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Guidance Document on typical approaches for estimating emission reductions from IKI project activities

AFOLU Sector

Version 1 (February 2024)

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Table of Contents

Figures

Tables

Boxes

List of Abbreviations

AFOLU	Agriculture/Forestry/Other Land Use
A/R	Afforestation/Reforestation
BAU	Business-as-Usual
BCS	Baseline carbon stock enhancement
BE	Baseline emissions
CDM	Clean Development Mechanism
CH_4	Methane
CO_2e	Carbon dioxide equivalents
CSE	Carbon stock enhancement
EF	Emission factor
ER	Emission reductions
GEF	Global Environment Facility
GHG	Greenhouse gas emissions
GHGP	GHG Protocol
GS	Gold Standard
IKI	International Climate Initiative
IPCC	Intergovernmental Panel on Climate Change
LE	Leakage emission
N_2O	Nitrous oxide
PCS	Project carbon stock enhancement
PE	Project emissions
REDD	Reducing Emissions from Deforestation and Forest Degradation
SI 1	Standard Indicator 1
VCS	Verified Carbon Standard

1 Introduction and purpose

The International Climate Initiative (IKI) has been using Standard Indicators since 2015 to assess the effects and results of its portfolio. In 2021, these indicators were revised to provide more precise information on IKI results and improve the data quality. Since 2022, all new IKI projects are required to use this revised set of Standard Indicators[1].

An important change relates to Standard Indicator 1 - Mitigation (SI 1 - Mitigation) with stricter requirements for IKI projects. SI 1 - Mitigation measures the degree to which IKI project activities contribute to reducing greenhouse gas emissions (GHG) during project implementation, i.e. projects must transparently present assumptions and parameters for target and actual values in metric tonnes of CO_2 equivalents (CO_2e).

IKI projects have the potential to lead to GHG reduction or the enhancement of carbon stocks in various sectors. To support IKI projects to identify typical approaches for estimating emission reductions / carbon stock enhancements, the IKI Standard Indicator Helpdesk provides several guidance documents for the most relevant sectors / mitigation areas: Energy, Agriculture/Forestry/Other Land Use (AFOLU), Buildings and Transport.

This Guidance Document on **AFOLU** presents typical approaches for estimating *emission reductions* and *carbon stock enhancements* from IKI project activities in the AFOLU sector. Through two fictitious projects, one on *methane emission reduction in rice cultivation* and one on *afforestation*, the methodological approaches are explained in detail and provide further guidance for IKI implementing organisations. This Guidance covers the following points:

(1) Common understanding of direct and indirect mitigation,
(2) typical emission sources for emission reduction activities / measures in the target sector,
(3) typical baseline and project scenario (and leakage emissions, if applicable),
(4) calculation of emission reductions / carbon stock enhancements, illustrated with sample calculations using the IKI Standard Indicator Report (Excel Tool), and
(5) relevant default values and reference sources are provided, incl. tips for helpful resources and other tools in the respective sector.

This Guidance Document complements the Guidelines on Project Planning and Monitoring in the International Climate Initiative - Version 2. In the Guidelines the guidance sheet on Standard Indicator 1 - Mitigation (Section 6.2.1) includes helpful methodological guidance on estimating projects' direct or indirect GHG emission reductions / carbon stock enhancements. Additional guidelines and online seminars regarding the estimation of GHG reductions / carbon stock enhancements are available on the IKI website. Further helpful information on mitigation estimation can be found in the Mitigation Action Facility Mitigation Guideline (2023)[2], which has also been used for this document.

[1] IKI Monitoring and Evaluation (M&E) Unit (2023): Guidelines on Project Planning and Monitoring in the International Climate Initiative. Version 2; Chapter 6.1. Retrieved from here.

[2] Mitigation Action Facility (2023): Mitigation Action Facility Mitigation Guideline (Outline & Proposal Phase). Retrieved from here, and Mitigation Action Facility (2023): Mitigation Guideline for the Project Concept Phase. Retrieved from here.

2 IKI understanding of direct and indirect mitigation

Within SI 1 - Mitigation, the IKI differentiates between direct and indirect GHG mitigation, which need to be reported quantitatively in tonnes of CO_2e. In addition, the Standard Indicator also captures qualitative information related to potential long-term mitigation impacts of enhanced policy frameworks.

Box 1: Differentiation between direct and indirect GHG mitigation

Direct mitigation: GHG emission reduction / carbon stock enhancement through financing of mitigation measures

Direct GHG emission reduction / carbon stock enhancement refers to the amount of CO_2e reduced, avoided, or sequestered immediately through mitigation measures that are (partly) financed by the IKI project or measures.

Indirect mitigation: GHG emission reduction / carbon stock enhancement through technical support of mitigation measures

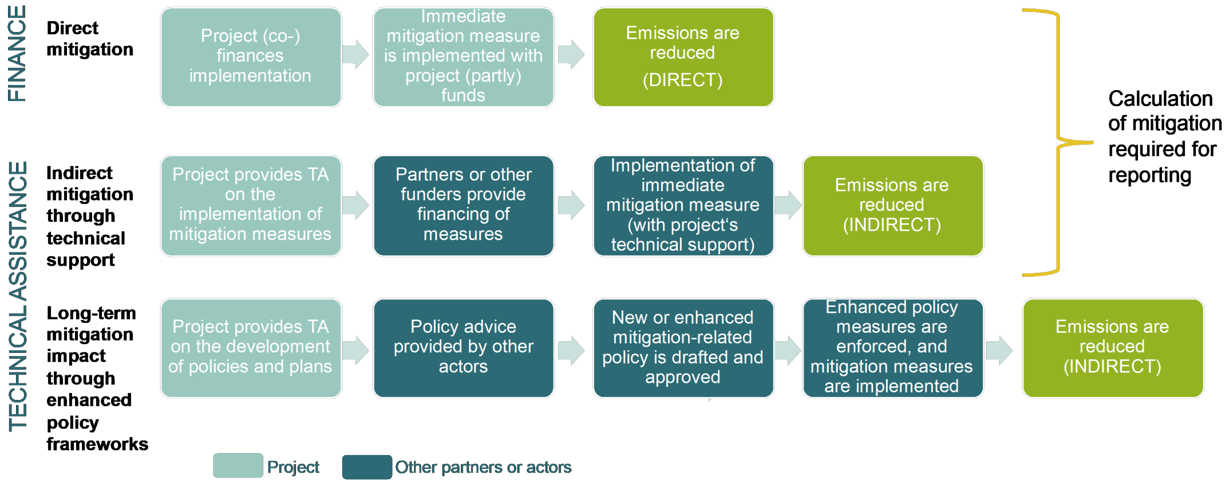
Indirect GHG emission reduction / carbon stock enhancement refers to an amount of CO_2e reduced, avoided, or sequestered with the help of IKI-funded technical assistance or capacity development measures. This includes cases where a physical mitigation measure was financed by an actor other than the IKI (e.g., a city government in a partner country) but where the IKI delivers crucial technical implementation support.

Enhanced policy frameworks: Long-term mitigation impact through enhanced policy frameworks

This category captures substantial contributions of IKI projects to new or improved policies, strategies or plans that are expected to lead to substantial long-term mitigation impacts in the future if they are fully implemented. In order to report on this category, projects need to plausibly contribute to an improvement in policy frameworks that increases the potential long-term mitigation impact of the policy. This can be achieved through more ambitious but realistic targets or through increasing the feasibility of implementing the policy framework.

Figure 1 illustrates simplified causal chains for each of the categories. Further details and examples for each category of mitigation action can be found in the SI 1-Indicator Guidance Sheet in Guidelines on Project Planning and Monitoring in the International Climate Initiative - Version 2.

Figure 1: Simplified causal chain for reporting categories in SI 1



IKI projects can only report on the Standard Indicator, if the contributions to mitigation fall within any of the three reporting categories defined above: direct / indirect mitigation / potential future GHG emission reductions / carbon stock enhancement through enhanced policy frameworks. Projects should indicate whether and how they contribute to direct and/or indirect mitigation and shall provide separate estimates for these in the respective sheets for Standard Indicator 1 in the **IKI Standard Indicator Report (Excel Tool)** available here on the IKI website. Regarding the long-term mitigation impact through enhanced policy frameworks, projects are not asked to calculate projected future emissions reductions / carbon stock enhancements resulting from policy implementation. Projects are expected to name the policy frameworks they address and explain how they contribute to strengthening the mitigation potential of these policies.

The following chapters focus on the estimation of emission reductions / carbon stock enhancements which can be used for direct and indirect mitigation.

3 Typical emission reduction and carbon stock enhancement activities in the AFOLU sector

The AFOLU sector plays a substantial role in global GHG emissions, comprising around 22% of the total emissions.[3] Sources of GHG emissions within the AFOLU sector encompass for instance the release of CH_4 emissions from animal husbandry, N_2O emissions from fertilisation and CO_2 and CH_4 emissions arising from the combustion or decomposition of biomass.

At the same time, the AFOLU sector represent a significant carbon sink. Therefore, climate change mitigation in the AFOLU sector can be achieved through both **emission reduction** and **carbon stock enhancement** activities.

Different management practices can be implemented to reduce GHG emissions in the AFOLU sector or enhance carbon sinks. These include for instance:[4]

- **Reducing emissions from agriculture**, e.g.
  - Cropland nutrient management, e.g. reduced fertiliser application rate enables to reduce N_2O emissions;
  - Reduced N_2O from manure left on pasture;
  - Manure management, e.g. through capture of methane from existing manure management system can reduce CH_4 emissions;
  - Improved Agricultural Land Management Practices, e.g. Improved Rice Cultivation: Implementation of alternate wetting and drying irrigation practice instead of continuous flooding reduces CH_4 emissions;
  - Reduced enteric fermentation, e.g. through improved feeding can reduce CH_4 emissions.
- **Reducing emissions from forests and other ecosystems**, e.g.
  - Prevention of deforestation;
  - Prevention of forest degradation;
  - Prevention of conversion, draining, burning of peatlands;
  - Prevention of conversion of coastal wetlands (mangroves, seagrass, marshes);
  - Avoiding conversion of savannahs and natural grasslands
- **Enhancing carbon sinks**, e.g.
  - Afforestation/Reforestation (A/R)
  - Improved Forest Management
  - Agroforestry
  - Peatland restoration
  - Coastal wetland restoration
  - Soil carbon sequestration in croplands and grazing lands
  - Biochar application to soils

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[3] IPCC (2022): Climate Change 2022: Mitigation of Climate Change. Contribution of Working Group III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. Retrieved from here.

[4] IPCC (2019): Technical Summary. In: Climate Change and Land: an IPCC special report on climate change, desertification, land degradation, sustainable land management, food security, and greenhouse gas fluxes in terrestrial ecosystems. Retrieved from here.

A crucial aspect of such projects is to address the **risk of reversals**. Reversals occur when previously stored carbon is released back into the atmosphere, potentially undoing the benefits of carbon sequestration achieved in previous years. This risk highlights the need for careful planning and management of AFOLU projects to ensure long-term benefits and stability.

Understanding Reversals and Permanence

- Reversals: They are significant because they can negate the positive impact of carbon sequestration. For instance, if a forest planted for carbon stock enhancement is later destroyed by fire or logging, the stored carbon is released, reversing the benefits.
- Permanence: It refers to how long the increased carbon stock remains stable in the ecosystem, whether in soil or vegetation. The goal is to make sure this carbon stays stored for as long as possible.

Certain types of mitigation activities have different risks and permanence levels. For example, avoiding nitrous oxide (N_2O) emissions from fertilizer use is effectively permanent since once these emissions are prevented, they cannot be re-emitted. In contrast, carbon sinks created through activities like afforestation/reforestation or enhancing agricultural soil carbon are more vulnerable to reversals.

In addition to addressing the risk of reversals, it is important to ensure that AFOLU projects do not harm **natural ecosystems**. The goal of these projects is not only to reduce emissions and enhance carbon storage but also to maintain or improve the health and diversity of local ecosystems. One critical concern is avoiding the creation of monocultures, where a single type of crop or tree is planted extensively over a large area. While monocultures might seem efficient for e.g. forest carbon stock enhancement, they can have adverse effects on ecosystems.

These include:

- Reduced Biodiversity: Monocultures can lead to a significant decrease in plant and animal species diversity. A diverse ecosystem is crucial for maintaining a healthy environment, as different species play various roles in the ecosystem, like pollination, soil enrichment, and pest control.
- Increased Vulnerability: Monocultures are more susceptible to diseases and pests, so a single pest or disease can affect the area, potentially releasing stored carbon back into the atmosphere.
- Soil Degradation: Monocultures can lead to soil nutrient depletion and reduce soil quality over time. Healthy, diverse soils are essential for sustainable agriculture and forestry, as well as for maintaining overall ecosystem health.

Therefore, it is vital that AFOLU projects prioritise ecological diversity. This means choosing a variety of plant species suited to the local environment and supporting a range of habitats and wildlife. By doing so, these projects can ensure they contribute positively to the environment, reducing emissions and enhancing carbon stocks effectively while supporting vibrant, resilient ecosystems.

4 How to assess the results from mitigation actions

4.1 Basic formula to estimate emission reductions

This section outlines the underlying calculation principles for assessing mitigation potential of activities in the AFOLU sector (see Section 3). AFOLU projects need to compare the GHG emissions / carbon stock arising from a proposed intervention (project scenario) against a baseline scenario (i.e. scenario in which the proposed intervention is not implemented) to estimate mitigation effects.

This involves analysing relevant parameters and data prior to project implementation (baseline scenario) and after the implementation of the project activities.

The specific approach projects need to take differs depending on whether the AFOLU project seeks to **reduce emissions** or **enhance carbon stocks**:

For **emission reductions**, the assessment, measured in terms of reduction of tCO_{2e}, is based on comparing the level of GHG emissions without (baseline scenario) and with the implementation of the project's mitigation activity (project scenario), considering any leakage emissions *(see section 4.4 for further information)*.

The net emission reduction achieved by the project is determined by deducting project emissions and potential leakage emissions from the baseline emissions (see Equation 1).

$$ER_y = BE_y - PE_y - LE_y \qquad \text{Equation (1)}$$

Where:

ER_y	=	Emission reductions in year y (tCO_2)
BE_y	=	Baseline emissions in year y (tCO_2)
PE_y	=	Project emissions in year y (tCO_2)
LE_y	=	Leakage emissions in year y (tCO_2)

In the case of **carbon stock enhancement**, the assessment, measured in terms of carbon sequestration in tCO_2e, involves subtracting baseline carbon stock and potential leakage emissions from the project's carbon stocks (see Equation 2). This calculation ultimately yields the net anthropogenic greenhouse gas (GHG) removals by sinks, referred to as carbon stock enhancement, achieved by the project.

$$CSE_y = PCS_y - BCS_y - LE_y \quad \text{Equation (2)}$$

Where[5]:

CSEy	=	Carbon stock enhancement in year y (tCO_2e)
PCSy	=	Project carbon stock enhancement in year y (tCO_2e)
BCSy	=	Baseline carbon stock enhancement in year y (tCO_2e)
LEy	=	Leakage emissions in year y (tCO_2e)

As a result, it is crucial to estimate emissions and/or sequestration for both the baseline project scenario and potential leakage.[6] To accurately determine the required parameters and data for these calculations, it is necessary to identify the emission sources and GHGs as well as the carbon stocks associated with each technology/measure. Established carbon market methodologies and standards can be used as a reference to identify technology-specific emission sources and GHGs associated with the baseline scenario and project scenario (see Section 4.4).[7] The same applies for carbon stock enhancement. Projects can refer to existing methodologies for mitigation calculations.

4.2 Suitable methodological approaches

Numerous methodologies assist in determining emission reductions / carbon stock enhancements for AFOLU activities. Projects can identify suitable methods by searching for those that cover similar underlying mitigation activities.

To identify a suitable methodology, projects should categorise:

- the underlying mitigation activity type (e.g. improved irrigation practice for rice cultivation) and
- the applied technology type and measure (e.g. alternate wetting and drying irrigation for rice cultivation).

By identifying the mitigation activity type, methodologies are selected according to the relevant sectoral scopes and types of mitigation activities. The categorisation by technology type usually helps to identify a set of comparable methodologies applicable to the technology that is going to be implemented. This encompasses well-known frameworks such as the Clean Development Mechanism (CDM), the Global Environment Facility (GEF), the Gold Standard (GS), GHG Protocol (GHGP), and the Verified Carbon Standard (VCS). Any necessary simplifications of these methods could be considered and applied as required and justifiable.[8] This guidance is in line with the general principles of the recognised methodologies.

[5] Within the AR-ACM003 methodology, these components are identified using slightly different terminologies. In this context, the equation and terms are defined as follows: $\Delta C_{AR\text{-}CDM,t} = \Delta C_{ACTUAL,t} - \Delta C_{BSL,t} - LK_t$, where the constituent elements are defined like those illustrated in Equation 2.

[6] Ebeling, Johannes, and Álvaro Vallejo (2011): AR Guidance. Technical Project Design. In Building Forest Carbon Projects, Johannes Ebeling and Jacob Olander (eds.). Washington, DC: Forest Trends. Retrieved from here.

[7] Ibid, p. 15. Retrieved from here.

[8] Ibid, p. 15. Retrieved from here.

Reversal risks and ecosystem diversity

Especially for AFOLU-related projects, the issue of non-permanence or reversibility is important to consider. When selecting an appropriate methodology, careful consideration should be given to whether the methodologies adequately address the issue of permanence (see section (2)3). This involves evaluating how well these methods can ensure that the carbon sequestered remains captured over the long term and are not prone to rapid reversals due to environmental or human factors.

Key considerations to identify suitable methodologies include for example:

- a risk assessment for potential reversals or at least information on insurance mechanisms that are used to reduce the risk of non-permanence (e.g. risk buffer or applying more conservative discount factors on mitigation outcomes)[9]
- recommendations on sustainable management practices that enhance the resilience of the ecosystem
- outlined procedures for regular monitoring of carbon stocks and the health of the ecosystem, allowing for early detection and mitigation of any factors that might lead to carbon release

By addressing these areas, the methodology can effectively ensure the long-term success and sustainability of AFOLU projects.

Significance

Methodologies often define the significance of a value or emission based on a set of criteria or thresholds that determine the impact of the value or emission on the overall project outcomes. Exemplary ways to assess significance include threshold values, materiality tests or statistical significance. Depending on the project type, methodologies typically provide tailored determination approaches.

[9] VCS (2019): AFOLU Non-Permanence Risk Tool. Retrieved from here.

Box 2: Source for identifying applicable methodological approach for the AFOLU sector

To identify suitable methodological approaches and useful default/reference values,

- check other projects that estimated emission reduction or carbon stock enhancement from same/similar activities, e.g.
  - CDM Methodologies, VERRA / VCS Project Registry, Gold Standard Impact Registry, etc.
  - consult existing methodologies: CDM, VCS, GS, etc., e.g. in the CDM Methodology Booklet. Keep in mind the tools directly connected to these methodologies: Soil organic carbon stocks Tool, Trees and Shrubs carbon stocks Tool, Emissions from activity displacement Tool, Non-CO_2 emissions Tool
- consult and use simplified tools and guides for the estimation, if existing. For example:
  - FAO Ex-Ante Carbon Balance Tool (EX-ACT) based on the IPCC methodology and covers the entire AFOLU sector, it can be used ex-ante or ex-post
  - CBP Carbon Benefits Projects: Carbon-balance Tool
  - Forest Trends Carbon Accounting Overview and Principles
  - VCS AFOLU Non-Permanence Risk Tool
  - Building Forest Carbon Projects - AR Guidance
  - Digital solutions like CTrees
- make use of default values and reasonable assumption source from references:
  - Allometric equations, wood densities, raw biomass and volume data, biomass expansion factors: GlobAllomeTree
  - IPCC Good Practice Guidance for LULUCF Biomass Default Tables

Several small-scale CDM methodologies provide a good orientation for the calculation approaches of numerous AFOLU projects. For a complete list of CDM methodologies, please consult CDM: Approved SSC methodologies (unfccc.int), Verra Methodologies or similar standard bodies.

Reducing emissions from agriculture:

1. Cropland Nutrient Management:
   - VM0022: Quantifying N_2O Emissions Reductions in Agricultural Crops through Nitrogen Fertilizer Rate Reduction, v1.1
   - Avoidance of methane emissions through controlled biological treatment of biomass
   - Reduction of N_2O emissions from use of Nitrogen Use Efficient (NUE) seeds that require less fertilizer application
2. Reduced N_2O from Manure on Pasture:
   - VM0042: Methodology for Improved Agricultural Land Management, v2.0
3. Manure Management (Methane Capture):
   - Methodology for Reducing Cattle Methane Emissions Through Direct Reduction of Exhaled Methane
   - Gold Standard Agriculture Smallholder Dairy Methodology
4. Improved Agricultural Land Management Practices, e.g. Improved Rice Cultivation:
   - Methane emission reduction in rice cultivation
   - VM0042: Methodology for Improved Agricultural Land Management, v2.0
   - Soil Organic Carbon Activity Module: Increasing Soil Carbon Through Improved Tillage Practices

5. Reduced Enteric Fermentation:
    - VM0041: Methodology for the Reduction of Enteric Methane Emissions from Ruminants through the Use of Feed Ingredients, v2.0
    - Reducing Methane Emissions from Enteric Fermentation in Dairy Cows Through Application Of Feed Supplements
    - Gold Standard Agriculture Smallholder Dairy Methodology

Reducing emissions from forests and other ecosystems:

6. Prevention of Deforestation:
    - VM0015: Methodology for Avoided Unplanned Deforestation, v1.1
7. Prevention of Forest Degradation:
    - VM0048 Reducing Emissions from Deforestation and Forest Degradation, v1.0
8. Prevention of Conversion, Draining, Burning of Peatlands:
    - VM0036: Methodology for Rewetting Drained Temperate Peatlands, v1.0
9. Prevention of Conversion of Coastal Wetlands:
    - VM0033: Methodology for Tidal Wetland and Seagrass Restoration, v2.1
10. Avoiding Conversion of Savannahs and Natural Grasslands:
    - VM0026: Methodology for Sustainable Grassland Management (SGM), v1.1

Enhancing Carbon Sinks

1. Afforestation/Reforestation (A/R)
    - CDM: Afforestation / Reforestation Methodologies
    - AR-AM0014: Afforestation and reforestation of degraded mangrove habitats - Version 3.0
    - VM0047 Afforestation, Reforestation, and Revegetation, v1.0
    - Afforestation/Reforestation GHG Emissions Reduction & Sequestration Methodology
2. Improved Forest Management
    - VM0003: Methodology for Improved Forest Management through Extension of Rotation Age, v1.3
    - VM0045 Methodology for Improved Forest Management Using Dynamic Matched Baselines from National Forest Inventories, v1.0
    - VM0012 Improved Forest Management in Temperate and Boreal Forests (LtPF), v1.2
    - VM0035 Methodology for Improved Forest Management through Reduced Impact Logging v1.0
    - VM0010 Methodology for Improved Forest Management: Conversion from Logged to Protected Forest, v1.3
3. Agroforestry
    - VM0047 Afforestation, Reforestation, and Revegetation, v1.0

4. Peatland Restoration
    - VM0036 Methodology for Rewetting Drained Temperate Peatlands v1.0
5. Coastal Wetland Restoration
    - VM0024 Methodology for Coastal Wetland Creation, v1.0
    - VM0033 Methodology for Tidal Wetland and Seagrass Restoration, v2.1
6. Soil Carbon Sequestration in Croplands
    - VM0042: Methodology for Improved Agricultural Land Management, v2.0
    - Soil Organic Carbon Activity Module: Increasing Soil Carbon Through Improved Tillage Practices

7. Soil Carbon Sequestration in Grazing Lands
    - Soil Organic Carbon Framework Methodology
    - VM0026: Methodology for Sustainable Grassland Management (SGM), v1.1
8. Biochar Application to Soils
    - VM0044 Methodology for Biochar Utilization in Soil and Non-Soil Applications, v1.0

4.3 Project boundary

The project boundary encompasses all greenhouse gas (GHG) emissions and carbon stocks that fall under the project's control and are both significant and reasonably attributable to project activities. Defining the boundary for GHG emissions and carbon stocks assessment allows project developers to make informed decisions about which carbon pools and other potential sources or sinks to include when quantifying the mitigation potential.

The specific project boundary is determined by the project's interventions and technologies and can refer to either operational control or geographical delineation. In cases where defining the project boundary proves challenging, users should refer to approved methodologies, such as those provided by the CDM or GHG Protocol, for detailed guidance on delineation.

The project boundary for the estimation should typically contain the **geographical area** where mitigation measures are implemented. For carbon stock enhancement measures, it should also typically contain the **carbon pools** selected for accounting of carbon stock changes. Considering the example of afforestation or reforestation activities, this could include the following:

Table 1 Carbon pools selected for accounting of carbon stock changes

Carbon pool	Whether selected	Justification / Explanation
Above-ground biomass	Yes	This is the major carbon pool subjected to project activity
Below-ground biomass	Yes	Carbon stock in this pool is expected to increase due to the implementation of the project activity
Dead wood Litter and Soil organic carbon	Optional	Carbon stock in these pools may increase due to implementation of the project activity

Source: UNFCCC (2013): AR-ACM0003: Afforestation and reforestation of lands except wetlands.

The project boundary should also include **significant anthropogenic GHG emissions** by sources influenced by the project interventions. Table 2 displays the example of an emission source (burning of woody biomass) and the corresponding GHGs emissions considered for accounting purposes.

Table 2: Emission sources and GHG selected for accounting

Carbon pool	Gas	Whether selected	Justification / Explanation
Burning of woody biomass	CO_2	No	CO_2 emissions due to burning of biomass are accounted as a change in carbon stock
	CH_4	Yes	Burning of woody biomass for the purpose of site preparation, or as part of forest management, is allowed under this methodology
	N_2O	Yes	Burning of woody biomass for the purpose of site preparation, or as part of forest management, is allowed under this methodology

Source: UNFCCC (2013): AR-ACM0003: Afforestation and reforestation of lands except wetlands.

More detail on emission sources to be considered for afforestation and reforestation activities can be found in the excerpts from the CDM AR-ACM0003 methodology.

4.4 Baseline scenario, project scenario and leakage emissions

For each mitigation action, it is required to determine both the baseline and project scenarios. These scenarios help determine the project's impact on carbon emissions and sequestration.

The **baseline scenario** serves as the reference case for the project, representing a hypothetical description of what would likely have happened in the absence of the project to deliver a product or service similar to the project's outcome. It is used to estimate baseline emissions. Generally, the baseline approach, as defined in the applied methodology (section 4.2, should be adhered to, considering the following guidance.

There are three generic possibilities for the baseline scenario and related emissions that would occur without the proposed project, according to the Clean Development Mechanism (CDM) and GHG Protocol:

1. **Business-as-Usual (BAU):** This refers to the continuation of existing activities, technologies, or practices that offer the same type, quality, and quantity of product or service as the project. BAU results in emissions based on current or historical data, as applicable.

2. **Benchmark Approach:** In this approach, the focus is on current activities, technologies, or practices that provide a product or service similar to the project. Only activities undertaken in the previous five years, under similar social, economic, environmental, and technological conditions, and demonstrating top 20 percent performance in low emissions or sequestering carbon, are considered. Adopting the benchmark approach facilitates the identification of technical parameters for establishing the baseline scenario and estimating baseline emissions.
3. **Economically Attractive Alternatives:** This approach considers emissions from an activity, technology, or practice that represents an economically attractive option when compared to the project. It takes into account investment barriers and assesses alternative activities, technologies, or practices within a specific geographical area and timeframe that can provide a similar product or service as the project.

When establishing the baseline, pinpoint the scenario that most likely would occur had the project not been implemented.

To establish a solid baseline scenario, it is indispensable to formulate plausible and credible land-use scenarios that would have naturally unfolded within the designated project area in the absence of the project/measure. These scenarios should consider relevant national and/or sectoral policies, along with historical land utilisation patterns, customary practices, and economic trends. Once these scenarios are identified, the subsequent phase entails a thorough evaluation, with the selection of the most likely scenario being determined in cases where multiple options exist.

Conservative assumptions are of paramount importance to ensure that emission reduction and/or carbon sequestration within the project is not profoundly overestimated. Hence, particular attention should be paid to adhering to rigorous guidelines, particularly when documenting forestry initiatives. An illustrative example is VERRA's latest REDD Methodology, which serves as a valuable reference in maintaining accuracy, transparency, and conservativeness.

The **project scenario** outlines the anticipated GHG emissions or carbon stocks resulting from the implementation of the specific mitigation activity. It represents the changes in emissions or carbon stocks brought about by the project's activities.

Many agricultural practices come along with opposing effects, which lead to the substitution of one type of GHG emissions with another, which must be assessed as project emissions. For instance:

- Measures taken to enhance soil carbon sequestration (e.g. no till-practices or increased irrigation) can lead to increased soil N_2O emissions.
- Wooded riparian buffer zones can increase carbon sequestration but lead to increased soil N_2O emissions, compared to field margins.
- Aerating a manure lagoon to reduce CH_4 emissions will increase N_2O emissions.
- Removal of straw from flooded rice paddies to reduce CH_4 emissions can lead to the requirement for more fertiliser and increased N_2O emissions.
- The application of N-transformation inhibitors to soils to reduce the leaching of some N_2O precursors may increase that of others.

It is important to consider the expected lifetime of a project measure or technology in order to correctly assess the project’s mitigation impact throughout its lifetime. The lifetime should be derived from project information or be derived from typical experiences or expert evaluation in the country or region. Alternatively, default values can also be used, e.g. as provided in the CDM Tool to determine the remaining lifetime of equipment, if no specific information on the project’s technology is available.

With regard to the IKI Standard Indicator Report (Excel tool), the project lifetime and carbon accounting period is normally defined by the lifetime of implemented technologies estimated on a conservative basis. In the absence of a suitable technology lifetime (e.g. change in agricultural practices), the accounting period should include the project duration / implementation period and an additional period thereafter as follows:

In consultation with experts in the field of carbon accounting and the IKI Standard Indicator Helpdesk, the additional period has been set at between 5 and a maximum of 10 years.

- 5-10 years if it can be clearly demonstrated that the project practice will continue over the reporting period for this duration. A justification for the chosen period of time needs to be provided in the IKI Standard Indicator Report (Excel Tool).
- If this cannot be (demonstrably) ensured, then a maximum of 5 years after the end of the project duration / implementation period is to be applied.

The user should apply a conservative approach and document their choice and data used.

Leakage emissions refer to the additional emissions that occur outside the boundaries of the mitigation action project as a result of implementing that project. Leakage in the context of forest conservation measures in the AFOLU sector can occur when a forest protection project in one area reduces deforestation but shifts land use activities to neighbouring areas, leading to an unintended increase in deforestation or forest degradation in those adjacent areas. This illustrates how measures to reduce deforestation in one area can cause emissions shifts to other areas.

In a national program aimed at reducing greenhouse gas emissions from livestock farming by promoting methane capture in livestock barns, leakage could occur if farmers in neighbouring regions expand their livestock farming activities to take advantage of less regulated and cost-effective conditions. This could increase methane emissions in the neighbouring regions and partially offset the positive impact of the program in the original project area. These examples highlight the need for comprehensive analysis and planning to minimize potential side effects and leakage effects.

5 Sample calculation of emission reductions and carbon stock enhancements

This chapter illustrates the calculation of emission reductions for an example of a mitigation activity for improved rice irrigation practices in the agriculture sector and the increase in carbon stocks for an example of an afforestation project activity.

5.1 Reducing emissions in farming, forestry, and other ecosystems

Based on the list in section 3 and the corresponding methodologies in section 4.2, exemplary emission reduction projects are briefly listed here, followed by a more detailed examination and calculation of a case study on improved agricultural land management practices to reduce methane emissions in rice cultivation.

1. **Cropland Nutrient Management (Reduced Fertilizer Application)**
   - **Project Aim:** To reduce nitrous oxide (N_2O) emissions by optimizing fertilizer use.
   - **Mitigation Activities:** Implementing precision farming techniques, training farmers in efficient fertilizer application, and promoting organic farming practices.
   - **Stakeholders:** Farmers, environmental NGOs.
2. **Prevention of Deforestation**
   - **Project Aim:** To reduce carbon emissions by preventing the cutting down of forests.
   - **Mitigation Activities:** Enforcing forest protection laws, promoting alternative livelihoods for local communities, implementing reforestation programs.
   - **Stakeholders:** Forest communities, environmental NGOs, government forestry departments, international conservation organizations.
3. **Prevention of Forest Degradation**
   - **Project Aim:** To conserve forest carbon stocks by preventing forest degradation.
   - **Mitigation Activities:** Sustainable forest management, monitoring and patrolling against illegal logging, community forest management initiatives.
   - **Stakeholders:** Local forest dwellers, timber companies, law enforcement agencies, environmental advocacy groups.
4. **Prevention of Conversion of Coastal Wetlands**
   - **Project Aim:** To protect coastal wetlands from conversion and maintain their carbon sequestration capacity.
   - **Mitigation Activities:** Establishing protected areas, promoting ecotourism, engaging in wetland restoration projects.
   - **Stakeholders:** Coastal communities, tourism businesses, environmental conservation groups, government environmental agencies.

To examine and calculate the case study of improved agricultural land management practices to reduce methane emissions in rice cultivation, the general approach of the Gold Standard methodology the general approach of the Gold Standard methodology "methane emission reduction by adjusted water management practice in rice cultivation" is used in this chapter.

Example 1: Emission Reductions - CH_4 emission reduction in rice cultivation

The aim of the project is to reduce CH_4 emissions from rice cultivation. Rice fields are continuously flooded which provides anaerobic conditions for degradation of organic matter, resulting in methane emissions. This makes rice cultivation one of the main sources of AFOLU-related GHG emissions. If the rice fields are not flooded constantly and the surface of the fields are drained one or multiple times, this reduces the period under anaerobic conditions, and therefore reduces methane emissions.

The project targets fields with a single cropping period, aiming to switch from continuous flooding to multiple drainage irrigation practices. To achieve this, the project developer will introduce these practices to a group of 100 farmers, each owning 1 ha. The project will directly finance the implementation of irrigation systems and provide necessary resources like water-efficient seeds.

Additionally, comprehensive advisory services will be provided to assist with practice changes, including seed selection. The project will also engage with the local community to raise awareness about the benefits of sustainable farming. The project can therefore report on indirect mitigation.

The **baseline scenario** is the continuation of the practices implemented so far in the project fields being considered the most likely scenario:

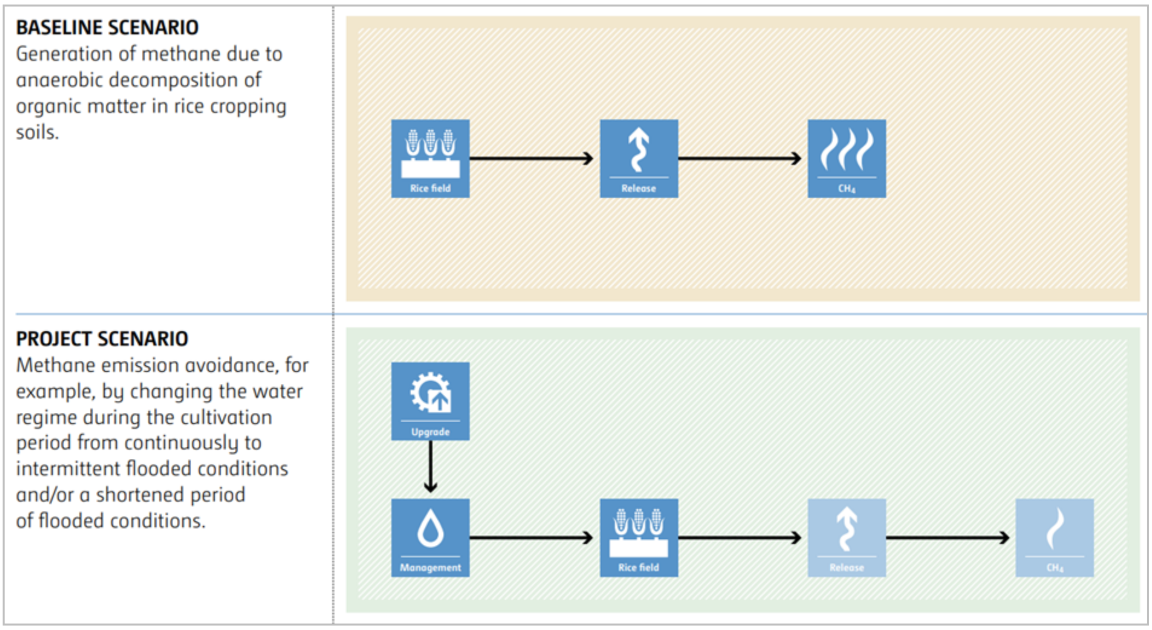
100 ha of fields flooded during the cultivation period (of 140 days / year)

Under the **project scenario**, direct measures are introduced, including financing the implementation of efficient irrigation systems and providing essential resources such as water-efficient seeds. These effects do not arise all at once but are achieved progressively:

100 ha of fields progressively shifting from continuously to intermittent flooded conditions (multiple drainage)

Progressive shifting: 30ha in 1st year, 30 additional ha in 2nd year, and the 40 remaining ha 3rd year

Figure 2: Typical baseline and project scenario for rice cultivation



Source: UNFCCC (2022): CDM Methodology Booklet, p. 280.

In determining the project lifetime, and thus the emission reductions taken into account, the specifications described in Section 4.4 are used as a guideline.

5 years project duration + 10 years of continued mitigation activity

If the project data or other sources suggest a shorter duration, this should be used. A longer period is not intended due to the principle of conservativeness.

Please note: For the lifetime of projects, it must be clearly demonstrated that the project practice will continue over the reporting period. A rationale must be explained in the IKI Standard Indicator Report (Excel Tool) and may differ from forest projects (see Section 4.4)

Leakage emissions are deemed negligible because the adoption of methane-reducing practices within the same rice cultivation region does not lead to a significant increase in methane emissions in neighbouring areas, due to the localized nature of these emissions.

5.1.1 Project boundary

For projects that aim to reduce emissions in farming and forestry areas, e.g. by changing cultivation or management practices, the project boundary is usually the geographical boundary of intervention as well as the GHG emissions covered. The spatial extent includes the agricultural area with changes in cultivation / management as a result of the project. Furthermore, identifying the main sources of greenhouse gas emissions within the project area is essential and usually listed in the respective methodologies. These sources can include emissions from soil management, use of fertilizers, livestock management, and any land-use changes, such as deforestation or land conversion (see Table 2). Understanding these emission sources is critical for developing strategies to minimize them. By doing so, projects can ensure that their efforts in carbon storage are not undermined by high emissions from other activities within the same area.

Example 1: Emission Reductions - CH_4 emission reduction in rice cultivation

In the project example, the **spatial extent** of the project boundary includes all flooded rice fields of the farmers implementing the project activity (change in irrigation practices): *100 farmers x 1 ha/farmer = 100 ha*

GHG emissions considered: *CH_4, N_2O and CO_2*

Carbon pools: *not relevant for this mitigation activity*

5.1.2 Baseline, project, and leakage emissions

Estimating **baseline emissions** involves an assessment of current land use and management techniques, understanding the types of agricultural and forestry practices in place. Additionally, engaging with local stakeholders provides insights into these practices. Historical data analysis is also crucial, examining past trends in agricultural expansions, deforestation rates, and policy or technological changes to predict future scenarios without the project.

Project emissions for emission reduction activities include the remaining emissions after implementing project activities. This accounts for emissions from activities like machinery use in planting or harvesting and fertilizer application. It also considers interacting effects, where reducing one type of emission might increase another, such as increased methane (CH_4) emissions due to sustainable forest management practices.

Leakage emissions refer to unintended increases in GHG emissions outside the project area, such as the displacement of agricultural activities or deforestation.

Overall, the complex nature of natural processes does not allow full coverage of the calculations of emission reductions for all project types. This is because varying indicators must be considered in differing contexts, necessitating the use of distinct formulas to accurately derive the results. But methodologies (see section 4.2) typically provide detailed guidance on how to approach these assessments, tailoring the approach to specific project types.

Here is a simplified overview of the process, which is described in more detail and tailored to specific project types in suitable methodologies:

1. **Baseline Emission Estimation**
   - Projects begin by estimating the baseline emissions, which represent the emissions that would occur without the project. This step involves assessing current emission levels from sources like agricultural practices, livestock, and land use at year = 0. Standardized factors provided by methodologies are often used for simplified estimation.
2. **Monitoring Emission Sources**
   - Continuous monitoring of key emission sources such as fertilizer application, manure management, and livestock practices is conducted. This monitoring forms the basis for quantifying reductions in emissions.
3. **Applying Emission Factors**
   - Emission estimates are refined using specific emission factors. For instance, factors that quantify emissions per unit of fertilizer applied, per head of livestock, or per hectare of land are used. These factors are based on standard values or specific measurements (see methodologies for details).
4. **Calculating Project Emissions**
   - Project emissions are calculated based on the changes in practices brought about by the project. This includes improved management techniques, changes in land use, or adoption of new technologies.
5. **Conversion of Emissions to CO_2 Equivalents**
   - To standardize different types of greenhouse gases, emissions are to be converted to CO_2 equivalents using global warming potential (GWP) factors.
6. **Net Emission Reductions Calculation**
   - The net reduction in emissions is determined by comparing the project emissions with the baseline emissions. Adjustments are made for any leakage emissions and uncertainties. This calculation follows a conservative approach to ensure accurate representation of emission reductions (see methodologies for specific equations).

For different types of mitigation activities, baseline emissions, project emissions, and leakage emissions can vary significantly. Here are some examples for each emission reduction project type mentioned in section 3:

Table 3: Emission reduction examples for baseline, project, and leakage emissions

Project Type	Baseline Emissions	Project Emissions	Leakage Emissions
Cropland Nutrient Management (Reduced Fertilizer Application)	High N_2O from extensive fertilizer use	Lower N_2O from reduced/efficient fertilizer use	Increase in N_2O if fertilizer use intensifies elsewhere
Prevention of Deforestation	High emissions from ongoing/planned deforestation	Reduced emissions from prevention of deforestation	Deforestation in adjacent areas due to displaced logging activities
Prevention of Forest Degradation	Emissions from unsustainable logging, forest fires, etc.	Lower emissions with sustainable forest management	Increased degradation activities in nearby forests
Prevention of Conversion of Coastal Wetlands	Emissions from conversion of mangroves, seagrass, marshes	Lower emissions through conservation efforts	Displacement of conversion activities to other wetland areas

Following the detailed explanation of emissions and the outlined estimation process, including some examples (for other project types see corresponding methodologies in section 4.2), the focus now shifts to the crucial first step in estimating emission reductions: the determination of **baseline emissions**. Baseline emissions are essentially the hypothetical level of emissions that would be expected if the project were not implemented. This concept is pivotal in assessing the effectiveness of any project aimed at reducing emissions, as it provides a reference against which the actual impact of the project can be measured and evaluated.

Example 1: Emission Reductions - CH_4 emission reduction in rice cultivation

Following the exemplary methodology on "methane emission reduction by adjusted water management practice in rice cultivation", the baseline emissions of the project example shall be calculated on a seasonal basis using the following formula:

$$BE = \sum_{s}^{S} BE_s \quad \text{Equation (3)}$$

$$BE_s = \sum_{g=1}^{G} EF_{BL,s,g} \times A_{s,g} \times 10^{-3} \times GWP_{CH4} \quad \text{Equation (4)}$$

Where:

BE_y = Baseline emissions in year y (tCO_2e)

BE_s = Baseline emissions from project fields in season s (tCO_2e)

$EF_{BL,,}$ = Baseline emission factor of group g in season s ($kgCH_4$/ha per season)

$A_{s,}$ = Area of project fields of group g in season s (ha)

GWP_{CH4} = Global warming potential of CH_4 (tCO_2e/tCH_4)

g = Group g, covers all project fields with the same cultivation pattern

s = Single season / S = Seasons in a year considered in the project activity

Required data, such as for the calculation of the baseline emission factor, can be found in the methodology or guidance is provided on where to find this data.

Moving forward in the process, the next critical element is the determination of **project emissions**. Project emissions are basically the sum of emissions occurring during the project lifecycle plus emissions directly resulting from project activities, along with any additional emissions or reductions due to (e.g., biophysical) interactions related to the project. This encompasses all emissions associated with the implementation and operation of the project, including any side-effects that may arise as a consequence of project activities.

Example 1: Emission Reductions - CH_4 emission reduction in rice cultivation

The project scenario should take into account CH_4 emissions, which will continue to be released with the altered cultivation practices, as well as increased N_2O emissions compared to the baseline. Additionally, it should consider CO_2 emissions resulting from land preparation activities, if significant (see section 4.2).

Additionally, the methodology indicates to also consider significant N_2O emissions from optimised nitrogen (N) fertilisation practice and significant CO_2 emissions from land preparation. The estimation of project emissions, and whether they are significant are to be determined following the information provided by the methodology (see section 4.2). Therefore, projects should design and implement a monitoring plan to ensure that all necessary information is monitored and available for verification purposes.

$$\boldsymbol{PE_y = \sum_{s}^{n} PE_s + PE_N + PE_p} \qquad \text{Equation (5)}$$

Where:

PE_y = Project emissions (CH_4) in year y (tCO_2e)

PE_s = Project emissions (CH_4) from project fields in season s (tCO_2e)

PE_N = Project emissions (N_2O) from N-inputs in the project fields (tCO_2e)

PE_p = Project emissions (CO_2) from fields preparations (tCO_2e)

$$\boldsymbol{PE_s = \sum_{g=1}^{G} \left(EF_{P,s,g} \times A_{s,g}\right) \times 10^{-3} \times GWP_{CH4}} \qquad \text{Equation (6)}$$

Where:

$\mathrm{P}E_y$ = Project emissions in year y (tCO_2e)

$\mathrm{P}E_s$ = Project emissions from project fields in season s (tCO_2e)

$EF_{\mathrm{P},,}$ = Project emission factor of group g in season s ($kgCH_4$/ha per season)

$A_{s,}$ = Area of project fields of group g in season s (ha)

GWP_{CH4} = Global warming potential of CH4 (tCO_2e/tCH_4)

g = Group g, covers all project fields with the same cultivation pattern

s = Single season / S = Seasons in a year considered in the project activity

Although there is no increase of N-inputs between baseline and project scenario, the fact of shifting from continuously flooded conditions to intermittent flooding could result in higher N_2O emissions (PE_N).

$$\boldsymbol{PE_N = PE_{N,Proj} + PE_{N,AWD}} \quad \text{Equation (7)}$$

Where:

PE_N = Project emissions (N_2O) from N-inputs in the project fields (tCO_2e)

$PE_{N,}$ = Project emissions (N_2O) from N-inputs in the project fields (tCO_2e) where application rate of N-input in the project exceeds the baseline.

$PE_{N,}$ = Project emissions (N_2O) from N-Inputs in the project fields (tCO_2e) where application rate of N-input in the project does not exceed the baseline.

Land preparation is calculated according to the following equation. However, this factor is deemed to be negligible, therefore there are no CO_2 project emissions (PE_p).

$$\boldsymbol{PE_p = \sum_{i}^{n}\left(EF_{fuel,i} \times Q_{F,i}\right)} \quad \text{Equation (8)}$$

Where:

$Q_{F,i}$ = Quantity of fuel of type i (quantified as energy input) (TJ)

$EF_{fuel,}$ = Emission factor of fuel type i based on IPCC guidelines (tCO_2e/TJ) Default emission factor may be sourced from IPCC or other comparable sources. The most conservative values for fuel efficiency shall be considered, either from the manufacturer’s manual or other comparable sources.

Required intermediate data, such as for the calculation of the baseline emission factor and project emissions from N-inputs, can be found in the methodology or guidance is provided on where to find this data.

Another essential component in the emission reduction estimation process is the assessment of **leakage emissions**. Leakage refers to emissions that occur outside of the project boundary but are indirectly caused by the project's implementation. Additionally, leakage can encompass uncertainty factors that account for potential variances in emission estimates. These uncertainty factors help in addressing the possible inaccuracies or unpredictability in emission calculations that are indirectly linked to the project activities.

Example 1: Emission Reductions - CH_4 emission reduction in rice cultivation

The methodology also recommends applying an uncertainty deduction factor of 15% on emission reductions when default values are used for calculation (which is in this case). Thus, here the uncertainty-related decrease of emission reductions (based on baseline and project emissions) was calculated and reflected.

$$LE_y = (BE_y - PE_y) * 15\% \quad \text{Equation (9)}$$

Consequently, the emission reduction for the first year of project implementation is calculated according to the general approach in Section 4 and the applied methodology as follows:

Example 1: Emission reductions – CH_4 emission reduction in rice cultivation

The **baseline emissions** are calculated on a seasonal basis, adhering to a specific formula. This formula multiplies following key components:

- Baseline Emission Factor of each group of project fields in a given season (in kilograms of methane per hectare per season).
- **T**he total area of the project fields belonging to each group for each season, measured in hectares (ha).
- Global Warming Potential of Methane over 100 years acknowledging the higher global warming potential compared to carbon dioxide.
- If different cultivation patterns or field specifics exist, the project fields can be divided into groups (g), each with a similar cultivation pattern to accurately consider all the diversity in cultivation practices and environmental conditions.

The calculation of the **project emissions** takes into account several factors that differ from the baseline scenario. This formula multiplies the following key components:

- Project Emission Factor of each group of project fields in a given season (in kilograms of methane per hectare per season). This factor accounts for CH_4 emissions under altered cultivation practices that continue post-project implementation.
- The total area of the project fields for each group belonging to each group for each season, measured in hectares (ha).
- Global Warming Potential of Methane over 100 years.

Added to this:

- N_2O Emissions from Optimized Nitrogen Fertilization, as the shift from continuously flooded conditions to intermittent flooding result in higher N_2O emissions.
- CO_2 Emissions from Land Preparation are calculated based on the quantity of fuel used and its emission factor according to IPCC guidelines. However, in this case, these emissions are considered negligible and are not factored into the total project emissions.

According to the project information, any **leakage** effects of the project activity on GHG emissions outside the project boundary are deemed to be negligible and are not to be considered under the applied methodology.

For more details on the calculations, please consult the filled in IKI Standard Indicator Report for the project example available on the IKI website.

Key parameters required for the calculation

For calculating the emission reduction from this exemplary agriculture projects, the following parameters are required.

Parameter	Unit	Value / source
Cultivation period of rice	days/year	Project documentation
Default Emission factor - Global $EF_{,BL,C}$	$kgCH_4$/ha/day	Gold Standard Methodology
Baseline scaling factor for water regime during cultivation period (continuously flooded) $SF_{BL,w}$	-	Gold Standard Methodology, referencing to: IPCC 2019, Volume 4, chapter 5.5, Table 5.12
Baseline scaling factor for water regime prior to rice cultivation (single cropping / Non flooded pre-season > 180 days) $SF_{BL,P}$	-	Gold Standard Methodology, referencing to: IPCC 2019, Volume 4, chapter 5.5, Table 5.13
Baseline scaling factor related to organic amendment $SF_{BL,o}$	-	Gold Standard Methodology, referencing to: IPCC 2019, Volume 4, chapter 5.5, Table 5.14
Project scaling factor for water regime during cultivation period (single drainage period) $SF_{P,w}$	-	IPCC 2019, Volume 4, chapter 5.5, Table 5.12
Project scaling factor for water regime prior to rice cultivation (single cropping / Non flooded pre-season > 180 days) $SF_{P,p}$	-	IPCC 2019, Volume 4, chapter 5.5, Table 5.13
Project scaling factor related to organic amendment $SF_{P,o}$	-	IPCC 2019, Volume 4, chapter 5.5, Table 5.14
Application rate of N-input, $Q_{N,g}$	kg N inputs / ha	Project documentation
N_2O correction factor, CF_{N2O}	kg N_2O/kg N input	IPCC Guidelines 2019

5.2 Enhancing carbon sinks in farming, forestry, and other ecosystems

Based on the list in section 3 and the corresponding methodologies in section 4.2, exemplary carbon stock enhancement projects are briefly listed here, followed by a more detailed examination and calculation of a case study on afforestation on degraded land.

1. **Afforestation/Reforestation (A/R)**
    - **Project Aim:** To enhance carbon stocks by converting deforested or degraded lands into forests.
    - **Mitigation Activities:** Planting native tree species, protecting young forests, and managing forest growth.
    - **Stakeholders:** Environmental NGOs, local communities, forestry departments, international climate organizations.

2. **Agroforestry**
   - **Project Aim:** To augment carbon stocks by integrating trees with agricultural practices.
   - **Mitigation Activities:** Planting trees on agricultural lands, training farmers in agroforestry practices, and promoting diversified crop production.
   - **Stakeholders:** Farmers, agricultural extension services, environmental organizations, agribusinesses.
3. **Peatland Restoration**
   - **Project Aim:** To restore carbon stocks in degraded peatlands.
   - **Mitigation Activities:** Re-wetting drained peatlands, restoring native vegetation, and controlling peat extraction.
   - **Stakeholders:** Environmental agencies, local communities, landowners, conservation experts.
4. **Coastal Wetland Restoration**
   - **Project Aim:** To enhance carbon sequestration through the restoration of coastal wetlands.
   - **Mitigation Activities:** Replanting mangroves, restoring seagrass beds, and conserving marshlands.
   - **Stakeholders:** Coastal communities, marine conservation organizations, government environmental bodies, local NGOs.

The methodology "AR-ACM0003 - Afforestation and reforestation of lands except wetlands" under the CDM framework guides this chapter's exploration of carbon stock enhancements through afforestation on degraded land. The methodology provides a structured approach for quantifying the increase in carbon stocks resulting from afforestation activities.

Please keep in mind that reversal risks and ecosystem diversity should be considered in AFOLU projects (see section 3). But, for ease of calculation, a project example was chosen here that results in the creation of a monoculture with fast-growing trees.

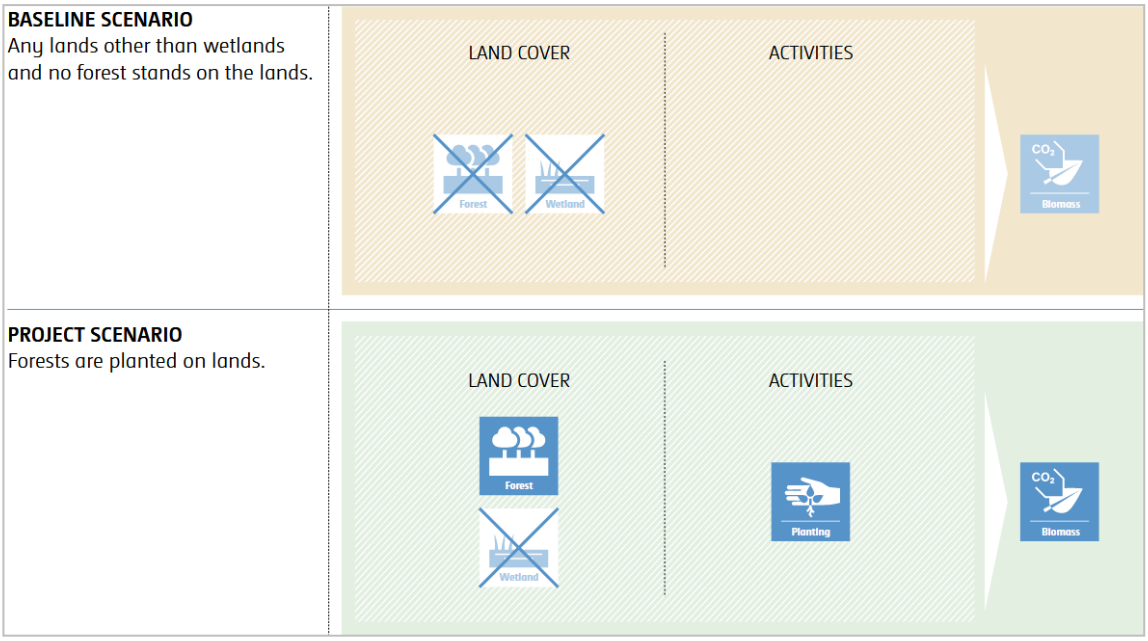
Example 2: Carbon Stock Enhancement - Afforestation/Reforestation

The project aims to transform 342 ha of degraded land into forestry area and thereby increase carbon stocks. It focuses on engaging local farmers and rural communities responsible for managing this area in afforestation efforts. directly funds critical activities, such as land preparation, purchasing and planting diverse, fast-growing tree species, and providing essential resources for the initial years of seedling growth. The project therefore reports on direct mitigation. These measures were set as the **project scenario** *(described in section 4.4).*

This direct investment addresses the financial barriers outlined in the **baseline scenario** *(described in section 4.4)* Without this intervention, the land would remain as pasture, continuing its degradation, as farmers and communities lack the means for such afforestation initiatives. Afforestation requires significant upfront costs for land preparation, seedling procurement, and sustained care during the early growth stages, which may not be feasible for them. Additionally, the long-term nature of returns from tree plantations compared to the immediate benefits of pastureland use further diminishes their willingness to undertake such investments without external financial support.

For an illustration of the baseline and project scenario for afforestation (carbon stock enhancement), please see Figure 2.

Figure 3: Typical baseline and project scenario for afforestation



Source: UNFCCC (2022): CDM Methodology Booklet, p. 280.

In determining the project lifetime, and thus the carbon stock enhancements taken into account, the specifications described in section 4.4 are used as a guideline.

5 years project duration + 10 years of continued mitigation activity

If a shorter period can be found in the project data, then this should be used. A longer period is not intended due to the principle of conservativeness.

Please note: For the lifetime of projects, it must be clearly demonstrated that the project practice will continue over the reporting period. A rationale must be explained in the IKI Standard Indicator Report (Excel Tool) and may differ from agriculture projects (see Section 4.4)

It is assumed that there will be no activity displacement, leading to **leakage** being set at zero.

5.2.1 Project boundary

A vital step in projects that focus on storing more carbon in farming and forestry areas is to clearly define the project's area. It involves choosing the specific areas where the changes in carbon stock will be measured. In addition to defining the geographical scope, selecting the right carbon pools is crucial. Carbon pools refer to different components of the ecosystem where carbon is stored (see Table 1). Each of these pools can store different amounts of carbon and has different rates of carbon sequestration and release. By choosing which carbon pools to monitor, the project can get a more accurate picture of the overall carbon impact of the project.

Example 2: Carbon Stock Enhancement - Afforestation/Reforestation
The **project boundary** was defined as the geographical project area (in ha) and the inclusion of all carbon pools and all significant anthropogenic GHG emissions. ***Spatial extent:*** *342 ha* **Carbon pools:** *Above-ground biomass, Below-ground biomass, Dead wood Litter and Soil organic carbon*

5.2.2 Baseline and project carbon stocks and leakage emissions

Establishing **baseline carbon stocks** includes assessing current land use and forestry practices and analyzing historical data to model the expected carbon stocks without the project. Engagement with local stakeholders and analysis of historical trends, such as deforestation rates and land use changes, are integral to this assessment. Alternatively, newer digital solutions can be used (see section 4.2)

For **projects enhancing carbon stocks**, the focus is on the net increase in carbon storage achieved through project activities. This includes carbon stored through activities such as afforestation, improved forest management, or changes in soil management practices. However, it's important to note that any greenhouse gas emissions resulting from the implementation of these projects must be subtracted from the calculated project carbon stocks to get a true net value. These emissions can arise from various sources, such as:

- The use of machinery for planting or land preparation, which might emit CO_2.
- Fertilizer application in agroforestry projects leading to N_2O emissions.
- Any initial clearing or site preparation that might release stored carbon.

The net carbon stock enhancement is, therefore, the total carbon sequestered minus the GHG emissions from project activities.

Leakage emissions in the context of carbon stock enhancement could include the displacement of activities leading to carbon stock decreases outside the project area, such as shifting deforestation to other areas.

Overall, the complex nature of natural processes does not allow full coverage of the calculations of carbon stock enhancements for all project types. This is because varying indicators must be considered in differing contexts, necessitating the use of distinct formulas to accurately derive the results. But **methodologies (see section 4.2) typically provide detailed guidance on how to approach these assessments, tailoring the approach to specific project types.**

Here is a simplified overview of the process, which is described in more detail and tailored to specific project types in suitable methodologies:

1. **Initial Assessment and Baseline Establishment:**
    - Projects start by assessing the existing carbon stock on the degraded land. This involves measuring soil and vegetation carbon content at year = 0 and establishing a baseline for carbon stock developments without project implementation against which future carbon stocks through project implementation are compared (for simplified estimation: methodology usually provide standardized factors).

2. **Measurement of Tree Growth:**
    - Regular measurements of tree growth, including height, diameter, and density, are conducted to estimate biomass accumulation. This data forms the basis for calculating the increase in carbon stocks (for simplified estimation: methodology usually provide standardized factors).
3. **Application of Conversion Factors:**
    - Biomass measurements are converted to carbon stock estimates using conversion factors. A typical factor is 0.47, indicating that 47% of the biomass is carbon (apart from e.g. water). Additional factors for wood density of specific species and below-ground biomass may also be applied (see methodology).
4. **Soil Carbon Changes:**
    - Changes in soil carbon stocks due to the project are assessed through soil sampling and analysis, with appropriate conversion factors applied to estimate carbon stock changes.
5. **Conversion of Carbon to Carbon Dioxide Equivalents (CO_2e)**
    - Carbon (C) has a weight of about 12 units, and carbon dioxide (CO_2), which has one carbon atom and two oxygen atoms, has a weight of about 44 units.
        - Conversion Formula: To convert carbon to CO_2, multiply the amount of carbon by $\frac{44}{12}$ (the ratio of their weights).
        - Example: If you have 1 kg of carbon stored, it would be equivalent to $1 \times \frac{44}{12}$ kilograms of CO_2, which is about 3.67 kilograms of CO_2.
    - To standardize different types of greenhouse gases, emissions from project activities are to be converted to CO_2 equivalents using global warming potential (GWP) factors.
6. **Net Carbon Gains Calculation:**
    - The net increase in carbon stocks is calculated by subtracting the baseline carbon stocks from the measured stocks in the project scenario, adjusted for leakage emissions, uncertainties and using conservative estimates (see equation 2 in section 4.1).

For different types of mitigation activities, baseline carbon stocks, project carbon stocks, and leakage emissions can vary significantly. Here are some examples for each carbon stock enhancement project type mentioned in section 3:

Table 4: Carbon stock enhancement examples for baseline and project carbon stocks and leakage emissions

Project Type	Baseline Carbon Stocks	Project Carbon Stocks	Leakage Emissions
Afforestation / Reforestation (A/R)	Low due to deforested or degraded lands	Increased through planting of new forests	Potential deforestation in nearby areas

Project Type	Baseline Carbon Stocks	Project Carbon Stocks	Leakage Emissions
Agroforestry	Low in mono-cropped or degraded agricultural lands	Higher through integration of trees with crops/livestock	Risk of land use change in nearby areas due to reduced agricultural space
Peatland Restoration	Reduced due to drained or degraded peatlands	Increased by restoring water levels and natural vegetation	Displacement of activities causing degradation to other peatlands
Coastal Wetland Restoration	Reduced due to degraded or converted wetlands	Increased through restoration of mangroves, marshes, and seagrass	Possible impact on nearby undeveloped wetlands

Following the detailed explanation of carbon stocks and the outlined estimation process, including some examples (for other project types see corresponding methodologies in section 4.2), the focus now shifts to the crucial first step in estimating carbon stock enhancements: the determination of project carbon stocks. **Project carbon stocks** represent the net changes in carbon stock during the project lifecycle minus emissions directly resulting from project activities (such as herbaceous vegetation removal, fossil fuel combustion of machines, fertiliser application, wood utilisation, litter decomposition, fine roots decomposition of N-fixing trees, construction of access roads within the project boundary, and transportation linked to the project activity), adjusted for any additional changes due to (e.g. biophysical) interactions related to the project. These carbon stocks encompass all the carbon sequestered due to the afforestation activities, including any changes caused by the project's influence on the local environment.

Example 2: Carbon Stock Enhancement - Afforestation/Reforestation

The actual net GHG removals of the project shall be calculated as follows:

$$PCS_y = \Delta C_{P,y} - GHG_{E,y} \qquad \text{Equation (10)}$$

Where:

PCS_y = Actual net GHG removals by sinks, in year t; t CO_2-e

$\Delta C_{P,y}$ = Change in the carbon stocks in project, occurring in the selected carbon pools, in year y; t CO_2-e

$GHG_{E,y}$ = Increase in non-CO_2 GHG emissions within the project boundary as a result of the implementation of the A/R CDM project activity, in year y, as estimated in the tool "Estimation of non-CO_2 GHG emissions resulting from burning of biomass attributable to an A/R CDM project activity"; t CO_2-e

The latter parameter focuses primarily on the increase in non-CO_2 GHG emissions within the project boundary (deemed negligible in this example), considering that CO_2 emissions are accounted for as changes in stock within various carbon pools during the carbon stock estimation process below.

Carbon stocks in the selected area and pools are typically gauged through field measurements on sample plots, leading to a plot-level estimate. An average carbon stock is derived from these plot estimates. Changes in carbon stocks for each pool are calculated by comparing successive stock measurements. While calculating the net change in carbon stocks, GHG emissions from project activities should be considered. However, in this example, these emissions are deemed negligible and recorded as zero.

If such emissions are significant, the CDM methodology provides tools to tackle such emissions (see section 4.2).

Change in the carbon stocks in project, occurring in the selected carbon pools in year t is calculated as follows:

$$\Delta C_{P,y} = \Delta C_{Tree\_Proj,y} + \Delta C_{Shrub\_Proj,y} + \Delta C_{DW\_Proj,y} + \Delta C_{LI\_Proj,y} + \Delta SOC_{AL,y} \quad \text{Equation (11)}$$

Where:

$\Delta C_{P,y}$ = Change in the carbon stocks in project, occurring in the selected carbon pools, in year y; t CO_2-e

$\Delta C_{Tree\_Proj,y}$ = Change in carbon stock in tree biomass in project in year y, tCO_2-e

$\Delta C_{Shrub\_Proj,y}$ = Change in carbon stock in shrub biomass in project in year y; tCO_2-e

$\Delta C_{DW\_Proj,y}$ = Change in carbon stock in dead-wood biomass in project in year y; tCO_2-e

$\Delta C_{LI\_Proj,y}$ = Change in carbon stock in litter biomass in project in year y, tCO_2-e$\Delta SOC_{AL,y}$ = Change in carbon stock in SOC in project, in year y; t CO_2-e

In the process of estimating carbon stock enhancements, attention turns to baseline carbon stocks. Baseline carbon stocks represent the hypothetical level of carbon stocks that would have been present without the project implementation. This measure is essential in evaluating the effectiveness of afforestation projects in enhancing carbon stocks, providing a benchmark against which the actual carbon stock changes due to the project are compared.

Example 2: Carbon Stock Enhancement - Afforestation/Reforestation

The baseline net GHG removals by sinks is calculated as follows:

$$BSC_y = \Delta C_{Tree\_BSL,y} + \Delta C_{Shrub\_BSL,y} + \Delta C_{DW\_BSL,y} + \Delta C_{LI\_BSL,y} \quad \text{Equation (12)}$$

Where:

BSC_y = Baseline net GHG removals by sinks in year y; t CO_2-e

$\Delta C_{Tree\_BSL,y}$ = Change in carbon stock in tree biomass in baseline in year y, tCO_2-e

$\Delta C_{Shrub\_BSL,y}$ = Change in carbon stock in shrub biomass in baseline in year y; tCO_2-e

$\Delta C_{DW\_BSL,y}$ = Change in carbon stock in dead-wood biomass in baseline in year y; tCO_2-e

$\Delta C_{LI\_BSL,y}$ = Change in carbon stock in litter biomass in baseline in year y, tCO_2-e

In the context of projects enhancing carbon stocks, **leakage** refers to unintended carbon stock changes outside the project boundary indirectly caused by the project's implementation. Leakage also includes uncertainty factors to account for variances in carbon stock estimates, addressing potential inaccuracies or unpredictability in calculations related to the project's indirect effects.

Example 2: Carbon Stock Enhancement - Afforestation/Reforestation

Leakage emissions shall be estimated as follows :

$$LE_y = LK_{Agric,y} \qquad \text{Equation (13)}$$

Where:

LE_y = GHG emissions due to leakage, in year y; t CO_2-e

$LK_{Agric,y}$ = Leakage due to the displacement of agricultural activities in year y, tCO_2-e

To calculate alterations in carbon stocks, the CDM tools "Estimation of carbon stocks and changes in carbon stocks of trees and shrubs in A/R CDM project activities" (AR-Tool 14), "Tool for estimating changes in soil organic carbon stocks due to the implementation of A/R CDM project activities" (AR-Tool 16), "Estimation of the increase in GHG emissions linked to the displacement of pre-project agricultural activities in A/R CDM project activities" (AR-Tool 15), and "Estimation of non-CO_2 GHG emissions resulting from biomass burning related to an A/R CDM project activity" (AR-Tool 08) can be utilised.

Based on the general approach in Section 4 and the applied methodology described above, the carbon stock enhancement for the first year of project implementation is calculated as follows:

Example 2: Carbon Stock Enhancement – Afforestation/Reforestation

The **baseline carbon stocks** are calculated using the above-mentioned equation 5. This involves estimating the changes in carbon stock that would have occurred in the absence of the afforestation project. The calculation aggregates changes across various carbon pools - tree biomass, shrub biomass, dead-wood, and litter biomass. These carbon pools collectively represent the potential carbon that could have been sequestered naturally, without any intervention. Since the baseline scenario assumes the land continues its current use as pastureland, it is anticipated that there will be no biomass growth - thus no significant changes in these carbon pools - leading to the conclusion that carbon removals in the baseline scenario are effectively zero.

BSC_y = 0 tCO_2e/year

Moreover, there is no activity displacement expected, so **leakage** is also set as zero.

LE_y = 0 tCO_2e/year

The calculation of **project carbon stocks** involves assessing net GHG removals of carbon sinks and non-CO_2 emissions resulting from activities prior to replanting of the land. There was no change in the non-CO_2 GHG emissions within the project boundary as a result of the implementation of the project activity. Therefore, it was also set at zero.

$GHG_{E,y}$ = 0 tCO_2e/year

Lastly, the computation of $\Delta C_{Tree\_Proj,y}$, pertaining to the tree biomass pool, is conducted in accordance with the calculations outlined in the methodology, utilising data derived from the project. The ensuing calculation is presented below.

$\Delta C_{Tree\_Proj,y}$ = Biomass increment above and below ground per hectare per year (b_{TREE}) * Carbon Factor (CFTREE) * CO_2 Factor (44/12) * Plantation Area

$\Delta C_{Tree\_Proj,y}$ = 37.44 t/ha/year * 0.47 * 44/12 * 342.7773 ha

$\Delta C_{Tree\_Proj,y}$ ≈ 22,115 tCO_2e/year

The same calculation approach was applied for the remaining carbon pools.

$PCSy = \Delta C_{Tree\_Proj,y} + \Delta C_{Shrub\_Proj,y} + \Delta C_{DW\_Proj,y} + \Delta C_{LI\_Proj,y} + \Delta SOC_{AL,y}$

$PCSy = 22{,}115 + 0 + 221 + 221 + 735$

$PCSy = 23{,}292\ tCO_2e/year$

The project plans to reforest 342 ha of degraded land, creating a natural carbon sink capable of removing 23,292 tCO_2e/year. Subtracting baseline carbon stocks and leakage, as indicated in equation 2, leads to the final equation of:

$CSE_{y=1} = 23{,}292 - 0 - 0 = 23{,}292\ \mathbf{tCO_2e/year}$	Equation (14)

For more details on the calculations, please consult the filled in IKI Standard Indicator Report for the project example available on the IKI website.

Key parameters required for the calculation

For calculating the carbon stock enhancement for A/R projects, the following parameters are required. Potential default values are listed in Table 5 (see Section 6 below).

Parameter	Unit	Value / source
Area to be planted	ha	Project data
Planting density	plants/ha	Project data
Species	-	Project data
Information on the previous land use in the project area	-	Project data

Carbon stock changes in carbon pools		
Above-ground biomass (AGB)	tCO_2/ha/year	Calculated following the CDM methodology AR-ACM0003, applying default values listed in Section 6, CDM tool used: AR-Tool 14
Below-ground biomass (BGB)	tCO_2/ha/year	Calculated following the CDM methodology AR-ACM0003, applying default values listed in Section 6, CDM tool used: AR-Tool 14
Dead wood (DW)	tCO_2/ha/year	Calculated following the CDM methodology AR-ACM0003, applying default values listed in Section 6, CDM tool used: AR-Tool 12
Litter (LI)	tCO_2/ha/year	Calculated following the CDM methodology AR-ACM0003, applying default values listed in Section 6, CDM tool used: AR-Tool 12
Soil Organic Carbon (SOC)	tCO_2/ha/year	Calculated following the CDM methodology AR-ACM0003, applying default values listed in Section 6, CDM tool used: AR-Tool 16
Leakage (LK)	tCO_2/ha/year	Calculated following the CDM methodology AR-ACM0003, applying default values listed in Section 6, CDM Tool used: AR-Tool 15

5.3 Mitigation estimation using the IKI Standard Indicator Report (Excel Tool)

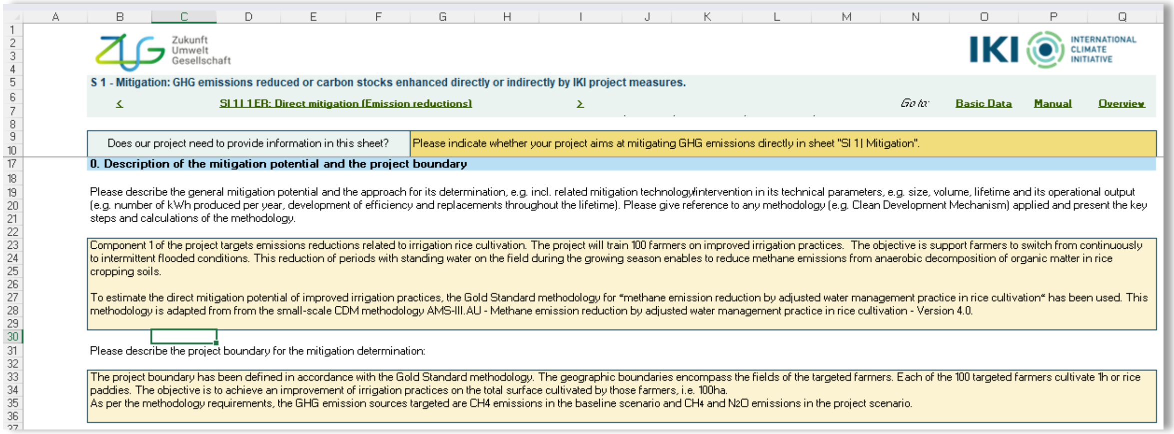
IKI projects are required to use the IKI Standard Indicator Report (Excel Tool) to collect project-level data on those IKI Standard Indicators that are relevant to the project. In this subchapter, it is shown how to enter data on the example project in the IKI SI Report Excel file. The filled-in Excel tool illustrating the project examples can be accessed on the IKI website.

Input method for mitigation potential calculations

In the IKI Standard Indicator Report (Excel Tool) any cells where projects should enter data or information are yellow. Instructions on the information that should be provided in the yellow cell can be found in in the text above the cell. In some cases, additional explanatory text will appear in a pop-up window, if the cell is selected. The tool leads the user through the different steps required to calculate the project's mitigation effects, as outlined above. There are separate sheets for direct and indirect mitigation. While the calculations for direct and indirect mitigation follow the same structure, this guidance document describes the approach to assess a project's direct mitigation (i.e. sheet SI1 | 1 ER in the Excel Tool).

The following list provides a brief overview of the steps required to calculate the project's direct mitigation potential:

0) **Project description, scope, and project boundary** (sheet SI1 | 1 ER and sheet SI1 | 1 CSE): In the beginning, the project's background, scope and potential mitigation, incl. the approach for its determination and the project boundary, are narratively described.



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IKI INTERNATIONAL CLIMATE INITIATIVE

S 1 - Mitigation: GHG emissions reduced or carbon stocks enhanced directly or indirectly by IKI project measures.

< SI 1 | 1 ER: Direct mitigation (Emission reductions) > Go to: Basic Data Manual Overview

Does our project need to provide information in this sheet?	Please indicate whether your project aims at mitigating GHG emissions directly in sheet "SI 1 | Mitigation".

0. Description of the mitigation potential and the project boundary

Please describe the general mitigation potential and the approach for its determination, e.g. incl. related mitigation technology/intervention in its technical parameters, e.g. size, volume, lifetime and its operational output (e.g. number of kWh produced per year, development of efficiency and replacements throughout the lifetime). Please give reference to any methodology (e.g. Clean Development Mechanism) applied and present the key steps and calculations of the methodology.

Component 1 of the project targets emissions reductions related to irrigation rice cultivation. The project will train 100 farmers on improved irrigation practices. The objective is support farmers to switch from continuously to intermittent flooded conditions. This reduction of periods with standing water on the field during the growing season enables to reduce methane emissions from anaerobic decomposition of organic matter in rice cropping soils.

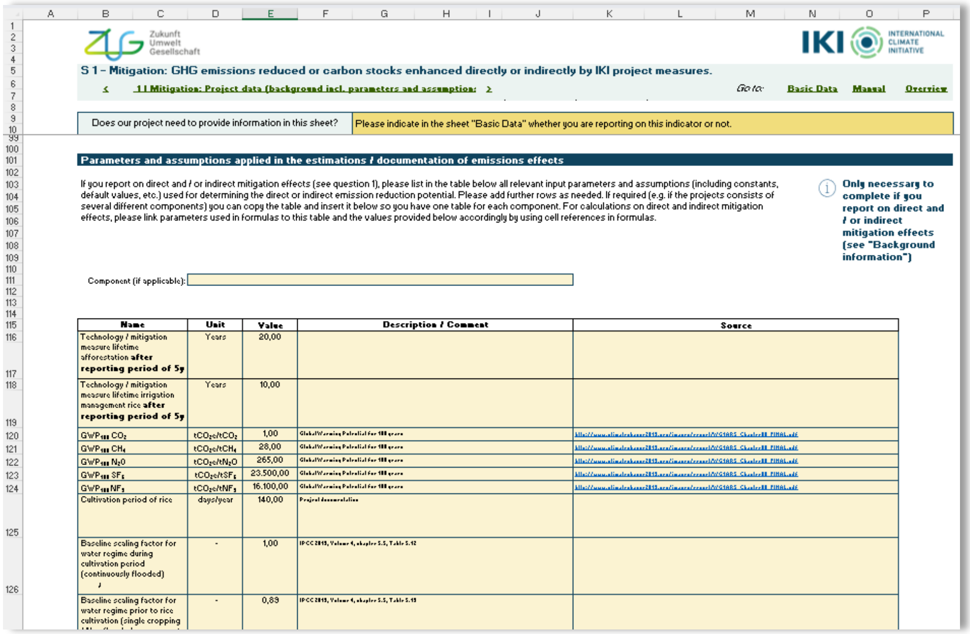
To estimate the direct mitigation potential of improved irrigation practices, the Gold Standard methodology for "methane emission reduction by adjusted water management practice in rice cultivation" has been used. This methodology is adapted from from the small-scale CDM methodology AMS-III.AU - Methane emission reduction by adjusted water management practice in rice cultivation - Version 4.0.

Please describe the project boundary for the mitigation determination:

The project boundary has been defined in accordance with the Gold Standard methodology. The geographic boundaries encompass the fields of the targeted farmers. Each of the 100 targeted farmers cultivate 1h or rice paddies. The objective is to achieve an improvement of irrigation practices on the total surface cultivated by those farmers, i.e. 100ha.
As per the methodology requirements, the GHG emission sources targeted are CH4 emissions in the baseline scenario and CH_4 and N_2O emissions in the project scenario.

1) **Parameters and assumptions applied in the estimations / documentation of emissions effects** (sheet SI1 | 1 ER and sheet SI1 | 1 CSE with reference to SI1 | Mitigation): For the calculation all parameters needed to estimate the mitigation potential should be included and transparently listed. The source and units of the respective parameters should be mentioned, making use of and direct referencing to the table for *Parameters and assumptions applied* in sheet SI1 | Mitigation. For the project examples, the baseline emission factor must be calculated to assess the baseline emissions associated with the rice cultivation under permanent flooded conditions. When filling all calculation tables, reference to the parameter sheet in the general information Sheet SI1 | Mitigation should be made.

Parameter table:



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IKI INTERNATIONAL CLIMATE INITIATIVE

S 1 – Mitigation: GHG emissions reduced or carbon stocks enhanced directly or indirectly by IKI project measures.

< 1 | Mitigation: Project data (background incl. parameters and assumption: > Go to: Basic Data Manual Overview

Does our project need to provide information in this sheet?	Please indicate in the sheet "Basic Data" whether you are reporting on this indicator or not.

Parameters and assumptions applied in the estimations / documentation of emissions effects

If you report on direct and / or indirect mitigation effects (see question 1), please list in the table below all relevant input parameters and assumptions (including constants, default values, etc.) used for determining the direct or indirect emission reduction potential. Please add further rows as needed. If required (e.g. if the projects consists of several different components) you can copy the table and insert it below so you have one table for each component. For calculations on direct and indirect mitigation effects, please link parameters used in formulas to this table and the values provided below accordingly by using cell references in formulas.

Only necessary to complete if you report on direct and / or indirect mitigation effects (see "Background information")

Component (if applicable):

Name	Unit	Value	Description / Comment	Source
Technology / mitigation measure lifetime afforestation **after reporting period of 5y**	Years	20,00		
Technology / mitigation measure lifetime irrigation management rice **after reporting period of 5y**	Years	10,00		
GWP$_{100}$ CO_2	tCO_2e/tCO_2	1,00	Global Warming Potential for 100 years	[illegible]
GWP$_{100}$ CH_4	tCO_2e/tCH_4	28,00	Global Warming Potential for 100 years	[illegible]
GWP$_{100}$ N_2O	tCO_2e/tN_2O	265,00	Global Warming Potential for 100 years	[illegible]
GWP$_{100}$ SF_6	tCO_2e/tSF_6	23.500,00	Global Warming Potential for 100 years	[illegible]
GWP$_{100}$ NF_3	tCO_2e/tNF_3	16.100,00	Global Warming Potential for 100 years	[illegible]
Cultivation period of rice	days/year	140,00	Project documentation	
Baseline scaling factor for water regime during cultivation period (continuously flooded)	-	1,00	IPCC 2019, Volume 4, chapter 5.5, Table 5.12	
Baseline scaling factor for water regime prior to rice cultivation (single cropping ...	-	0,89	IPCC 2019, Volume 4, chapter 5.5, Table 5.13	

Parameters needed to calculate emissions or carbon stocks can then be linked to the parameter table, e.g. for the calculation of baseline emissions or carbon stocks:

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S 1 - Mitigation: GHG emissions reduced or carbon stocks enhanced directly or indirectly by IKI projec

< SI 1 | 1 ER: Direct mitigation (Emission reductions) >

Does our project need to provide information in this sheet?	Please indicate whether your project aims a

Planned target estimate - "Baseline emissions"

Please use the table below to qutantify the baseline emission for the planned target estimate.

Item / Description	Row reference	Calculation / Source	Unit
Area of project fields with continuously flooded irrigation conditions	A	Project documentation	ha
Cultivation period of rice	B	Project documentation	days/year
Baseline scaling factor for water regime	C	IPCC 2019, Volume 4, chapter 5.5, Table	-
Baseline scaling factor for water regime prior	D	IPCC 2019, Volume 4, chapter 5.5, Table	-
Baseline scaling factor related to organic	E	IPCC 2019, Volume 4, chapter 5.5, Table	-
Default Emission factor - Global EF,BL,C	F	Gold Standard methodology for methane	kgCH4/ha/day
Baseline emission factor EF,BL	G	Calculated	kgCH4/ha/day
Baseline emissions - CH4	H	Calculated	kgCH4
GWP100 CH4	I	Global Warming Potential for 100 years	tCO2e/tCH4
	insert more ro		
		Baseline emissions (BE) per annum	tCO_2e
		Baseline emissions cumulative (BE)	tCO_2e

2) **Calculation tables for "Baseline emissions/carbon stocks, "Project emissions/carbon stocks" and "Leakage emissions"** (sheet SI1 | 1 ER and sheet SI1 | 1 CSE): The figures related to the used parameters are either directly entered or– where needed – calculated. Note: the grey cells are filled automatically based on the information provided in the yellow cells. For example, "Baseline emissions cumulative" are filled in automatically once the equation for calculating the baseline emissions per annum is filled.

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S 1 - Mitigation: GHG emissions reduced or carbon stocks enhanced directly or indirectly by IKI project measures.

< SI 1 | 1 ER: Direct mitigation (Emission reductions) > *Go to:* **Basic Data**

Does our project need to provide information in this sheet?	Please indicate whether your project aims at mitigating GHG emissions directly in sheet "SI 1 | Mitigation".

Planned target estimate - "Baseline emissions"

Please use the table below to qutantify the baseline emission for the planned target estimate.

Item / Description	Row reference	Calculation / Source	Unit	2020 Year 1	2021 Year 2	2022 Year 3	2023 Year 4	2024 Year 5
Area of project fields with continuously flooded irrigation conditions	A	Project documentation	ha	100,00	100,00	100,00	100,00	100,00
Cultivation period of rice	B	Project documentation	days/year	140,00	140,00	140,00	140,00	140,00
Baseline scaling factor for water regime	C	IPCC 2019, Volume 4, chapter 5.5, Table	-	1,00	1,00	1,00	1,00	1,00
Baseline scaling factor for water regime prior	D	IPCC 2019, Volume 4, chapter 5.5, Table	-	0,89	0,89	0,89	0,89	0,89
Baseline scaling factor related to organic	E	IPCC 2019, Volume 4, chapter 5.5, Table	-	1,48	1,48	1,48	1,48	1,48
Default Emission factor - Global EF,BL,C	F	Gold Standard methodology for methane	kgCH4/ha/day	1,19	1,19	1,19	1,19	1,19
Baseline emission factor EF,BL	G	Calculated	kgCH4/ha/day	1,57	1,57	1,57	1,57	1,57
Baseline emissions - CH4	H	Calculated	kgCH4	21.944,55	21.944,55	21.944,55	21.944,55	21.944,55
GWP100 CH4	I	Global Warming Potential for 100 years	tCO2e/tCH4	28,00	28,00	28,00	28,00	28,00
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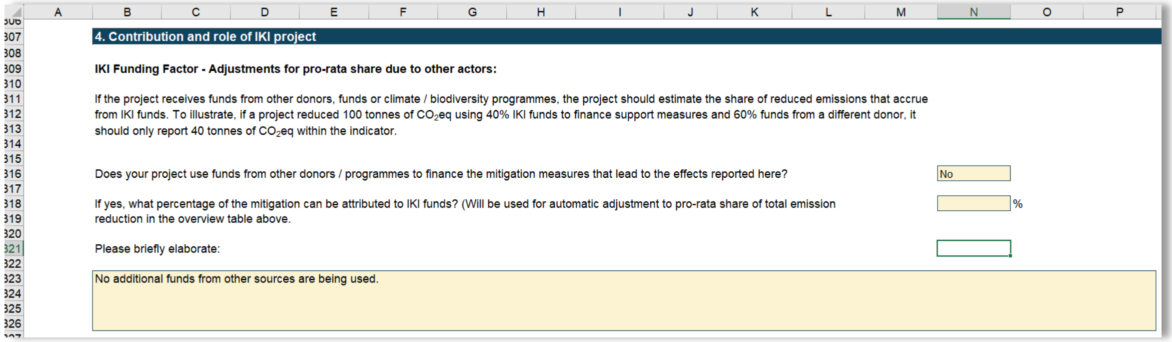
		Baseline emissions (BE) per annum	tCO_2e	614	614	614	614	614
		Baseline emissions cumulative (BE)	tCO_2e	614	1.229	1.843	2.458	3.072

3) The project figures or assumption for the “Baseline emissions/carbon stocks”, “Project emissions/carbon stocks”, and – if applicable – “Leakage emissions” are entered or calculated. For each of these three emission categories, there are two sections: i) **Planned target estimate** and ii) **Reporting**. Depending on the status of the project, e.g. the project’s planning or monitoring phase, the corresponding need tables needs to be filled or updated. See Guidelines on Project Planning and Monitoring in the International Climate Initiative for more information and the definition of **Planned target estimate** and **Reporting** figures.

4) **Contribution and role of IKI project** (sheet SI1 | 1 ER and sheet SI1 | 1 CSE): If the project receives fund from other donors, the project should estimate the share of reduced emissions that accrue from IKI funds. For instance, if a project reduced 100 tCO_2e using 40% IKI funds and 60% funds from a different donor, it should only report 40 tCO_2e within the indicator. The contribution estimation only applies for direct emission reductions and is not applicable for indirect mitigation.



5) **Overall accuracy and rebound effects** (sheet SI1 | 1 ER and sheet SI1 | 1 CSE): Lastly, users should describe any uncertainties regarding estimations and assumptions. Moreover, users should describe any rebound effects expected through the project and, if possible, provide an estimate of their scale.

6 Relevant default values and reference sources

The following table provides a short list of exemplary and useful default values for estimating the baseline and project emissions from AFOLU projects. For more specific and typical default values tailored to the particular types of these projects, refer to the corresponding methodologies. These methodologies contain comprehensive sets of default values and parameters, carefully defined to suit various project scenarios and conditions within the AFOLU sector.

Table 5: Default values, emission factors and references for mitigation estimation of AFOLU projects

Parameter	Value and Unit	Source
Overarching IPCC GHG guidance for AFOLU sector		
2019 Refinement to the 2006 IPCC Guidelines for National GHG Inventories - Volume 4 - Agriculture, Forestry and Other Land Use		
Forest Activities		
Carbon fraction of dry matter	0.47	IPCC Good Practice Guidance for LULUCF
Carbon conversion rate from C to CO_2	3.6667 (44/12)	IPCC Good Practice Guidance for LULUCF
Annual increment in volume of wood (species specific)	m^3/ha/year	IPCC – TABLE 3A.7 of ANNEX 3A.1 “Biomass Default Tables for Section 3.2 Forest Land” of IPCC Good Practice Guidance for LULUCF.
Wood Density (species specific)	tonnes dry matter/m^3 fresh volume	IPCC – TABLE 3A.1.9-2 of ANNEX 3A.1 “Biomass Default Tables for Section 3.2 Forest Land” of IPCC Good Practice Guidance for LULUCF
Biomass Expansion Factor	dimensionless	IPCC – TABLE 3A.1.10 of ANNEX 3A.1 “Biomass Default Tables for Section 3.2 Forest Land” of IPCC Good Practice Guidance for LULUCF
Root-Shoot-Ratio	dimensionless	IPCC – TABLE 3A.1.8 of ANNEX 3A.1 “Biomass Default Tables for Section 3.2 Forest Land” of IPCC Good Practice Guidance for LULUCF
Other important reference values	-	Biomass Default Tables and IPCC Good Practice Guidance for LULUCF More precise information can potentially be obtained through national sources such as the national forest inventory or the national GHG inventory. Additionally, utilising available local data, such as that from comparable ecological contexts, or referencing peer-reviewed literature can enhance accuracy.

For AFOLU projects, the EX-ACT can be used to create an overview of the expected emissions and carbon stock changes from different sources. It follows default values (IPCC tier 1) applicable for different project contexts but can be updated with more accurate values if those are available for the project.

References

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