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 support 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 Annex 1:

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. **Wetlands Ecosystems:** Activities on wetlands 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 FCO 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.
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 that prevent emissions from occurring, such as avoiding planned or unplanned deforestation.

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

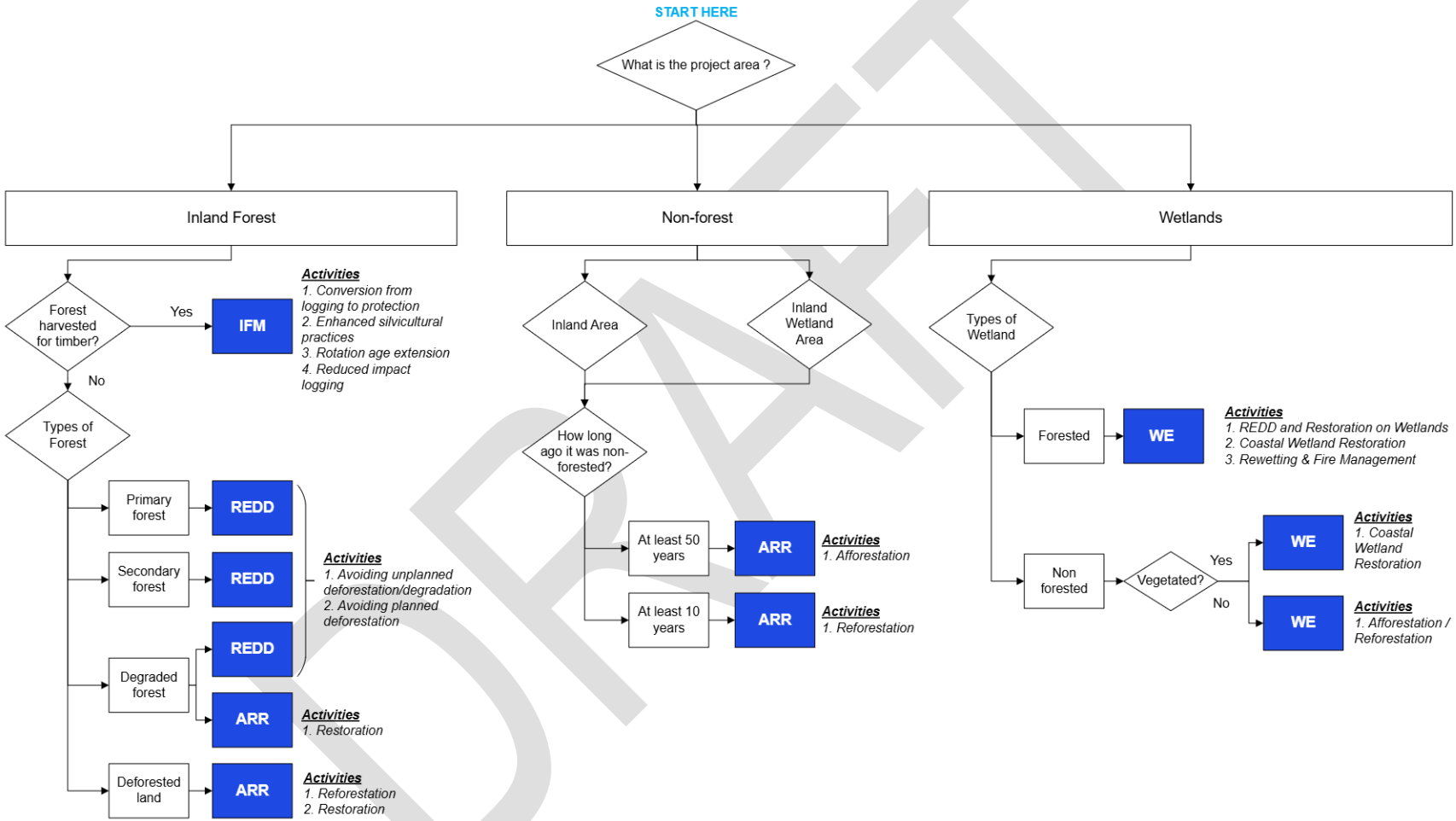
b. **GHG Reduction or Removal Activities**: Interventions that actively reduce or sequester emissions, tailored to forest lands, wetlands, or production forests.

1.4 Focus of this FCO Methodology document:

This document specifically focuses on the ARR Methodology. It should be used in conjunction with the overarching FCO Program Guidelines, Subsidiary Guidelines, and standardized 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, 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 ARR activities is detailed in the following section.

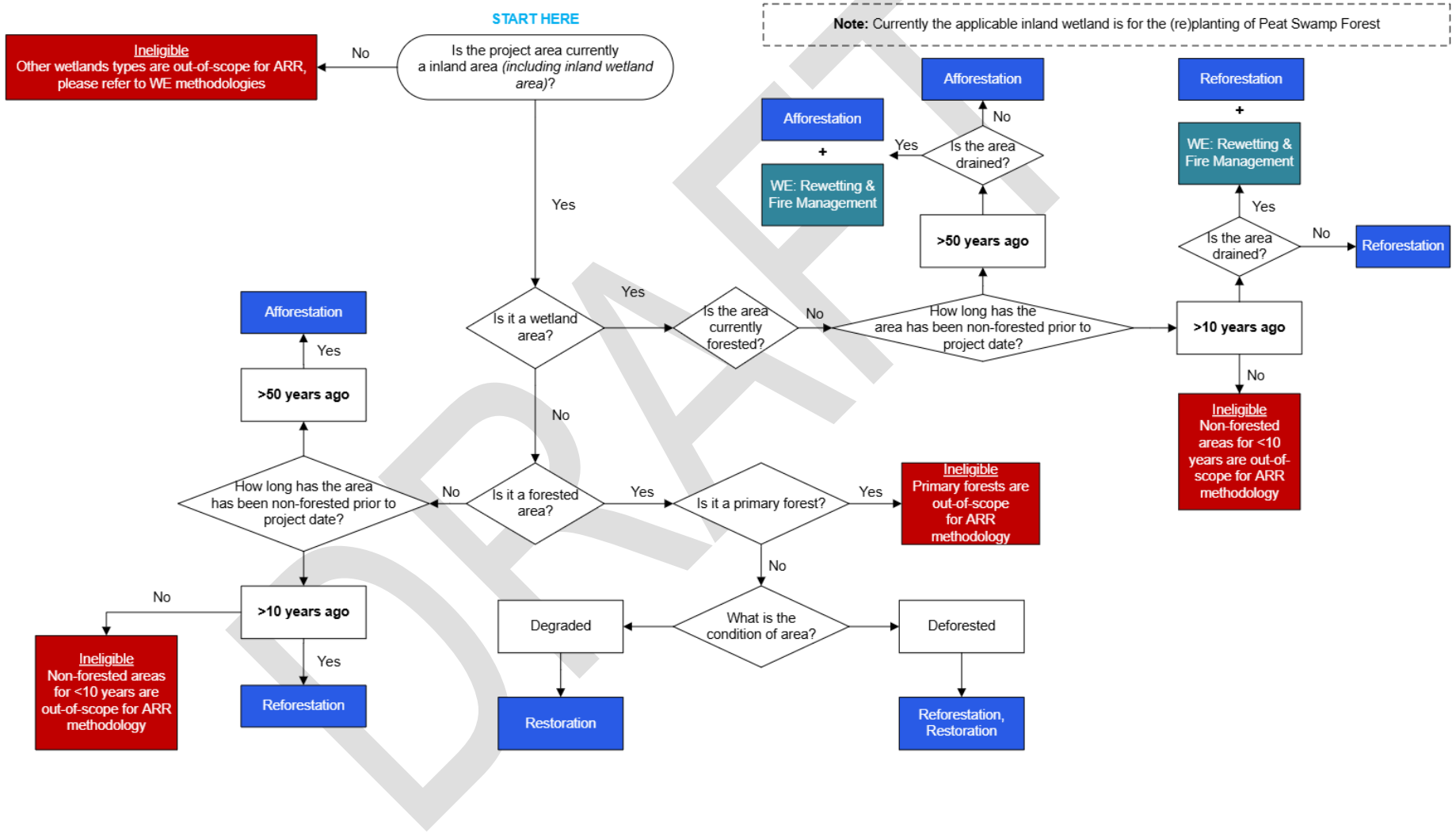
II. ELIGIBILITY FLOWCHART

The eligibility flowchart guides Project Proponents in determining whether a proposed project area qualifies for ARR activities under the FCO program.

Afforestation, Reforestation and Restoration applicable to project areas that are currently:

a. **Afforestation:** Non-forest land for the past 50 years.
b. **Reforestation:** Non-forest land for the past 10 years.
c. **Restoration:** Degraded forest or deforested land.

Figure 2: Eligibility Flowchart for Afforestation, Reforestation, and Restoration modules



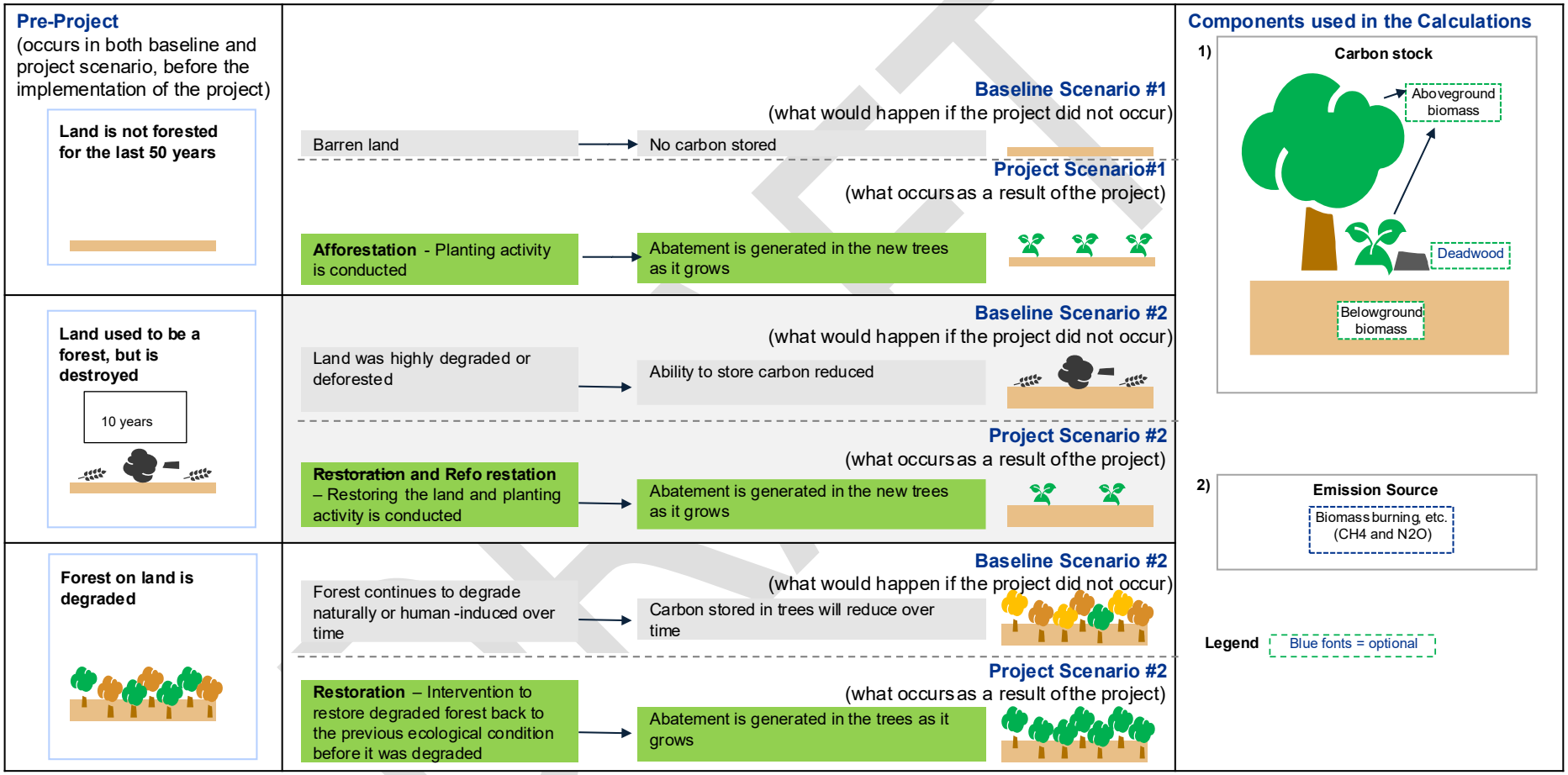
III. SUMMARY DESCRIPTION

This section provides an overview of the ARR Methodology - activity description, applicable ecosystem as well as the pre-project, baseline and project scenarios for an applicable project.

Type of GHG Emissions Mitigation Action *Refers to how the project reduces GHG emissions*	Project activities that increase carbon sequestration and/or reduce GHG emissions through: • **Planting** • **Sowing** • **Human-assisted natural regeneration** (may involve multiple species within a single stand of woody vegetation)
Applicable Ecosystem *Identifies the type of environment where the project can be implemented*	• **Afforestation and Reforestation**: Land that does not meet the forest definition **(non-forest land)**, including barren land, deforested land, inland wetland and other revegetation areas. • **Restoration: Degraded forest or deforested land** which are expected to remain/continue to degrade/deforest without the project. This includes degraded land of inland wetland, selective-harvest forest, conservation forest, urban forestry, abandoned logged-site, agriculture fields, pasture, former croplands/shrublands/grassland and in 'settlements' or 'other lands' land use category.
Pre-Project *Refers to the state of the land prior to the start of the FCO project*	• **Non forest**: A land that does not meet the definition of forest for the last numbers of years (depending on the activity to implement, further detail in following section). • **Degraded forest/deforested land**: A land that has reduced in canopy cover and aimed to restore to its previous condition.
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*	• Land is expected to **remain to be non-forest** land for number of years. The number of years will be determined by the implementing activity. • Land is expected to **remain degraded/deforested** or to **continue to degrade/deforest** in the absence of the project.
Project Scenario *Describes the proposed interventions to be implemented under the FCO project to prevent or reduce GHG emissions*	• **Afforestation and Reforestation** activities are performed, through planting, sowing or human-assisted natural regeneration, resulting in the **increase in vegetation cover** and increase in soil organic carbon. • **Restoration** performed to **restore** the forest **to** its **previous conditions** and regain its ecological functionality.

Figure 3: Overview of ARR Methodology: pre-project, baseline scenario and project scenario

For illustration purposes only



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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
AFOLU	Agriculture, Forestry and Other Land Use
ALM	Agriculture Land Management
ARR	Afforestation, Reforestation and Restoration
CF	Carbon fraction of dry biomass
CH_4	Methane
CO_2	Carbon dioxide
DWR_{LI}	Dry-to-wet ratio
FCO	Forest Carbon Offset
GHG	Greenhouse gases
IFM	Improved Forest Management
N_2O	Nitrous oxide
QA/QC	Quality assurance/Quality control
R	Root to Shoot ratio
REDD	Reducing Emissions from Deforestation and forest Degradation
SOC	Soil organic carbon

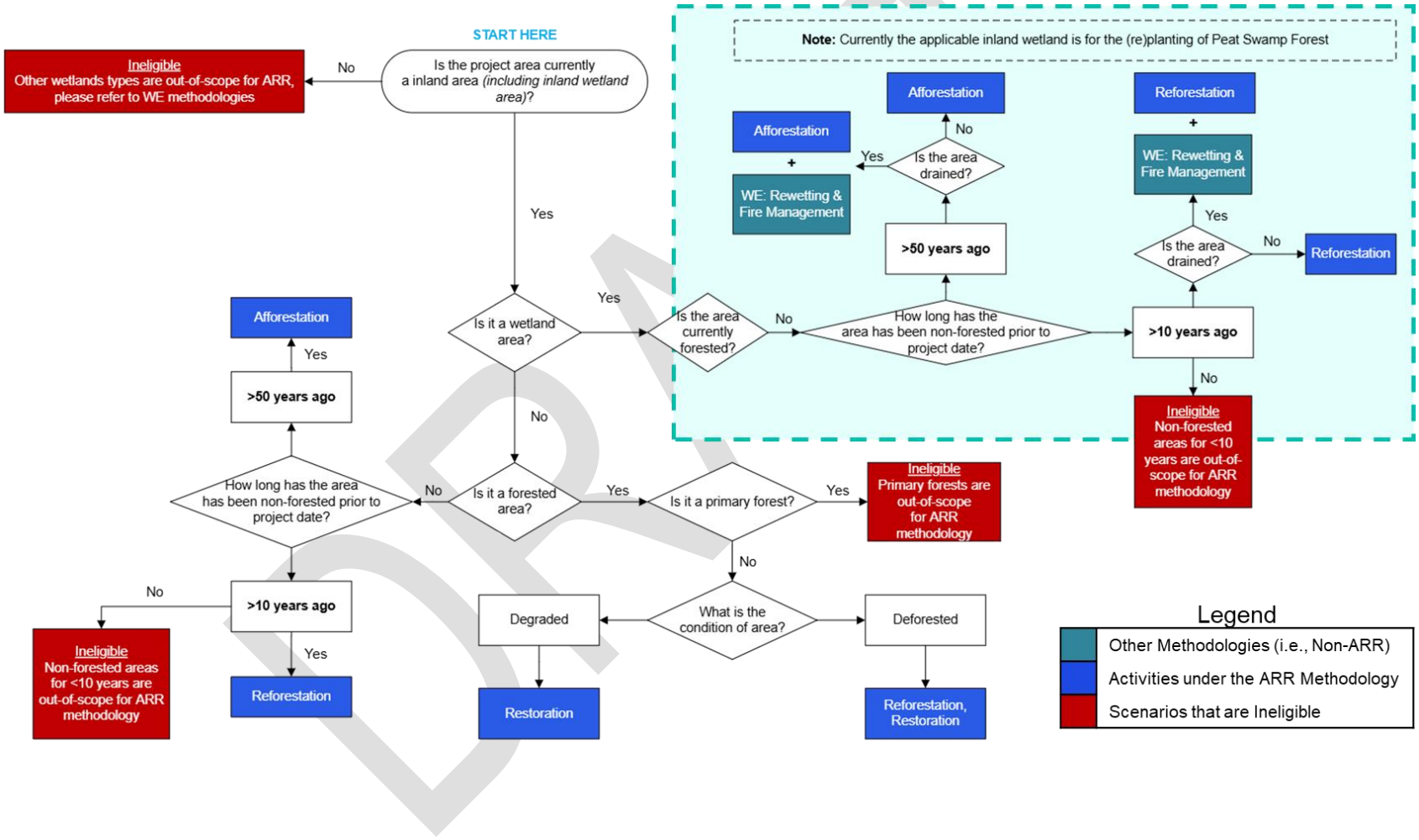
1 Definitions

Table 1 Definition for ARR Methodology

Terms	Definition
Afforestation	Direct human-induced conversion of land that has not met the forest definition for at least 50 years into forest, through planting (from seedlings or seeds) and/or interventions that promote natural regeneration.
Agroforestry	An ecologically based natural resource management system in which trees are integrated into farmland and rangeland.
Deforestation	Human induced permanent conversion of forested land to non-forested land.
Degradation	A direct human induced loss of forest values likely to be characterised by a reduction of tree canopy cover over long term.
Monoculture	A crop or a population of a single species.
Native species	A species that has been observed in the region, is naturally occurring and self-sustaining as demonstrated by peer-reviewed literature, expert judgement, or government registry.
Non-forest	Land that does not meet the national definition of a forest.
Organic Soil	Organic soils that fulfil one of the following requirements: I. If the soil is never saturated with water for more than a few days and contains > 20% (by weight) of organic carbon (35% organic matter) II. If the soil is subject to water saturation episodes
Reforestation	Direct human-induced conversion of land to forest, where the land was previously forested but has not met the forest definition for at least 10 years, through planting (from seedlings or seeds) and/or interventions that promote natural regeneration.
Restoration	Process of regaining ecological functionality and restore the land to its previous condition on deforested land or degraded forest.
Silvopasture	A combination of tree cultivation with livestock grazing on the same land with both forest products and forage managed to generate income in short and long term.
Soil disturbance	Activities like ploughing, digging of pits, stump removals or infrastructure done on organic soils.

2 Special Consideration: Inland Wetland

Figure 4 Flowchart focusing the integration of Inland Wetland



2.1 Combination of methodologies

For projects implemented on inland wetlands such as Peat Swamp Forests (PSF), Afforestation, Reforestation and Restoration (ARR) activities are structured under a multiple-project activity design that combines suitable methodologies according to site conditions.

The following outlines the scenarios based on the site conditions of a PSF, which is summarised in Table 2:

- For PSF areas that are barren but not drained, ARR may be complemented with Wetland Ecosystem (WE) approaches such as Rewetting and Fire Management (R&FM), accounting for biomass and soil organic carbon pools with emission arising from biomass burning, fertiliser use, fossil fuels, peat oxidation and fire incidence and stratification following the ARR approach.
- For sites that are barren and drained, a combined application of ARR and WE: R&FM methodologies is suggested with similar carbon pools and emission sources as above while stratification is applied in a phased manner.

Table 2 Proposed combination of methodology for Peat Swamp Forest (PSF)

PSF Condition	Methodologies	Section Reference	Applicability Conditions	Carbon Pools	Emission Sources	Stratification
Barren, but Not Drained	Afforestation, Reforestation and Restoration	ARR	To meet the eligibility and ineligibility conditions	Biomass	• Burning of biomass • Emission from fertiliser • Fossil Fuels	Following the ARR stratification approach
		WE: R&FM	-	Soil Organic Carbon (SOC)	• Peat Oxidation • Fire Incidence	-
Barren and Drained	• Afforestation, Reforestation and Restoration • WE: Rewetting & Fire Management	-	Both Methodologies -to meet all of the eligibility and ineligibility conditions	[As per Row 1]	[As per Row 1]	• Ex-Ante: WE: R&FM • During: ARR • Post: ARR

3 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 ARR 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.

3.1 Eligibility

For a project to qualify under this ARR Methodology, it must meet the following applicability criteria:

Table 3: Eligible Applicability Conditions

No	Category	Applicability conditions
1	Baseline condition *(pre-project preconditions)*	• Afforestation: Non-forest land for the past **50 years.** • Reforestation: Non-forest land for the past **10 years.** • Restoration: **Degraded** forest or **deforested** land. • Project that takes place on inland wetlands, ARR activities are developed using a multiple project activity design, by applying this methodology together with a WE methodology like Rewetting & Fire Management. • Deforested land/degraded forest condition: ➢ Remain and continue to degrade or deforest without the project. ➢ Any degraded area on legally protected land is eligible for **restoration**, subject to the provisions under the respective jurisdiction. ➢ No restriction on forest classification for degraded forest or deforested land, provide if there are proofs of the land/forest being deforested/degraded.
2	Project technology or practice *(employed by the project)*	• Soil disturbances for site preparation should: 1. Occur only once during the first five year of initial site preparation; 2. Manage and treat the soil in manner to increase soil organic carbon such as using minimum tillage and organic fertiliser; 3. Areas with organic soil must not be drained or irrigated (except for planting); 4. Minimum threshold of soil inversion, must not exceed 25cm depth[2]; and

[2] *Shallow non-inversion tillage in organic farming maintains crop yields and increases soil C stocks: a meta-analysis*

		5. Soil disturbance on organic soils must not exceed 10%[3,4] of the area submitted for certification. • Project activities must lead to an increase in vegetative cover[5] that include direct, indirect activities and perennial planting[6]. Project can also apply all silvicultural systems. • Each planting units must be tagged with a physical marker onsite with a unique ID.
3	Project scale	Small and large-scale project depending on the number of greenhouse gases that can reduce or store. **>16,000 tCO_2eq/year – Large scale** • Projects are classified as large-scale if they are expected to generate more than 16,000 tonnes of CO_2 equivalent (tCO_2eq) in net GHG removals per year. These projects typically span between 1,400 and 4,000 hectares, although actual land area may vary depending on site conditions and carbon sequestration potential. **<16,000 tCO_2eq/year – Small scale** • Projects are classified as small-scale if they are expected to generate less than 16,000 tonnes of CO_2 equivalent (tCO_2eq) in net GHG removals per year. These projects typically cover an area of approximately 10 to 100 hectares, although the actual land size may vary depending on the carbon sequestration potential of the site and the intervention type.
4	Legal right and ownership	Refer to FCO Subsidiary Guidelines: Registration of Forest Carbon Offset Projects
5	Certification requirement (activities that receive independent certifications)	Refer to FCO Subsidiary Guidelines: Integrity Assessment Criteria and Requirements

[3] *Application of the CCQI methodology for assessing the quality of carbon credits*
[4] *A/R Methodological Tool - Tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM project activities (Version 01.1.0)*
[5] *Revealing the Structure and Composition of the Restored Vegetation Cover in Semi-Arid Mine Dumps Based on LiDAR and Hyperspectral Images*
[6] *Application Form for Emissions Units Programs*

3.2 Ineligibility

While the above lists down the eligible project activities, certain scenarios are explicitly excluded to maintain the integrity, additionality and permanence of emission reductions. Projects are considered ineligible if they meet any of the following conditions:

Table 4: Ineligible Applicability Conditions

No.	Category	Ineligibility
1.	Baseline condition	• Deforested land or degraded forest to implement restoration of carbon stock on a protection or reserved forest without the local government approval
2	Project technology or practice *(employed by the project)*	• Woody biomass and litter (includes leaves, branches, deadwood) has been removed[7] or transported out[8] within the last 10 years and during the first 10 years after project initiation, unless credible evidence is provided demonstrating that the clearing was not conducted with the intent of generating GHG credits • Burning of significant stocks of pre-existing dead wood. (Note: Refer to Annex A2 for the calculation of materiality threshold)
3	Forest clarification	• Projects involving Production Forest are ineligible for ARR Methodology, as they are classified under IFM Methodology; • Projects that pertain to Primary Forest are ineligible for ARR Methodology, as they are classified under REDD Methodology
4	Legal right and ownership	Land with unclear, contested or lacking consent cannot be reliably monitored, reported or verified

4 Project Boundary

This section defines the spatial and temporal boundaries within which ARR project activities are implemented and monitored under the FCO framework. Establishing a clear project boundary is essential to ensure transparency, consistency, and credibility in the quantification of GHG emission reductions and removals.

4.1 Geographical Boundaries

Geographical boundaries refer to the clearly defined physical area in which the project is implemented. This includes the land parcels or forest areas where activities take place. The boundaries are essential as it delineates the spatial scope of the project, ensuring that carbon accounting is accurate, verifiable, and not double-counted across overlapping projects. The geographical boundaries for this Methodology are as follows:

[7] *Afforestation, Reforestation and Revegetation (ARR) projects*
[8] *International Civil Aviation Organization (ICAO) Carbon Offsetting and Reduction, Re-application Form for Emissions Unit Programmes seeking eligibility to supply units to the CORSIA first phase (2024 – 2026 compliance period), (Version 1, February 2023)*

Project Area	The project area may consist of more than one discrete area of land, and the following information must be provided for each discrete area: 1) Name of project area (including compartment numbers and local name, if applicable); 2) Unique identifier for each discrete area of land; 3) Map(s) of the area (preferably in digital format); 4) Geographic coordinates of each parcel, along with documentation of accuracy (from a geo-referenced digital map); 5) Total land area; 6) Details and documentation of land rights holder and user rights. The project proponent must identify project location including geographic coordinate, as well as a legal land use certificate[9].
Site History Assessment	Proponents shall review historical records, topographic maps, satellite imagery, and other relevant documentation to understand the baseline conditions and the trajectory of land degradation or transformation prior to project implementation. This analysis must include the identification of previous land cover types, anthropogenic land use changes, disturbance regimes, and soil characteristics, which are critical for establishing the reference scenario and selecting suitable native or naturalised species for ARR.

4.2 Stratification

In a homogenous environment, stratification is conducted to improve the accuracy and precision of biomass estimates, different stratification method may be required for the baseline and project scenarios to optimally estimate net GHG removals by sinks.

For estimation of baseline net GHG removals by sinks or actual net GHG removals by sinks, strata should be defined based on parameters that are key entry variables in any method (i.e. growth models or yield curves/tables) used to estimate changes in biomass stocks.

As for inland wetlands such as peat swamp forest, reference may be made to the suggested combined-methodology scenario outlined in Section 2.1 above.

The following parameters shall be used to define strata within ARR project areas:

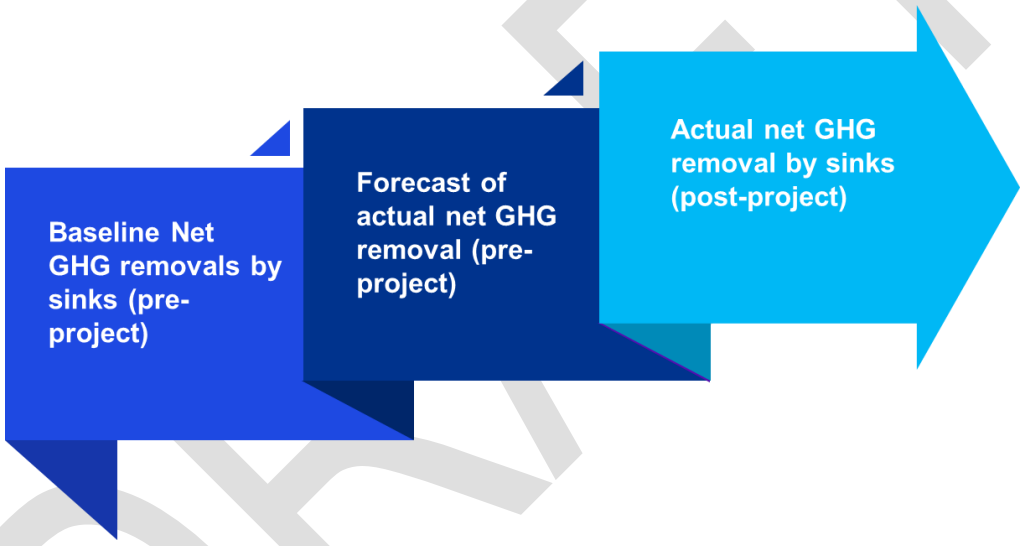
Soil type	In cases where the project area includes organic soils, such areas must be delineated and treated as a separate stratum. These soils have unique carbon dynamics and require specific monitoring and management protocols. Project developers are required to ensure that all applicability conditions of this Methodology are fully met within that stratum.
Disturbance history	Historical and recent disturbances (e.g., fire, logging, pest outbreaks) significantly influence biomass recovery and must be considered in stratification. Areas affected by such events should be stratified separately and monitored for changes in carbon sequestration trends. Areas under different land use histories (e.g., abandoned agricultural land, logged-over forest) or forest management must also be stratified accordingly.

[9] *Application Form for Emissions Units Programs*

Ecological zones	Stratification should reflect Malaysia's diverse ecological zones, including lowland dipterocarp forests, hill dipterocarp forests, upper dipterocarp forests, montane forests, and ericaceous forest. These zones differ in species composition, growth rates, and carbon storage capacity. Strata must also be delineated based on dominant vegetation classes (e.g., grassland, shrubland, secondary forest) and canopy density. This reflects differences in biomass accumulation potential and aligns with IPCC and forest definitions.

Project developers shall acquire these parameters by utilising recent remote sensing data, preferably acquired near the commencement of the project or following significant natural or anthropogenic events, to inform both initial (ex-ante) and subsequent (ex-post) stratification processes.

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)

Stratification should be conducted based on the area's predominant vegetation types (e.g., grassland, bushland), crown cover, and historical land use. This approach reflects the expected carbon stock in the absence of project intervention. It is generally assumed that baseline removals on degraded or degrading lands are minimal compared to those achieved through project activities.

2. Forecast of actual net GHG removal (pre-project)

Stratification shall be based on:

- The area's major vegetation types, which influence initial biomass levels and growth potential; and
- The proposed planting and forest management plan, which outlines species selection, planting density, and silvicultural practices.

This stratification enables the application of appropriate growth models tailored to each stratum's characteristics, thereby improving the accuracy of projected carbon sequestration.

3. Actual net GHG removal by sinks (post-project)

Following project implementation, stratification must be updated to reflect the actual conditions on the ground. This includes:

- Ex-Ante Stratification: Initially based on the intended planting and forest management plan as submitted in the project design documentation.
- Ex-Post Stratification: Revised to align with the actual implementation of planting and management activities. This ensures that monitoring and reporting are based on real, rather than planned, interventions.
- Adjustment for Disturbances: In the event of natural (e.g., fire, storms, pest outbreaks) or anthropogenic (e.g., harvesting, replanting) disturbances that significantly alter biomass growth patterns, strata must be redefined or adjusted accordingly. This dynamic approach ensures that carbon accounting remains accurate and reflective of on-the-ground realities.

4.3 Temporal Boundaries

Temporal boundaries refer to the timeframe in which a project starts and ends as well as the period in which emissions reductions/ removals are measured, monitored and credited. These boundaries are important because it sets and documents the period in which the activity will take place ensuring the accuracy and credibility of the project.

The project proponent must meet the following criteria:

- The crediting period may commence from the start of planting activities and can be retroactively applied for up to two years prior to the official project registration date.
- Further detail for crediting period may refer to FCO Subsidiary Guideline.

4.4 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 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. Note that, for inland wetlands such as peat swamp forest, the carbon pools and GHG emission sources may refer to other Wetland Ecosystem methodology (i.e. Rewetting & Fire management) based on suggested PSF condition in Section 2.1 above.

Table 5: Selected carbon pools for this Methodology

	Carbon Pool	Description
Include	Above-ground woody biomass	Included due to its direct and measurable response to implementation of project activity with increased vegetation growth and carbon uptake via photosynthesis
	Above-ground non-woody biomass	Included for its role in long-term carbon storage through root biomass expansion, which correlates with above-ground biomass development in tropical ecosystems

	Carbon Pool	Description
	Below-ground woody biomass	Included since it is expected to increase due to implementation of project activity
	Below-ground non-woody biomass	Included if the project activity significantly reduces the carbon pool. For other cases, this carbon pool is optional.
	Dead wood	Optional, this pool may increase over time as vegetation matures and natural mortality occurs. It contributes to long-term carbon storage and reflects ecosystem development
	Litter	Optional, unless project activities are expected to significantly reduce its stock, in which case its inclusion is required. Project activity that enhances canopy cover and vegetation increase litterfall, contributing to surface carbon accumulation and nutrient cycling. Including this pool supports the assessment of early-stage ecosystem recovery and carbon dynamics.
	Soil organic carbon (SOC)	Included if soil disturbance from the project activity during site preparation: 1) Occurs more than once during the project crediting period at site preparation; or 2) Involve soil inversion to a depth exceeding 25 cm (e.g., that would result from a moldboard plow). Optional when project activities do not involve significant soil disturbance. However, ARR interventions that enhance root biomass, increase organic matter inputs, and maintain or improve soil structure can lead to gradual SOC accumulation. In such cases, SOC becomes a valuable indicator of long-term ecosystem restoration and carbon sequestration potential.
Exclude	Harvested wood products	Excluded, it represents a stored carbon pool that is not directly emitted as a result of the ARR activity.

4.5 GHG Emission Sources

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

Table 6: Selected GHG emission sources for this Methodology

	Sources	Gas	Included	Description
Baseline	Burning of woody biomass	CO_2	✗	Conservative to exclude
		CH_4	✗	Conservative to exclude
		N_2O	✗	Conservative to exclude
	Emission from nitrogen fertiliser	CO_2	✗	Conservative to exclude
		CH_4	✗	Conservative to exclude
		N_2O	✗	Conservative to exclude
	Burning of fossil fuels	CO_2	✗	Conservative to exclude
		CH_4	✗	Conservative to exclude
		N_2O	✗	Conservative to exclude
Project	Burning of woody biomass (natural or anthropogenic causes)	CO_2	✗	CO_2 emissions resulting from the combustion of biomass are reported as a decrease in carbon stock. The carbon contained in biomass originates from atmospheric CO_2 and is temporarily stored in living biomass. Upon combustion, this stored carbon is released back into the atmosphere, thereby reducing the overall carbon stock
		CH_4	✓	CH_4 is included as a significant emission source due to its potential release during biomass burning, soil disturbance, and decomposition of organic matter under anaerobic conditions
		N_2O	✓	N_2O is included as a significant emission source due to its potential release from soils following land-use change, particularly through

Sources		Gas	Included	Description
				soil disturbance, organic matter inputs, and fertilizer application
	Emission from nitrogen fertiliser	CO_2	✗	Conservative to exclude
		CH_4	✗	Conservative to exclude
		N_2O	✓	May be a significant source
	Burning of fossil fuels	CO_2	✓	Use of fossil fuel in machines used for as part of forest management and reforestation such as site preparation must be used for GHG emission calculation of a large-scale project
		CH_4	✗	De minimis / Insignificant source
		N_2O	✗	De minimis / Insignificant source

5 Baseline and Additionality

This section outlines the procedures for establishing and reassessing the baseline scenario and demonstrating additionality for ARR projects 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.

5.1 Baseline Determination and Additionality Assessment

The baseline scenario represents the most likely land use or management practices that would occur in the absence of the project. It serves as the reference point for estimating GHG emissions or removals.

To determine and justify this scenario, Project Proponents should refer to the **FCO Tool : Baseline Determination and Additionality Assessment.** This standardised tool guides Project Proponents through a series of steps to ensure that the selected baseline is realistic, evidence based and conservative.

5.2 Reassessment of Baseline Scenario

The baseline scenario must be **reassessed every 5 years,** or earlier if there are significant changes observed, to account for any changes in the underlying drivers or agents influencing land use, degradation, and carbon stocks for the duration of Crediting Period. 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

At each re-assessment, regeneration must be compared to the regeneration assumptions from baseline, to determine whether seedlings per hectare varies from assumptions. If number of seedlings per hectare exceeds baseline estimate by more than 10%, and more than 10 trees per hectare, the baseline scenario must be modified to better reflect observed values.

6 Quantification of Estimated GHG Reductions and Removals

This section outlines the Methodology for calculating the GHG emission reductions achieved through ARR 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 ARR interventions in place).

6.1 Baseline Emissions

The baseline quantification is for estimating carbon stock and change in carbon stock in the biomass carbon pools for this Methodology. The detailed calculation methods for each carbon stock can be found in **FCO Tool: GHG Quantification Equations.**

To quantify the estimated GHG reductions and removals for baseline emissions is as follow:

$$\Delta C_{BSL,t} = \sum_{t}^{t*} (\Delta C_{TREE\_BSL,t} + \Delta C_{SAP\_BSL,t} + \Delta C_{DW\_BSL,t} + \Delta C_{LI\_BSL,t}) \times A_i \quad \textbf{(1)}$$

Where:

Variable	Description	Unit
$\Delta C_{bsl,t}$	Baseline net GHG removals by sinks in year t	$tCO_2e\ yr^{-1}$
$\Delta C_{TREE\_BSL,t}$	Change in carbon stock in baseline tree biomass within the project boundary in year t	$tCO_2e\ yr^{-1}$
$\Delta C_{SAP\_BSL,t}$	Change in carbon sink in baseline sapling within the project boundary in year t	$tCO_2e\ yr^{-1}$
$\Delta C_{DW\_BSL,t}$	Change in carbon stock in baseline dead wood biomass within the project boundary, in year t	$tCO_2e\ yr^{-1}$
$\Delta C_{LI\_BSL,t}$	Change in carbon stock in baseline litter biomass within the project boundary, in year t	$tCO_2e\ yr^{-1}$
A_i	Area of stratum *i*	hectare
t	1, 2, 3 …t^* years elapsed since the project start date	year

The total baseline emissions are then calculated as the sum of all baseline emissions per stratum i in the eligible project areas, as follows:

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

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

6.2 Project Emissions

Project emissions, similarly, to the baseline emissions shall be determined for estimating carbon stock and change in carbon stock in the biomass carbon pools for this Methodology. The detailed calculation methods for each carbon stock can be found in **FCO Tool: GHG Quantification Equations.**

To quantify the estimated GHG reductions and removals for project emissions is as follow:

$$\Delta C_{P,t} = \sum_{t}^{t*} (\Delta C_{TREE_{P\_L},t} + \Delta C_{SAP\_P,t} + \Delta C_{DW\_P,t} + \Delta C_{LI\_P,t} + \Delta SOC_{P,t}) \times A_i \quad \textbf{(3)}$$

Where:

Variable	Description	Unit
$\boldsymbol{\Delta C_{P,t}}$	Change in the carbon stocks in project, occurring in the selected carbon pools, in year	$tCO_2e\ yr^{-1}$
$\boldsymbol{\Delta C_{TREE_{P\_L},t}}$	Change in the carbon stocks in tree biomass in project in year t	$tCO_2e\ yr^{-1}$
$\boldsymbol{\Delta C_{SAP\_P,t}}$	Change in the carbon stocks in sapling in project in year t	$tCO_2e\ yr^{-1}$
$\boldsymbol{\Delta C_{DW\_P,t}}$	Change in the carbon stocks in dead wood in project in year t	$tCO_2e\ yr^{-1}$
$\boldsymbol{\Delta C_{LI\_P,t}}$	Change in carbon stock in litter in project in year t (alternative) in year t	$tCO_2e\ yr^{-1}$
$\boldsymbol{\Delta SOC_{P,t}}$	Change in carbon stock in SOC in project, in year t	$tCO_2e\ yr^{-1}$

The amount of change estimation for GHG emissions from biomass burning, fossil fuel use or from the use of nitrogen-based fertiliser in the baseline need to be included in the equation, in the event

that the implementation of the project significantly reduces GHG emissions from the baseline or may be set to zero according to conservative guidelines.

The sum of all project emissions per stratum i in the eligible project areas, as follows:

$$GHG_{FCO} = \sum_{i=1}^{M} GHG_{Burning\_FCO,t} + GHG_{Fuel\_FCO,t} \quad \textbf{(4)}$$

Where:

Variable	Description	Unit
GHG_{FCO}	Additional GHG emission from project activities in year t	tCO_2e
$GHG_{Burning\_FCO,t}$	GHG emission from project activities' biomass burning in year t	tCO_2e
$GHG_{Fuel\_FCO,t}$	GHG emission from project activities' fossil fuel use in year t	tCO_2e

6.3 Leakage Emissions

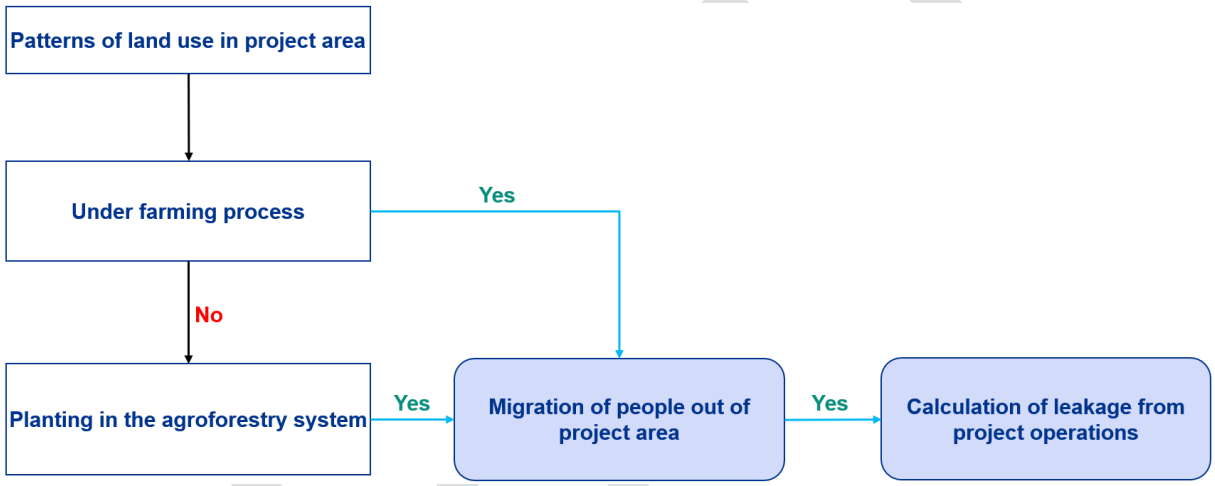
This section provides a standardized approach to quantify additional greenhouse gas (GHG) emissions ("leakage") that arise when agricultural activities displaced by a forest project expand into areas outside the project boundary. It applies to both the baseline (business-as-usual) and project scenarios.

Table 7 Summary for leakage emission

No.	Aspects	Description
1	Applicability of Leakage	Leakage in the context of ARR activities considers the following circumstances: • Applicable when a project's implementation directly or indirectly forces pre-project farming, settlement, or related activities to relocate to new areas. • Excludes indirect market impacts (e.g., price or demand shifts), which are deemed insignificant and set to zero.
2	Important Parameters for Leakage	Leakage emissions are calculated based on net losses in carbon stocks outside the project boundary, considering both: • Above-ground biomass and below-ground biomass changes arising from newly cleared/displaced agricultural land. • Soil organic carbon changes in those areas.
3	Leakage Estimation Steps	1 **Assess displacement effect:** Confirm whether relocated agricultural activities would emit more GHG than the original land use.

No.	Aspects	Description
		2 **Calculate biomass change:** Estimate carbon stock differences in vegetation and dead organic matter outside project boundaries. 3 **Calculate soil carbon change:** Evaluate difference in soil organic carbon stocks caused by land-use change; if results are positive (i.e., soil gains carbon), set ΔSOC_{LUC} to zero. 4 **Aggregate and convert to CO_2e:** Sum above and below contributions and apply the 44/12 conversion factor.

Figure 5 Leakage flowchart



Thus, quantification steps to calculate leakage for this Methodology is as follow:

$$LK_{AGR,t} = \frac{44}{12} \times (\Delta C_{BIOMASS,t} + \Delta SOC_{LUC,t}) \quad \textbf{(5)}$$

$$\Delta C_{BIOMASS,t} = \left[1.1 \times b_{TREE_{ABG}} \times (1 + R_{TREE}) + b_{SAP_{ABG}} \times (1 + R_{SAP})\right] \times CF \times A_{DISP,t} \quad \textbf{(6)}$$

$$\Delta SOC_{LUC,t} = SOC_{REF} \times (f_{LUP} \times f_{MGP} \times f_{INP} - f_{LUD} \times f_{FGD} \times f_{IND}) \times A_{DISP,t} \quad \textbf{(7)}$$

Where:

Variable	Description	Unit
$LK_{AGR,t}$	Leakage due to the displacement of agricultural activities from project activities in year *t*	tCO_2e
$\Delta C_{BIOMASS,t}$	Changes in carbon stock in carbo outside project boundaries affected by project activities in year *t* The number 1.1 is a constant used to calculate the total biomass of dead wood and plant waste as a percentage relative to the tree biomass.	t C
CF	Carbon fraction of tree biomass	
$A_{DISP,t}$	Agricultural area arising from the displacement of project activities in year *t*	ha
$b_{TREE_{ABG}}$	Mean above-ground biomass of trees in agricultural areas arising from displacement from project activities	ton dry weight/ha
R_{TREE}	Root-shoot ratio of tree	Dimensionless
$b_{SAP_{ABG}}$	Mean above-ground biomass of sapling in agricultural areas arising from displacement from project activities	ton dry weight/ha
R_{SAP}	Root-shoot ratio of sapling	Dimensionless
$\Delta SOC_{LUC,t}$	Changes in soil carbon stock caused by changes in land use outside the project before project initiation (tons of carbon). In the event that the value obtained from the assessment is less than 0 (meaning that the area outside the project scope has increased soil carbon accumulation after the project implementation)	Set to 0
SOC_{REF}	Carbon accumulated in the soil outside the project area prior to the project commencement	t C/ha
f_{LUP}	Coefficient of change in carbon stock in soil outside the project area according to land use before project initiation	
f_{MGP}	Coefficient of change in carbon stock in soil outside the project area according to land management method before project initiation	
f_{INP}	Coefficient of change in carbon stock in soil outside the project area according to the level of organic matter returned to the soil before the project initiation	

Variable	Description	Unit
f_{LUD}	Coefficient of change in carbon stock in soil outside the project area by land use after project activity	
f_{MGD}	Coefficient of change in carbon stock in soil outside the project area according to land management method after project activities	
f_{IND}	Coefficient of change in carbon stock in soil outside the project area according to the level of organic matter returned to the soil after the project activities	
t	1, 2, 3, … year since project initiation	

The calculation of carbon stock in soil can be done by referring to **FCO Tool: GHG Quantification Equations.**

6.4 Net Emission Reductions and Removals

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

$$NER = GHG_{FCO} - GHG_{BSL} - GHG_{LK} \quad \textbf{(8)}$$

Where:

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

6.5 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.**

6.6 Calculation of Forest Carbon Units

The calculation of Forest Carbon Units issued must account for the buffer credits deposited in the FCO Buffer Account.

The number of FCU is calculated as follows:

$$FCU_{t2} = (adj\_NER_{t2} - adj\_NER_{t1}) * (1 - Buffer\_Factor_{t2}) \quad \textbf{(9)}$$

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

7 Monitoring

This chapter outlines the monitoring framework required to ensure the accuracy, transparency, and credibility of GHG emission reductions and removals in ARR projects. It provides guidance on the development of a monitoring plan, including procedures for data collection, quality assurance/quality control (QA/QC), and data archiving.

7.1 Monitoring Plan

Project Proponents must develop a Monitoring Plan, which outlines the procedures for measuring and verifying the project's carbon sequestration and emissions reductions, which contain at least the following:

- Description of each monitoring task to be undertaken
- Parameters to be measured
- Data to be collected and data collection techniques
- Frequency of monitoring
- Quality assurance and quality control procedures
- Data archiving procedures
- Roles, responsibilities and capacity of monitoring team and management

Proponents must ensure continued compliance with the applicability conditions throughout the project crediting period.

Monitoring shall incorporate satellite-based remote sensing (e.g., SPOT5, Landsat) for forest cover assessment and disturbance detection, including fire and illegal logging. Image processing must follow standardized workflows (e.g., NDVI, NDBSI, supervised classification). Physical monitoring shall include geofencing, ground patrols, and community-based reporting, supported by national enforcement and disaster response systems.

7.2 Data and Parameters

7.2.1 Data and Parameters at Validation

Data/Parameter	R
Data unit	Dimensionless
Description	Root to Shoot ratio (i.e., ratio of belowground (root) biomass to aboveground biomass, per unit area or per stem)
Equation number	(1.2.1.3)
Source of Data	For projects involving natural regeneration or mixed-species stands, R values should be sourced in the following order of preference: (1) region-specific values based on the same forest type and ecoregion or Holdridge life-zone, or (2) global values specific to the forest type, such as those provided in the 2019 Refinement to the 2006 IPCC Guidelines. For monoculture plantations, R values should be selected based on species, genus, or family, prioritizing data from the same ecoregion or Holdridge life-zone. If regional data is unavailable, global values may be used, provided they are derived from or validated with destructive sampling data from similar ecological zones.
Purpose of data	Calculation of project emissions

Data/Parameter	CF
Data unit	t C/t d.m.
Description	Carbon fraction of dry biomass
Equation number	(1.2.1.3)
Source of Data	IPCC 2006 Guidelines for National Greenhouse Gas Inventories
Purpose of data	Calculation of project emissions

Data/Parameter	EF_{N20}
Data unit	t C ha^{-1}
Description	Emission factor for gas N_2O
Equation number	(2.1.3)
Source of Data	Table 2.5, Chapter 2, Volume 4 of the IPCC 2006 Guidelines for National Greenhouse Gas Inventories (see Appendix 2: Emission factors for various types of burning for CH4 and N2O)
Purpose of data	Calculation of project emissions

Data/Parameter	EF_{CO2i}
Data unit	tCO_2/GJ
Description	Emission factor of CO_2 from the fuel type *i* combusted
Equation number	(2.2.1.1)
Source of Data	Table 2.5, Chapter 2, Volume 4 of the IPCC 2006 Guidelines for National Greenhouse Gas Inventories (see Appendix 2: Emission factors for various types of burning for CH4 and N2O)
Purpose of data	Calculation of project emissions

Data/Parameter	$EF_{CH4,m}$
Data unit	G CH_4 (kg dry matter burnt)$_{-1}$
Description	Emission factor for CH_4 in stratum *m*
Equation number	(2.3.3.1.1)
Source of Data	Table 2.5, Chapter 2, Volume 4 of the IPCC 2006 Guidelines for National Greenhouse Gas Inventories (see Appendix 2: Emission factors for various types of burning for CH4 and N2O)
Purpose of data	Calculation of project emissions

Data/Parameter	$EF_{N2O,m}$

Data unit	G N_2O (kg dry matter burnt)$^{-1}$
Description	Emission factor for N_2O in stratum *m*
Equation number	(2.3.3.1.1)
Source of Data	Table 2.5, Chapter 2, Volume 4 of the IPCC 2006 Guidelines for National Greenhouse Gas Inventories (see Appendix 2: Emission factors for various types of burning for CH4 and N2O)
Purpose of data	Calculation of project emissions

Data/Parameter	GWP_{N20}
Data unit	Dimensionless
Description	Global warming potential of nitrous oxide Default factor from UNFCCC = 310
Equation number	(2.1.3), (2.3.3.1)
Source of Data	Default factor from the latest IPCC Assessment Report
Purpose of data	Calculation of project emissions

Data/Parameter	GWP_{CH4}
Data unit	Dimensionless
Description	Global warming potential of methane Default factor from UNFCCC = 21
Equation number	(2.3.3.1)
Source of Data	Default factor from the latest IPCC Assessment Report
Purpose of data	Calculation of project emissions

7.2.2 Data and Parameters Monitored

Data/Parameter	$A_{BURN,m,t}$
Data unit	ha
Description	Area burnt in stratum *m* in year t

Equation number	(2.3.3.1)
Source of Data	Calculated from GIS data
Purpose of data	Calculation of project emissions

Data/Parameter	SOC_{REF}
Data unit	tC ha^{-1}
Description	Reference soil organic carbon stock
Equation number	(1.5.2)
Source of Data	Field measurements
Purpose of data	Calculation of project emissions

8 General References

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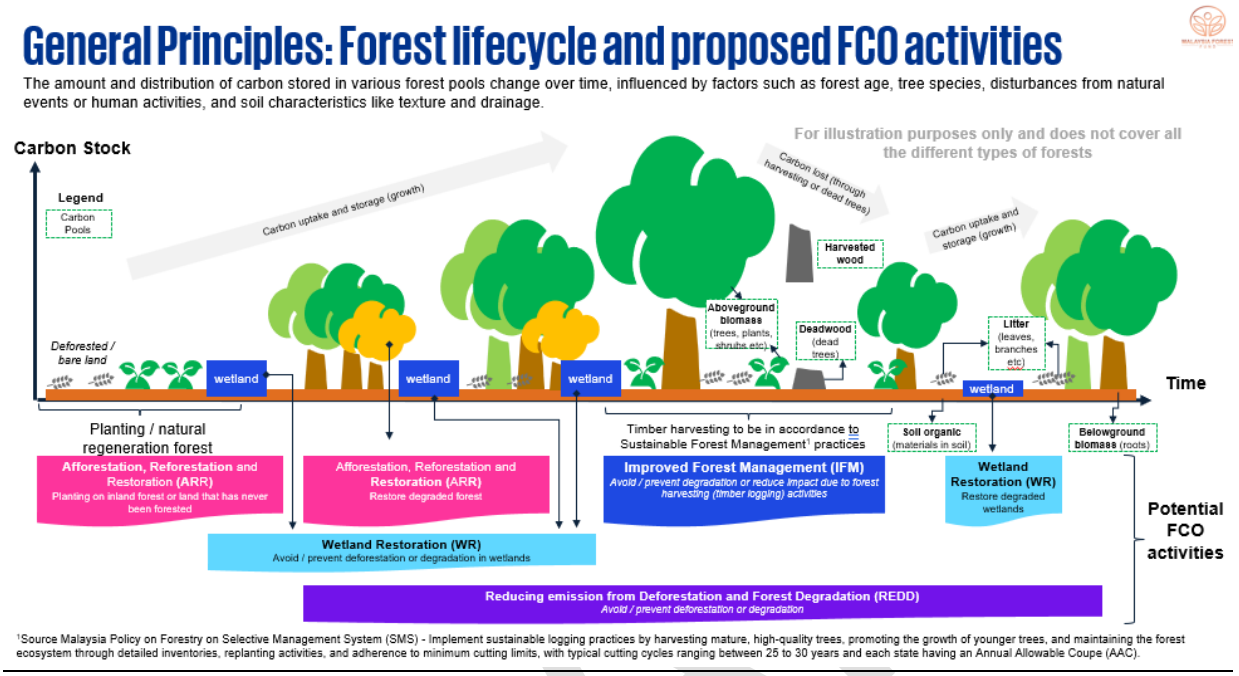
9 Annex

A1. General Principles of Forest Lifecycle



A2. Materiality threshold

Significance Threshold

A carbon pool or emission source may be considered **insignificant** and excluded from quantification if:

- Its relative contribution to the total GHG emissions (including project and leakage emissions) and/or decreases in carbon pools is **less than 5%**, or
- Its contribution is **less than 5% of the total carbon dioxide removals**, whichever is smaller.

Calculation Methodology

The relative contribution of each emission source or carbon pool is calculated using the following formula:

$$RC_{ES} = \frac{Es}{\sum_{s=1}^{S} ES}$$

Where:

- *RCEs* = Relative contribution of emission source or carbon pool (s)
- *Es* = Emissions or decreases in carbon pools from source (s)
- s = Total number of emission sources and carbon pool decreases

Ranking and Cumulative Assessment

1. Rank all emission sources and carbon pool decreases in **descending order** based on their relative contributions *RCEs*.
2. Begin summing the relative contributions from the **lowest-ranked** (least significant) source.
3. Continue the summation until the **cumulative total equals or exceeds 95%** of the total emissions and decreases.
4. Any remaining sources not included in the cumulative sum are considered **insignificant**, provided their **combined contribution is less than 5% of total carbon dioxide removals**.

If this condition is not met, continue the summation beyond the 95% threshold until the criterion is satisfied.