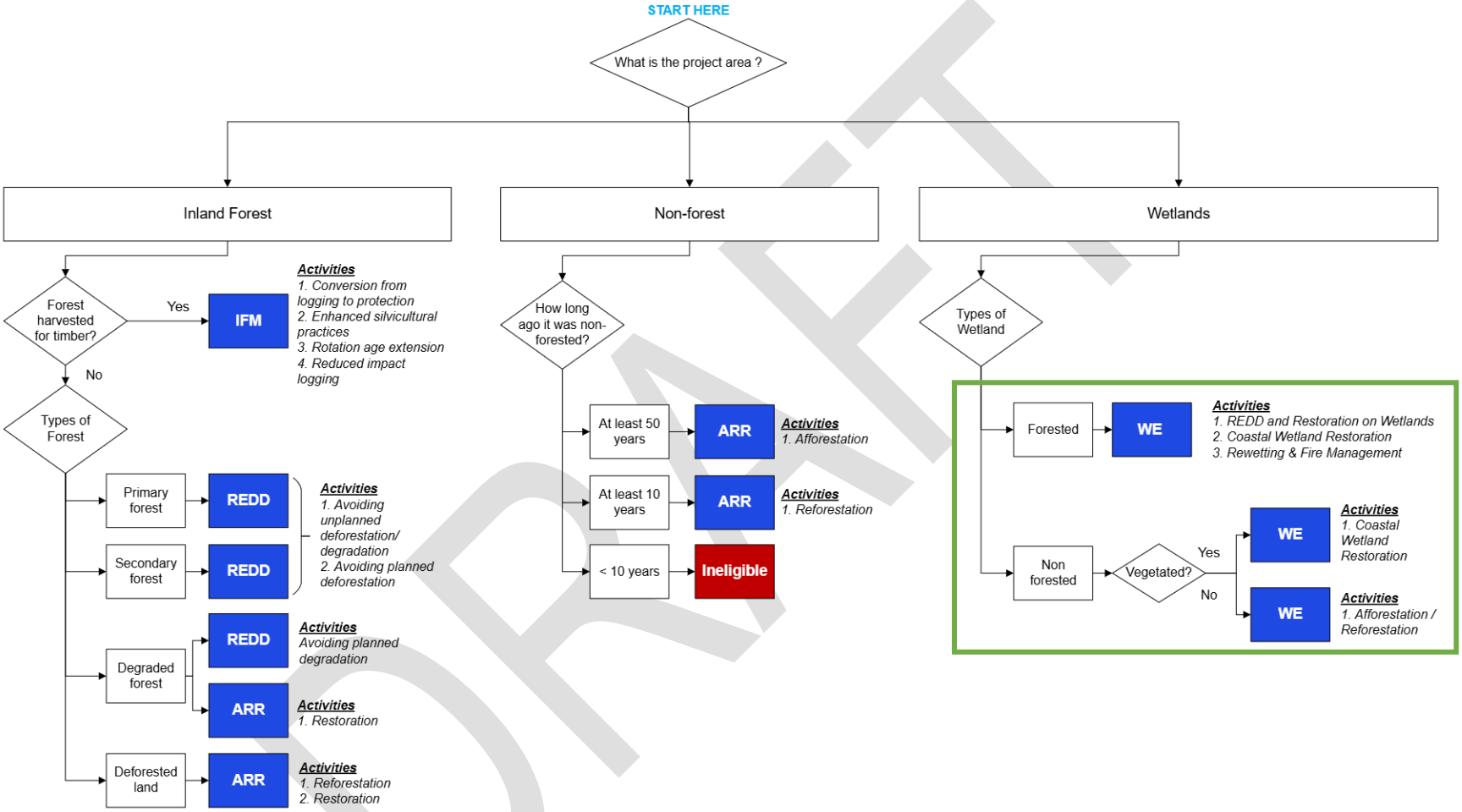
a. **GHG Avoidance Activities:** Actions the prevent emissions from occurring, such as avoiding planned or unplanned deforestation.
b. **GHG Reduction or Removal Activities:** Interventions that actively reduce or sequester emissions, tailored to forest lands, wetlands, or production forests.

1.4 Focus of this FCO Methodology Document

This document specifically focuses on the **Wetland Ecosystems: Afforestation/Reforestation Methodology**. It should be used in conjunction with the overarching FCO Program Guidelines, Subsidiary Guidelines, and standardised FCO Tools. These resources collectively ensure that project design, monitoring, and reporting are accurate, consistent, and aligned with program requirements.

Project proponents may reference relevant sources such as national strategies, sectoral reports, or frameworks developed by international organisations, NGOs and NPOs, or jurisdictional authorities, such as *Wetland Restoration: Contemporary Issues & Lessons Learned* by the National Association of Wetland Managers, when identifying anticipated implementation challenges, including data limitations, technical constraints, and other contextual factors.

Figure 1: Overall Flowchart for Methodologies under FCO



The eligibility flowchart for WE activities is detailed in the following section.

II. ELIGIBILITY FLOWCHART

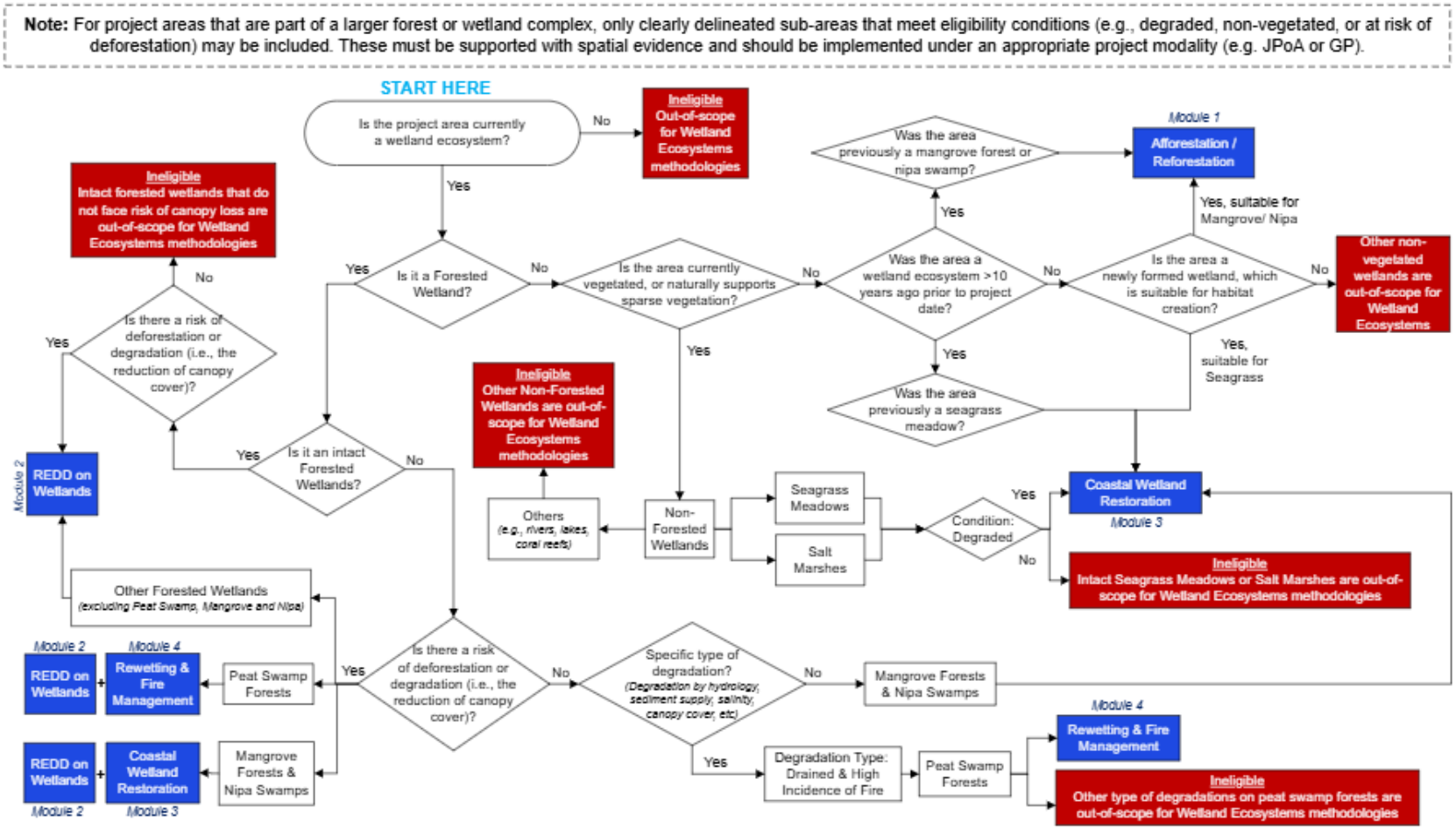
This flowchart guides project proponents in determining whether a proposed project area qualifies for WE activities under the FCO program. It outlines the step-by-step decision process based on land type, forest condition, and ecosystem classification.

The Wetland Ecosystems methodology comprise four ("4") modules – Afforestation/Reforestation, REDD on Wetlands, Coastal Wetland Restoration, as well as Rewetting and Fire Management. Figure 2 summarises the ecosystems applicable to each module.

Module 1: Afforestation/Reforestation applies to project areas that are:

- Barren or degraded forested wetlands (mangrove forests or nipa swamps) for at least 10 years prior to project start date.

Figure 2: Eligibility Flowchart for Wetland Ecosystems Modules.



III. SUMMARY DESCRIPTION

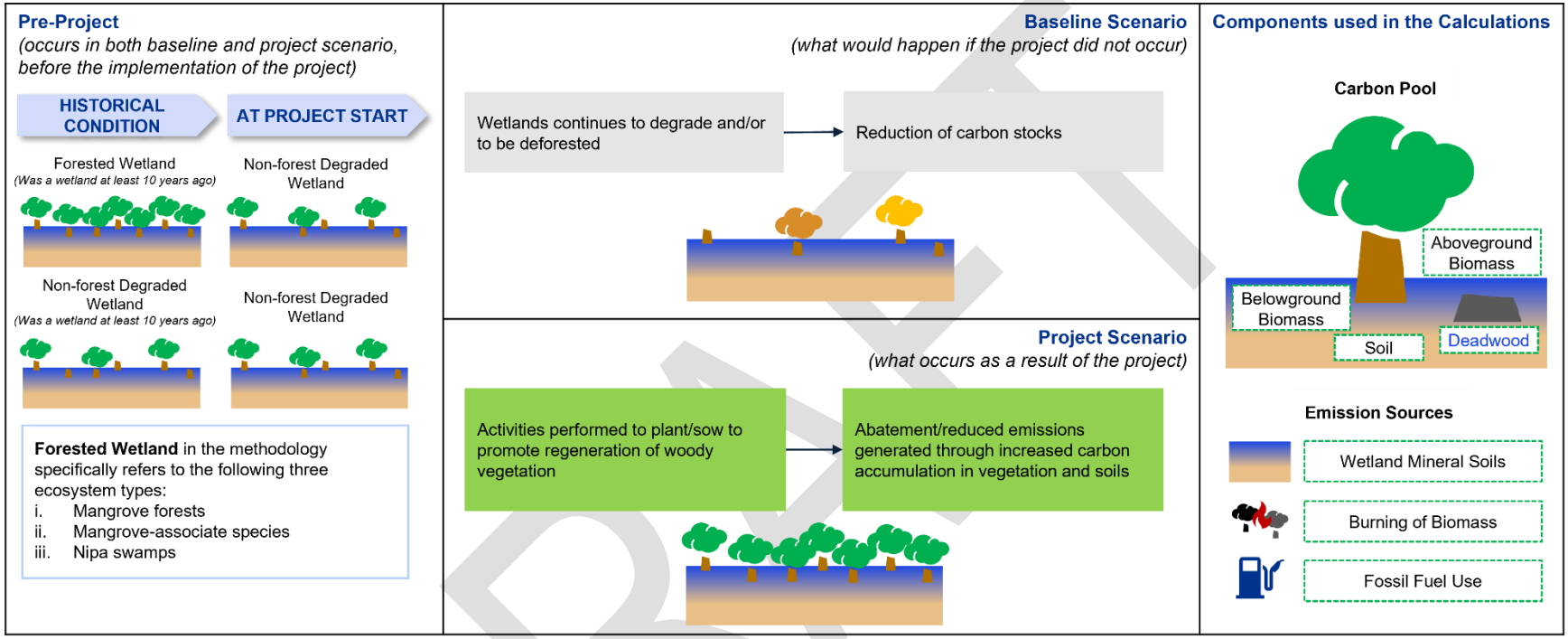
This methodology establishes a framework for quantifying carbon sequestrated, or GHG emission reductions and removals, from wetlands ecosystem that are applicable for WE project activities in Malaysia. It encompasses an overview of the types of GHG emissions mitigation actions, guidance on when to apply the methodology, the applicable ecosystem, and an outline of the pre-project, baseline scenario, and project scenario considerations, as detailed below:

Type of GHG Emissions Mitigation Action *Refers to how the project reduces GHG emissions*	i. Afforestation – The direct human-induced conversion of land that has not been forested for at least 50 years to forested land through planting, seeding and/or interventions that promote natural regeneration[2]. ii. Reforestation – The direct human-induced conversion of non-forested land to forested land, where the land was previously forested but has not met the national forest definition for at least 10 years, through planting, seeding and/or interventions that promote natural regeneration[3].
Applicable Ecosystem *Identifies the type of environment where the project can be implemented*	The term "forested wetlands", as used in this document, specifically refers to the following three ecosystem types: i. **Mangrove forests** ii. **Mangrove-associate species** iii. **Nipa swamps** *These three (3) categories are the only types of forested wetlands eligible under this methodology. Any reference to "forested wetlands" throughout this document shall be understood to exclusively mean these defined ecosystem types.*
Pre-Project *Refers to the state of the land and forest prior to the start of the FCO project*	Degraded vegetative cover, or lack of vegetative covers.
Baseline Scenario *Represents the "business-as-usual" projection on what would happen to the forest and its carbon stocks in the absence of the project*	Forested wetlands continue to degrade and/or to be deforested. Carbon stocks remain low due to minimal vegetation cover and ongoing soil carbon loss.
Project Scenario *Describes the proposed interventions to-be implemented under the FCO project to prevent or reduce GHG emissions*	Activities to restore wetland forests through planting, increasing carbon sequestration in trees, soil, and biomass over time. Hydrology and soil stability would improve, reducing further degradation. Abatement/reduced emissions generated through increased carbon accumulation in vegetation and soils.

Figure 3 in the following page illustrates the pre-project, baseline and project scenario as well as the relevant carbon pools and GHG emission sources for this methodology

[2] *2006 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 4: Chapter 4), IPCC, 2006.*
[3] *Ibid.*

Figure 3: Framework: Activity Conditions, Scenarios, and Carbon Accounting Components (pic is not ARR)



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VII. MODULES & TOOLS

This methodology uses the following modules and tools:

- FCO Tool: Baseline Determination and Additionality Assessment
- FCO Tool: GHG Quantification Equations
- FCO Tool: Buffer Risk Assessment
- FCO Tool: Allometric Equations Guidance

VIII. LIST OF ABBREVIATIONS

Abbreviations	Definition
ARR	Afforestation, Reforestation and Restoration
A/R	Afforestation/Reforestation
FCO	Forest Carbon Offset
FCU	Forest Carbon Units
GHG	Greenhouse gas emissions
GIS	Geographic Information System
IFM	Improved Forest Management
IPCC	Intergovernmental Panel on Climate Change
PDD	Project design document
REDD	Reducing Emissions from Deforestation and Degradation
SOC	Soil organic carbon
WE	Wetland Ecosystems

1 Definitions

Terms	Definition
Afforestation	Direct human-induced conversion of land that has not met the national forest definition for at least 50 years to forested land through planting, seeding and/or interventions that promote natural regeneration.[4]
Mangrove	An association of halophytic trees, shrubs, and other plants growing in brackish to saline tidal waters of tropical and sub-tropical coastlines.[5]
Mangrove associate species	Non-true mangrove species that are mainly distributed in a terrestrial or aquatic habitat but also occur in the mangrove ecosystem.[6] *Definition is provided for general guidance. Project proponents are encouraged to reference scientific publications, research studies or peer-reviewed literature to confirm species eligibility.*
Mineral Soil	Soils that do not fall within the definition of organic soil[7].
Nipa Swamps	Tidal, monospecific stands of the Nipa Palm (*Nypa fruticans*). Nipa occurs in association with mangroves and extent further into brackish water, often lining the tidal reaches of rivers and forming huge swamp in delta areas.[8]
Organic Soil	Soils are identified based on criteria 1 and 2, or 1 and 3[9]: 1) Thickness of organic horizon greater than or equal to 10 cm. A horizon of less than 20 cm must have 12% or more organic carbon when mixed to a depth of 20 cm. 2) Soils that are never saturated with water for more than a few days must contain more than 20% organic carbon by weight (i.e., about 35% organic matter). 3) Soils are subject to water saturation episodes and has either: a. At least 12% organic carbon by weight (i.e., about 20% organic matter) if the soil has no clay; or b. At least 18% organic carbon by weight (i.e., about 30% organic matter) if the soil has 60% or more clay; or An intermediate, proportional amount of organic carbon for intermediate amounts of clay.

[4] *2006 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 4: Chapter 4), IPCC, 2006.*
[5] *J. B. Kauffman and D. C. Donato, 2012. "Protocols for the measurement, monitoring, and reporting of structure, biomass, and carbon stocks in mangrove forests." Center for International Forestry Research. doi: 10.17528/cifor/003749.*
[6] *Lee, S. S., Muhamad, A., & Tong, J, 2015. "Mangrove Guidebook for Malaysia". Wetlands International, Malaysia.*
[7] *2006 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 4: Chapter 3), IPCC, 2006.*
[8] *Ismail Parlan, Mohd, I. and Tariq Mubarak Husin, 2021. "An Overview of Wetlands in Malaysia." Forest Research Institute Malaysia.*
[9] *2006 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 4: Chapter 3), IPCC, 2006.*

Terms	Definition
Reforestation	Direct human-induced conversion of non-forested land to forested land, where the land was previously forested but has not met the national forest definition for at least 10 years, through planting, seeding and/or interventions that promote natural regeneration.[10]
Soil disturbance	Any human activity that results in the release of carbon accumulated in organic form in the soil into the atmosphere, such as ploughing, ripping, scarification, digging of pits and trenches, stump removal, etc.[11]
Historic wetland coverage	An area where the occurrence of natural wetland ecosystem can be proven at least 10 years before the project start date.

[10] *Ismail Parlan, Mohd, I. and Tariq Mubarak Husin, 2021. "An Overview of Wetlands in Malaysia." Forest Research Institute Malaysia.*
[11] *UNFCCC, 2013. "Clean Development Mechanism, AR-AM0014: Afforestation and reforestation of degraded mangrove habitats - Version 3.0".*

2 Applicability Conditions

While the Eligibility Flowchart (Section II) provides a high-level visual guide to help project proponents quickly assess whether a proposed area may qualify for WE: A/R activities under the FCO Program, this chapter on Applicability Conditions offers a more detailed technical criteria that must be met for a project to be formally considered eligible.

The Applicability Conditions outlined here ensures that only those initiatives which align with the program's requirements proceed to quantification and crediting.

2.1 Eligibility

To qualify under this methodology, the project must meet the following criteria:

1. The activities shall involve afforestation and reforestation of degraded forest, with at least 90% of planted area constituting wetland forest[12]. If non-wetland forest exceeds 10%, the project may still proceed in areas where they do not interfere with the restoration of natural wetland hydrology.

2. The applicable activity (project) scale are as follows:
    a. Small-scale: Projects that generate less than or equal to 16,000 tCO_2e per year, without specific area limitations.[13]
    b. Large-scale: Projects that generate more than 16,000 tCO_2e per year.

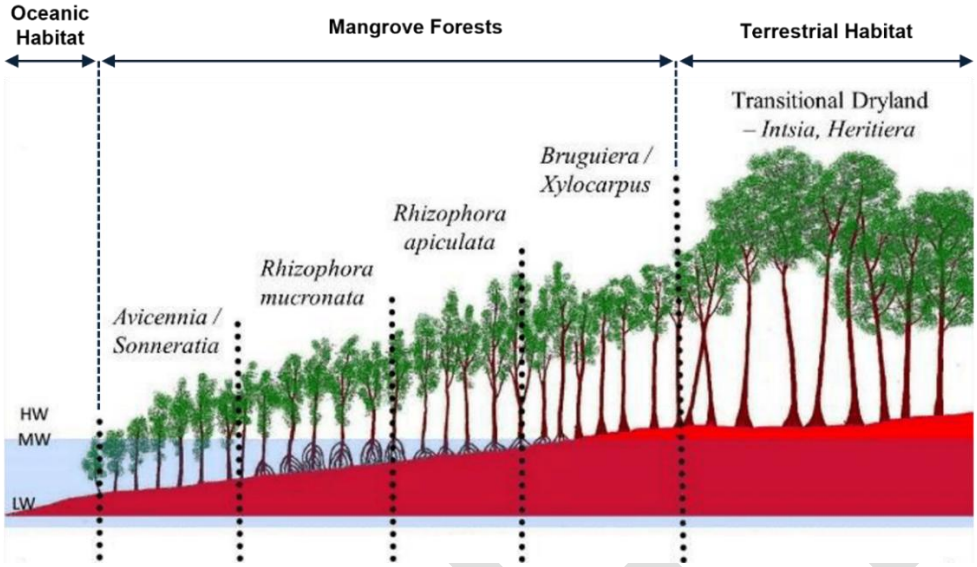
3. Forested wetlands eligible in the project area are limited to the following ecosystems:
    a. Mangrove forests along coastal zones and tidal rivers.
    b. Mangrove associate species, referring to non-true mangrove species that naturally grow within mangrove habitats.
    c. Nipa swamps in brackish water and tidal freshwater zones.

    Within these ecosystems, only true native species shall be planted. Project proponents are encouraged to reference scientific publications, research studies or peer-reviewed literature to confirm species eligibility in Malaysia.

4. The project area shall include adjacent transitional habitats that connect mangrove ecosystems to both oceanic (e.g., seagrass beds) and terrestrial habitats (e.g., back mangrove forests), provided they support the ecological integrity of the forested wetland system, as depicted in Figure 4.

[12] *UNFCCC, 2013. "Clean Development Mechanism, AR-AM0014: Afforestation and reforestation of degraded mangrove habitats - Version 3.0".*
[13] *UNFCCC, 2013. "Clean Development Mechanism CDM Methodology Booklet", 5th ed.*

Figure 4: Typical mangrove forest zonation in Peninsular Malaysia[14].



5. Project area was historically covered with wetland forest that has since been deforested or degraded due to human activities or natural events, and does not currently meet the definition of a forest (i.e., tree canopy cover <10% at maturity, <0.5 ha minimum area, and tree height <5m at maturity *in situ*), including non-forested or fully cleared lands where tree cover has been completely removed.

6. Projects must demonstrate that the area historically supported forested wetland ecosystems for at least 10 years prior to the project start date. The historical mangrove coverage can be provided by combination of spatial datasets such as satellite imagery, aerial photographs, and historical land use maps, published no later than 10 years before the start date.[15]

    a. Project areas with less than 10 years of documented wetland ecosystem history may be deemed eligible, if project intervention is essential to sustain the ecological and carbon functions of the wetland, under either of the following conditions:

        i. Project area was previously a forested wetland that was cleared or degraded within the past 10 years due to causes unrelated to the carbon project (e.g., agriculture, aquaculture, etc.), with proof that the clearing is not intentional for the purpose of generating carbon credits.
        ii. Project area was not historically a wetland but has naturally transitioned into a wetland ecosystem due to dynamic environment changes and the area is now ecologically suitable for native mangrove, nipa swamps or associated wetland species.

    b. For projects that meet the exemption under condition 6(a), project proponents must provide the following evidence to ensure environmental integrity and avoid perverse incentives:

[14] *Hashim, Ahmad & Shahruzzaman, Diana, 2017. Effectiveness of Mangrove Forest as Coastal Protection along the West Coast of Northern Peninsular Malaysia. doi: 10.1051/matecconf/20178701014.*
[15] *Verification should reference national datasets or scientifically recognized global sources (e.g., Global Mangrove Watch), with spatial data accompanied by metadata compliant with ISO 19115:2014 standards.*

i. Demonstration that the project is essential to restore, enhance, or maintain the wetland ecosystem and its carbon sequestration potential.
ii. Proof that under the baseline scenario, natural regeneration would not result in equivalent carbon sequestration levels without the project intervention.
iii. Spatial and ecological evidence (e.g., remote sensing, soil assessments, data, etc.) to justify both project eligibility and additionality.

7. Legal land-use rights on project ownership and to conduct project activities must be established before project initiation, and are documented (e.g. land title, lease agreements, government approval).

2.2 Ineligibility

A project area is not eligible if:

1. It is an intact, undisturbed wetland forest that is already sequestering carbon, defined as an area that is unaltered or only partially altered while still maintaining its natural functions[16], including hydrological conditions, sediment supply, salinity characteristics, water quality and/or native plant communities.

2. Wood biomass, whether from planted or naturally regenerated trees is harvested and removed from the project area for any purpose during the first 10 years after project initiation.

3. The project creates more than 10% of soil disturbance such as digging a plant hole[17], and making a trench, particularly in the following cases[18]:

    a. Lands containing organic soils, where disturbance may lead to significant carbon loss.
    b. Lands requiring prior soil management to enhance carbon sequestration (e.g., via minimum tillage, organic amendments).

    Exceptions may be allowed for more than 10% soil disturbance if project proponent provides robust evidence that:

    - The disturbance is necessary for site rehabilitation,
    - The intervention will result in net positive carbon benefits, and
    - Soil carbon loss is minimised through best management practices.

[16] *FAO, "Second Expert Meeting on Harmonizing Forest-Related Definitions for Use by Various Stakeholders," 2024. https://www.fao.org/4/y4171e/y4171e36.htm*
[17] *For example, digging pits of size 0.50m x 0.50m (length x width) at a spacing of 3m x 3m across the site results in approximately 2.78% soil disturbance by area, while continuous ploughing of the entire site would represent 100% disturbance. (Source: UNFCCC, 2013. "Clean Development Mechanism, AR-AM0014: Afforestation and reforestation of degraded mangrove habitats - Version 3.0").*
[18] *Project proponents shall demonstrate best efforts to minimize carbon loss by providing maps or site preparation records to justify that any physical soil disruption does not materially reduce the soil carbon sink potential of the site and remains within acceptable limits. Where quantification is uncertain, conservative assumptions or expert assessments may be used.*

3 Project Boundary

This section defines the spatial boundaries within which the WE: A/R project activities are implemented and monitored. Establishing a clear project boundary is essential for ensuring transparency, consistency and credibility in the quantification of GHG emission reductions. The project boundary encompasses four key dimensions.

1. **Geographical boundaries**
   These define the physical extent of the project area using spatial data such as satellite imagery, maps, and georeferenced coordinates. It includes delineation of project area and stratification requirements.

2. **Carbon pools**
   The project must identify which carbon pools are included or excluded in the accounting process. These typically include aboveground and belowground biomass, soil organic carbon, litter, deadwood, and harvested wood products.

3. **GHG emission sources**
   All relevant sources of GHG emissions within the project boundary must be identified and assessed. These may include emissions from biomass burning, fossil fuel combustion, and other project-related activities.

3.1 Geographical Boundaries

3.1.1 Project Area

1. Project area refers to the area under the control of the project proponents and encompasses the eligible and non-eligible areas.

2. The project area applies to all of Malaysia, covering Peninsular Malaysia, Sabah, and Sarawak.

3. Project area must be clearly delineated and mapped using Geographic Information System (GIS) tools, supported by remote sensing data. The data collected shall be used to produce land cover and change information for the project area during the baseline scenario period.

    a. Acceptable data sources include optical sensor systems, such as Landsat, Sentinel-2, SPOT, ASTER, or other satellite platforms capable of providing consistent, comparable data covering the relevant period.
    b. Temporal coverage must include imagery from at least two points in time:
        1. the project start date, and
        2. a historical reference point at least 10 years prior to project start date.
    c. Field-verified data from ground-truthing or field surveys shall be used to calibrate or validate remote sensing interpretations.

4. Project area could be composed of one single polygon or several non-contiguous polygons.

5. Three spatial classifications must be defined:

    a. **Historic Wetland Coverage**

i. A minimum 10-year historical reference using satellite imagery, aerial photographs, and historical land use maps to confirm prior wetland extent, with verification through national datasets.

b. **Eligible Project Area**

i. Project area shall be eligible where afforestation/reforestation of degraded mangrove/nipa swamps on historic wetland area is planned.
ii. Eligible areas are those sections of the project area that are classified as no wetland forest at the project start date and are classified as either one of the following 10 years before the project start date:

1. **Wetland Forest:** Only when the project proponent can prove that the change from wetland forest to no wetland forest is not a result of an intention to implement a carbon credit project.
2. **No Wetland Forest:** Eligible for wetland reforestation.

Land eligibility based on initial and current land cover is outlined in Figure 5 below.

Figure 5: Eligibility of Project Area

c. **Non-Eligible Area**

i. Area of intact forested wetlands or urbanized zones.
ii. Project area that falls outside of historic wetland coverage shall be considered as non-eligible.
iii. Area of the project area that is not in compliance with the eligibility criteria of this module.

6. The spatial boundaries of the project areas shall be clearly defined to facilitate accurate and robust measuring, monitoring, and verifying of the emission reductions and removals.

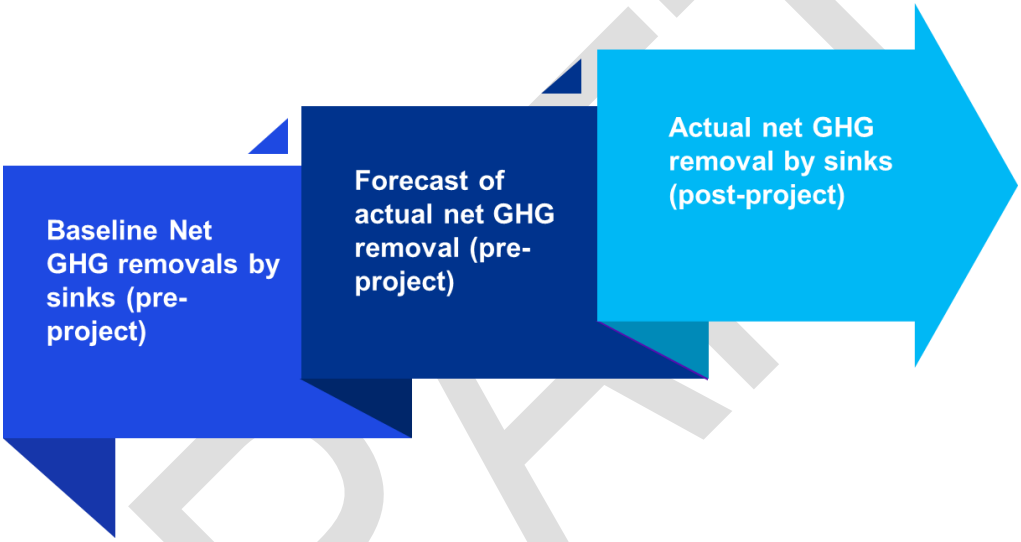
7. Projects shall define the boundaries for each spatial feature and explain the criteria and approach followed to define each boundary.

a. Vector information shall be provided for all geographical boundaries to unambiguously allow their identification.

b. The following information shall be provided for each identified project area in the project design document (PDD):
   i. Specific name and/or ID of the project area, and
   ii. Specific name and/or ID and the land cover type, and
   iii. Digital spatial data of the project boundaries and eligible project areas, and
   iv. Total land area in hectares for each spatial element, calculated using a planimetric formula[19], and
   v. Information about the legal rights of the landowner.

3.1.2 Stratification

Stratification is required if project area is heterogenous to improve precision of carbon estimation. The stratification approach shall be adapted to the specific context of each project phase, as outlined below:



1. **Baseline net GHG removals by sinks (Pre-Project)** – Stratify according to major vegetation types, associated crown cover, growth patterns and/or land use types.

2. **Forecast of actual net GHG removal (Pre-Project)** – Stratify according to major vegetation, growth patterns, planting date, silvicultural treatment, and forest management.

3. **Actual net GHG removal by sinks (Post-Project)** – Stratify according to major vegetation, growth patterns, planting date, silvicultural treatment, and implemented forest management practices. Re-stratification needed when project is impacted from natural or human-induced disasters (e.g., storms, sediment loads) that significantly affect biomass carbon sequestration.

3.2 Carbon Pools

Carbon pools are essential components of forest ecosystems where carbon is sequestered and stored, playing a crucial role in maintaining the balance of carbon stocks over time. These pools are integral

[19] A planimetric formula calculates the two-dimensional surface area of a land parcel based on horizontal, flat measurements, excluding terrain elevation or slope. (Source: Berry, J. K. (2016). *Map Analysis Topic 11: Characterizing Micro-Terrain Features*. http://www.innovativegis.com/basis/MapAnalysis/Topic11/Topic11.htm)

for accurately measuring and monitoring changes in carbon levels, particularly in the context of assessing the effectiveness of emission reduction strategies. Each carbon pool within the ecosystem contributes uniquely to the carbon cycle, making it essential to understand how forest management practices, growth patterns, or disturbances can influence the overall carbon balance of a project.

In order to quantify emissions reductions or removals effectively, it is imperative to identify and differentiate specific carbon pools based on their significance and potential emissions impact. Table 1 below outlines the list of included and excluded carbon pools.

Table 1: List of Included and Excluded Carbon Pools

Carbon Pool			Eligibility	Description
Included	Aboveground biomass	Tree	Eligible	Major carbon sink in forested wetlands.
		Non-tree	• Baseline: Eligible • Project: Optional • Leakage: Ineligible	Can contribute to carbon sequestration but is optional for project accounting due to smaller carbon stocks. Negligible for leakage.
	Belowground biomass	Tree	Eligible	Wetland trees store substantial carbon in extensive root networks, crucial for long-term sequestration.
		Non-tree	• Baseline: Eligible • Project: Optional • Leakage: Ineligible	Contributes to soil carbon, but optional in project due to limited long-term storage potential. Negligible for leakage.
	Soil organic carbon		Eligible	A key carbon pool in wetland ecosystems, major source of emissions if disturbed through deforestation or degradation.
	Dead wood		Optional	May occur from project activities and can store carbon temporarily but may decompose over time, leading to emissions.
Excluded	Wood products		Ineligible	Not relevant to wetland reforestation projects, as harvested wood is not a primary component.
	Litter		Ineligible	Comprises decomposing leaves and organic material with a fast turnover rate,

	Carbon Pool	Eligibility	Description
			contributing minimally to long-term carbon storage.

3.3 GHG Emission Sources

This subsection outlines the relevant GHG emission sources that must be considered within the defined project boundaries.

Emission sources included or excluded are summarized in

Table 2 below.

Table 2: List of Emission Sources Included or Excluded from Project Boundary.

	Sources	Gas	Included	Description
Baseline	Fossil fuel use	CO_2	✓	May be conservatively excluded.
		CH_4	✗	Conservatively excluded.
		N_2O	✗	Conservatively excluded.
Project	Wetland Mineral Soils	CO_2	✓	Considered under carbon pools.
		CH_4	Optional	Only if found significant (>5% of project removals). It shall be established by the projects that CH_4 emissions are insignificant, either through scientific literature or field measurements, with the wetland species and ecological condition of the region being considered. Published research[20] indicates that global CH_4 has the potential to offset the mangrove carbon burial values; however, there are also high uncertainties in the published value. Hence, more research of detailed global assessments is needed to fully demonstrate the accounting of this greenhouse gas (GHG). Until then, all CH_4 emissions from mangrove plantations are to be accounted for if found significant.
		N_2O	✗	Considered negligible since N_2O global inputs slightly exceed total outputs, suggesting a net N balance in mangrove ecosystems.[21]

[20] *J. A. Rosentreter, D. T. Maher, D. V. Erler, R. H. Murray, and B. D. Eyre, "Methane emissions partially offset 'blue carbon' burial in mangroves," Sci. Adv., vol. 4, no. 6, June 2018, https://www.science.org/doi/10.1126/sciadv.aao4985.*

	Sources	Gas	Included	Description
	Burning for site preparation	CH_4	✓	Where existing tree and non-tree biomass of the baseline is burned for the purpose of land preparation, an additional 10% of the baseline[22] shall be added in the first year of the activity. This is to account for additional emissions that are released during the burning process.
		N_2O	✓	
	Fossil fuel use	CO_2	✓	CO_2 emissions from combustion of fossil fuel for the management of mangrove plantations is to be quantified (e.g., dredging for tidal canals).
	Burning from project activities	CH_4	✗	Non-CO2 GHG emissions from the use of fossil fuels from project activities (e.g., flights, management operations) are insignificant and may therefore be neglected.
		N_2O	✗	

4 Baseline Scenario and Additionality

This section outlines the procedures for establishing and reassessing the baseline scenario and demonstrating additionality for WE project under the FCO framework. A robust baseline scenario is essential to conservatively estimate GHG emissions or removals that would occur in the absence of project intervention. Additionality ensures that project activities result in real, measurable climate benefits beyond business-as-usual practices.

4.1 Baseline Determination and Additionality Assessment

The baseline scenario is developed using the procedures outlined in the **FCO Tool: Baseline and Additionality Determination**. It enables a conservative estimation of net GHG emissions or removals that would occur without the WE intervention. Establishing this baseline is essential for demonstrating that the project delivers real, measurable and additional climate benefits.

4.2 Reassessment of Baseline Scenario

The baseline scenario must be reassessed every 10 years OR earlier if significant changes are observed to account for any changes in the underlying drivers or agents influencing land use, degradation, and carbon stocks. As part of this process, the validity of the original baseline must be reviewed, taking into consideration any new national or sectoral policies and evolving circumstances:

- If still valid – associated GHG emissions must be recalculated for the upcoming baseline period
- If deemed no longer valid – a new baseline scenario must be established.

[22] *The 10% factor is a conservative proxy in absence of direct measurements. This value aligns with estimates derived from IPCC (2006 Guidelines, Vol. 4, Chapter 2, Table 2.5) default emission factors and global warming potential of non-CO_2 gases.*

5 Quantification of Estimated GHG Reductions and Removals

This section outlines the methodology for calculating the GHG emission reductions achieved through WE: A/R project activities. It provides a structured approach to quantify the difference between baseline emissions (what would have occurred without the project) and actual project emissions (with WE: A/R interventions in place).

5.1 Baseline Emissions

The baseline emissions shall be determined on a per stratum basis ($GHG_{BSL,i}$), as defined in Equation 1, attributed to the change in carbon stock in the biomass carbon pools and emissions from fossil fuel use. The detailed calculation methods for each carbon stock can be found in **FCO Tool: GHG Quantification Equations**.

$$GHG_{BSL,i} = \sum_{t}^{t*} (-\Delta C_{BSL_{AGB},i,t} - \Delta C_{BSL_{BGB},i,t} - \Delta C_{BSL_{DW},i,t} - \Delta C_{BSL_{SO},i,t} + GHG_{BSL\_FC,i,t}) \quad \textbf{(1)}$$

Where:

Variable	Description	Unit
$\boldsymbol{GHG_{BSL,i}}$	Baseline emissions, per stratum i	tCO_2e
$\boldsymbol{\Delta C_{BSL_{AGB},i,t}}$	Change in carbon stock of aboveground biomass, per stratum i in year t in baseline scenario	$tCO_2e\ yr^{-1}$
$\boldsymbol{\Delta C_{BSL_{BGB},i,t}}$	Change in carbon stock of belowground biomass, per stratum i in year t in baseline scenario	$tCO_2e\ yr^{-1}$
$\boldsymbol{\Delta C_{BSL_{DW},i,t}}$	Change in carbon stock of deadwood, per stratum i in year t in baseline scenario	$tCO_2e\ yr^{-1}$
$\boldsymbol{\Delta C_{BSL_{SO},i,t}}$	Change in carbon stock of soils, per stratum i in year t in baseline scenario	$tCO_2e\ yr^{-1}$
$\boldsymbol{GHG_{BSL\_FC,i,t}}$	Net emissions from the fossil fuel combustion per stratum i in year t in baseline scenario	$tCO_2e\ yr^{-1}$

For all $\boldsymbol{\Delta C}$ variables, a positive value indicates an increase in carbon stock (i.e., carbon sequestration), while a negative value indicates a loss of carbon stock (i.e., emissions). In the equation, all $\boldsymbol{\Delta C}$ terms are preceded by a minus sign ($-\boldsymbol{\Delta C}$) to reflect their contribution to net GHG emissions.
The total baseline emissions are then calculated as the sum of all baseline emissions per stratum i in the eligible project areas, as per Equation 2.

$$GHG_{BSL} = \sum_{i=1}^{M} GHG_{BSL,i} \quad \textbf{(2)}$$

Where:

Variable	Description	Unit
$\boldsymbol{GHG_{BSL}}$	Total baseline emissions from all strata in the eligible project area	tCO_2e
$\boldsymbol{GHG_{BSL,i}}$	Baseline emissions, per stratum i	tCO_2e
$\boldsymbol{i}$	1, 2, 3 …. M_{BSL} strata in baseline scenario	-

5.2 Project Emissions

Project emissions, similarly, to the baseline emissions shall be determined on a per stratum basis ($GHG_{FCO,i}$). The emissions are attributed to the change in carbon stock in the biomass carbon pools, emissions for soil processes, fossil fuel use as well as burning of biomass for site preparation. The detailed calculation methods for each carbon stock and emission sources from soil and fossil fuel combustion can be found in **FCO Tool: GHG Quantification Equations**.

$$GHG_{FCO,i} = \sum_{t}^{t*} -\Delta C_{FCO\_AGB,i,t} - \Delta C_{FCO\_BGB,i,t} - \Delta C_{FCO\_DW,i,t} + GHG_{FCO\_SOC,i,t} + GHG_{FCO\_FC,i,t} + GHG_{FCO\_BURN,i,t} \quad \textbf{(3)}$$

Where:

Variable	Description	Unit
$\boldsymbol{GHG_{FCO,i}}$	Project emissions, per stratum i	$tCO_2e\ yr^{-1}$
$\boldsymbol{\Delta C_{FCO_{AGB},i,t}}$	Change in carbon stock of aboveground biomass, per stratum i in year t in project scenario	$tCO_2e\ yr^{-1}$
$\boldsymbol{\Delta C_{FCO_{BGB},i,t}}$	Change in carbon stock of belowground biomass, per stratum i in year t in project scenario	$tCO_2e\ yr^{-1}$
$\boldsymbol{\Delta C_{FCO_{DW},i,t}}$	Change in carbon stock of deadwood, per stratum i in year t in project scenario	$tCO_2e\ yr^{-1}$
$\boldsymbol{GHG_{FCO\_SOC,i,t}}$	Net GHG emissions from soil per stratum i in year t in project scenario	$tCO_2e\ yr^{-1}$
$\boldsymbol{GHG_{FCO\_FC,i,t}}$	Net emissions from the fossil fuel combustion per stratum i in year t in project scenario	$tCO_2e\ yr^{-1}$
$\boldsymbol{GHG_{FCO\_BURN,i,t}}$	Net emissions from the burning of biomass per stratum i in year t in project scenario[23]	$tCO_2e\ yr^{-1}$

For all $\boldsymbol{\Delta C}$ variables, a positive value indicates an increase in carbon stock (i.e., carbon sequestration), while a negative value indicates a loss of carbon stock (i.e., emissions). In the equation, all $\boldsymbol{\Delta C}$ terms are preceded by a minus sign ($-\boldsymbol{\Delta C}$) to reflect their contribution to net GHG emissions.

The total project emissions are then calculated as the sum of all project emissions per stratum i in the eligible project areas, as per Equation 4.

$$GHG_{FCO} = \sum_{i=1}^{M} GHG_{FCO,i} \quad \textbf{(4)}$$

Where:

Variable	Description	Unit
$\boldsymbol{GHG_{FCO}}$	Total project emissions from all strata in the eligible project area	tCO_2e
$\boldsymbol{GHG_{FCO,i}}$	Project emissions, per stratum i	tCO_2e
$\boldsymbol{i}$	1, 2, 3 …. M_{FCO} strata in project scenario	-

[23] *An additional 10% of the baseline shall be added to the first year of activity. Refer to Section 3.3 GHG Emission Sources for further details.*

5.3 Leakage Emissions

Leakage is the GHG emissions which occur outside the project area and are quantified and can be attributed to the project activities. Four categories of leakage are to be considered:

1. Collection of wood (for firewood, charcoal, etc.)
2. Timber harvesting
3. Agriculture (crop cultivation, shrimp cultivation, etc.)
4. Livestock

For leakage categories 1, 2, and 3, the following shall be used:

$$GHG_{LK} = A * Shift_{\%} * C_{Tree} \quad \textbf{(5)}$$

Where:

Variable	Description	Unit
$\boldsymbol{GHG_{LK}}$	Net CO_2 emissions due to leakage	tCO_2e
$\boldsymbol{A}$	Land within the project area where the activity is taking place.	ha
$\boldsymbol{Shift_{\%}}$	Percentage of the activity that will be displaced during the crediting period and will impact the tree biomass outside the project area.	%
$\boldsymbol{C_{Tree}}$	Average stock of tree biomass in the area to where the activity will be displaced. If it is not known to where the activity will be displaced, use the average stock of tree biomass of a natural forest in Malaysia.	$tCO_2e\ ha^{-1}$

While category 4 (livestock) is not often observed in mangrove areas, in the event that this is identified as a leakage activity, Equation 8 shall be used to account for the leakage value:

$$GHG_{LK} = Head * GR_{cap} * C_{Tree} \quad \textbf{(6)}$$

Variable	Description	Unit
$\boldsymbol{Head}$	Number of heads that: a. will be displaced during the crediting period, and b. will have impact on the tree biomass outside the project area. The factor is determined by: a. credible estimations, or b. a representative survey.	head
$\boldsymbol{GR_{cap}}$	Grazing capacity of the area to where the livestock will be displaced.	ha/head
$\boldsymbol{C_{Tree}}$	Average stock of tree biomass in the area to where the activity will be displaced. If it is not known to where the activity will be displaced, use the average stock of tree biomass of a natural forest in Malaysia.	$tCO_2e\ ha^{-1}$

5.4 Net GHG Emission Reductions and Removals

The total net GHG emission reductions or removals is calculated as show below:

$$NER = GHG_{BSL} - GHG_{FCO} - GHG_{LK} \quad \textbf{(7)}$$

Where:

Variable	Description	Unit
NER	Net CO_2 emissions reductions/removals from project activity	tCO_2e
GHG_{BSL}	Net CO_2 emissions in the baseline scenario	tCO_2e
GHG_{FCO}	Net CO_2 emissions in the project scenario	tCO_2e
GHG_{LK}	Net CO_2 emissions due to leakage	tCO_2e

A positive NER value indicates that the implemented FCO project has reduced emissions and/or increased removals compared to the baseline scenario, and thus represents a climate benefit. Conversely, a negative NER implies that the FCO project results in higher emissions or lower removals than the baseline.

5.5 Uncertainty

Uncertainty in emissions and carbon stock change estimates for both the baseline and project shall be determined following the procedures outlined in **FCO Tool: GHG Quantification Equations**.

5.6 Calculation of Forest Carbon Units

The calculation of FCU units issued must account for the buffer credits deposited in the FCO Buffer Account.

The number of FCU units is calculated as follows:

$$FCU_{t2} = (adj\_NER_{t2} - adj\_NER_{t1}) * (1 - Buffer\_Factor_{t2}) \quad \textbf{(8)}$$

Where:

Variable	Description	Unit
FCU_t	Number of Forest Carbon Units in year t	-
adj_NER_{t2}	Net CO_2 emissions reductions/removals from project activity up to year t2 adjusted to account for uncertainty	tCO_2e
adj_NER_{t1}	Net CO_2 emissions reductions/removals from project activity up to year t1 adjusted to account for uncertainty	tCO_2e
$Buffer\_Factor_{t2}$	Percentage of buffer credits to be contributed to the FCO Buffer Account in year t2	%

The buffer contribution to address non-permanence risk shall be determined using the **FCO Tool: Buffer Risk Assessment**, which applies a risk-based calculation across defined risk categories. Where a local jurisdiction has established a recognized buffer or insurance mechanism that demonstrably addresses non-permanence, the project may follow the jurisdictional approach, subject to MFF's approval and alignment with the tool.

6 Monitoring

This section outlines the monitoring framework required to ensure the integrity, transparency, and accuracy of WE: A/R project implementation and its associated GHG emission reductions. It provides guidance on the data and parameters to be validated and tracked throughout the project lifecycle.

Key components include:

a. **Data and Parameters at Validation:** Specifies the baseline variables that must be confirmed before project initiation, including forest area change and deforestation rates.
b. **Ongoing Monitoring Requirements:** Details the spatial, temporal, and carbon stock data that must be collected at regular intervals (typically every 3–5 years), using remote sensing, field measurements, and geolocation tools.
c. **Monitoring Plan Development:** Describes the structure of a comprehensive monitoring plan, including procedures for data collection, quality assurance, uncertainty management, and documentation.
d. **Baseline Renewal Protocols:** Establishes the criteria and frequency for reassessing baseline scenarios to reflect evolving land-use dynamics and maintain conservative estimates.

6.1 Monitoring Plan

Project proponents are required to create a Monitoring Plan. This plan will detail the specific methods used to measure and confirm the amount of carbon the project captures and the extent to which it reduces emissions. At a minimum, the plan must include the following elements:

a. Description of project
b. Implementation of project
c. Description of monitoring system applied by the project
d. Data and parameters
e. Safeguards reporting
f. Stakeholder inputs and legal disputes

Throughout the entire duration that the project generates carbon credits, proponents must continuously ensure that all the initial eligibility requirements continue to be met.

Although this provides the essential monitoring aspects, project proponents should customize and add more detail to these elements to perfectly match the unique goals, environmental setting, and planned methods described in their Project Design Document.

6.2 Data and Parameters

6.2.1 Data and Parameters at Validation

Variables	Definition	Unit	Equation
N/A	N/A	N/A	N/A

6.2.2 Data and Parameters Monitored

Variables	Definition	Unit	Equation
GHG_{LK}	Net CO_2 emissions due to leakage	tCO_2e	5

7 General References

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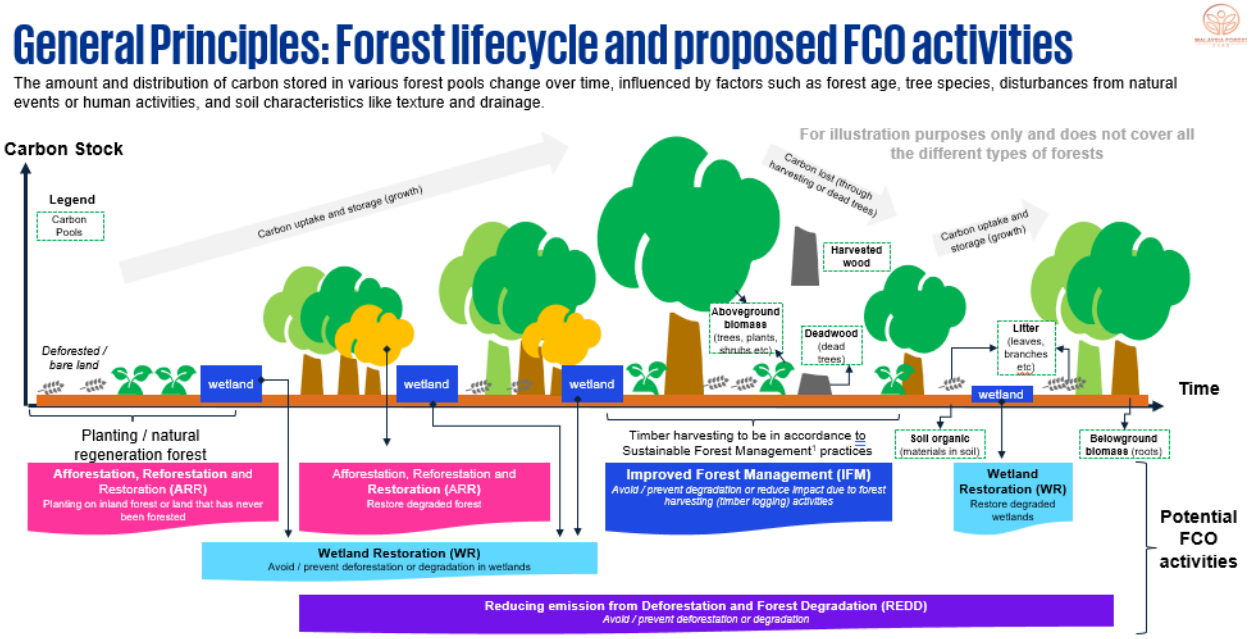
IX. ANNEX



[1]Source Malaysia Policy on Forestry on Selective Management System (SMS) - Implement sustainable logging practices by harvesting mature, high-quality trees, promoting the growth of younger trees, and maintaining the forest ecosystem through detailed inventories, replanting activities, and adherence to minimum cutting limits, with typical cutting cycles ranging between 25 to 30 years and each state having an Annual Allowable Coupe (AAC).