10 Monitoring performance over time

Monitoring during the policy implementation period serves two objectives. It allows users to evaluate the performance of a policy by monitoring trends in performance to understand whether the policy is on track and being implemented as planned. It also allows users to collect the information needed to quantify the GHG impacts during or after policy implementation. This chapter identifies data and parameters to monitor over time, and provides a method to develop a monitoring plan.

Checklist of key recommendations

- Identify the key performance indicators that will be used to track performance of the policy over time and define the parameters necessary to estimate GHG emissions ex-post
- Create a plan for monitoring key performance indicators and parameters
- Monitor each of the indicators and parameters over time, in accordance with the monitoring plan

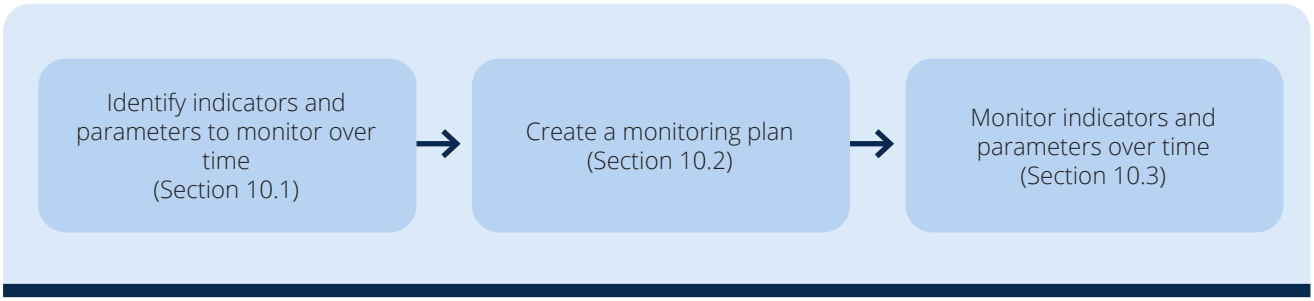
10.1 Identify indicators and parameters to monitor over time

This section describes the key performance indicators and parameters to monitor. A key performance indicator is a metric that indicates the performance of a policy (such as tracking changes in targeted outcomes). A parameter is a variable such as activity data or an emission factor that is needed to estimate emissions. Data are collected for indicators and parameters during or after the monitoring period. It is a *key recommendation* to identify the key performance indicators that will be used to track performance of the policy over time and define the parameters necessary to estimate GHG emissions ex-post.

Where the results of the assessment will be used to inform GHG accounting and reporting of progress made towards implementation and achievement of NDCs, and meet the reporting requirements of the transparency framework, the indicators and parameters listed in Tables 10.1–10.3 to monitor progress towards achieving GHG emissions reductions from the implementation of forest policies can also serve as inputs to monitor progress towards achieving national GHG reduction targets, such as NDCs.

FIGURE **10.1**

Overview of steps in the chapter



10.1.1 Key performance indicators

Table 10.1 defines, and provides examples of, the types of key performance indicators: inputs, administrative activities, intermediate effects, barriers, GHG impacts and sustainable development impacts.

10.1.2 Parameters

Table 10.2 defines and describes the three types of parameters: assumptions, activity data and carbon stock change factors.

TABLE **10.1**

Key performance indicators to monitor

Key performance indicator	Definition	Example
Inputs	Resources that go into implementing the policy	Taxation of ecosystem service users
Administrative activities	Administrative activities involved in implementing the policy	Number of contracts executed with landowners
Intermediate effects	Changes in behaviour, technology, processes or practices	Survival and growth of trees
Barriers	Activities that may limit the effectiveness of the policy	Degree to which corruption rules and regulations were enforced
GHG impacts	Changes in GHG emissions by sources or removals by sinks that result from the intermediate effects of the policy	Increased sequestration from biomass accumulation
Sustainable development impacts	Changes in relevant environmental, social or economic conditions that result from the policy	Number of endangered species planted

Source: Adapted from WRI (2014).

TABLE **10.2**

Parameters to monitor

Parameter	Definition	Example
Assumptions	Data that influence estimation of parameters	GDP
Activity data	A quantitative measure of a level of activity that results in GHG emissions. Activity data are multiplied by an emission factor to derive the GHG emissions associated with a process or an operation.	Non-forest land converted to forest land
Carbon stock change factors	The average emissions rate of a given GHG for a given source, relative to units of activity and the data needed to choose or derive emission factors.	CO_2 removals per hectare

Table 10.3 further elaborates specific parameters for A/R, SFM and reduced deforestation. In some cases, parameters may also be used as key performance indicators, as noted in the table. Parameters are organized by those needed for estimating GHG impacts of land-use change or of land management change. Those that are relevant to land management change on forest land remaining forest land are organized by the stock-difference method or the gain–loss method. Parameters that are needed regardless of land-use change or land management change are listed under "All". Parameters needed to estimate GHG impacts that can also be used to monitor policy performance are also designated as key performance indicators. The data needed to monitor these parameters may be measured, modelled or estimated. A suggested monitoring frequency is also provided. For parameters that are suggested to be monitored periodically, users can monitor annually, every 5 years or every 10 years, depending on data availability and the desired level of certainty.

TABLE 10.3

Monitoring parameters

Parameter and unit	Potential sources of data	Parameter type	Suggested monitoring frequency
All			
Land-use classification (by ecological domain and climate zone) (unitless)	Remotely sensed and aerial imagery Land-cover maps National forest inventory GHG inventory reports IPCC 2006 GL,[a] Table 4.1	Assumption	Once Can be updated in conjunction with collecting data on the area of land in each stratum
Carbon fraction of dry matter $CF_{i,j}$ (tonnes C per tonne dry matter)	IPCC 2006 GL,[a] Table 4.3 Published data	Carbon stock change calculation	Once per type
Land-use change			
Area of forest land converted to non-forest land (ha)	Remotely sensed and aerial imagery Land-cover maps National forest inventory GHG inventory reports	Activity data Key performance indicator	At least twice (at beginning and end of policy implementation period) or periodically during policy implementation period
Area of land converted to forest land (ha)	Remotely sensed and aerial imagery Land-cover maps National forest inventory GHG inventory reports	Activity data Key performance indicator	At least twice (at beginning and end of policy implementation period) or periodically during policy implementation period

TABLE **10.3,** continued

Monitoring parameters

Parameter and unit	Potential sources of data	Parameter type	Suggested monitoring frequency
Biomass carbon stocks on land type *i*, after the conversion $B_{after,i}$ (tonnes dry matter per ha)	Measured samples for tree attributes, such as diameters and heights, and applying species-specific allometric equations or biomass tables, from national forest inventory or country-specific research studies GHG inventory reports IPCC 2006 GL,[a] Tables 4.7, 4.8 and 4.12, for above-ground biomass carbon stocks in forests IPCC 2006 GL,[a] Table 5.9, for default biomass carbon stocks on cropland (tonnes C per ha) IPCC 2006 GL,[a] Table 6.4, for default biomass stocks on grassland	Carbon stock change calculation Key performance indicator	Once
Biomass carbon stocks on land type *i*, before the conversion $B_{before,i}$ (tonnes dry matter per ha)	Measured samples for tree attributes, such as diameters and heights, and applying species-specific allometric equations or biomass tables, from national forest inventory or country-specific research studies GHG inventory reports IPCC 2006 GL,[a] Tables 4.7, 4.8 and 4.12, for above-ground biomass carbon stocks in forests IPCC 2006 GL,[a] Table 5.9, for default biomass carbon stocks on cropland (tonnes C per ha) IPCC 2006 GL,[a] Table 6.4, for default biomass stocks on grassland	Carbon stock change calculation	Once
Forest land remaining forest land: all			
Area of forest land remaining forest land (ha)	Remotely sensed and aerial imagery Land-cover maps National forest inventory GHG inventory reports	Activity data Key performance indicator	At least twice (at beginning and end of policy implementation period) or periodically during policy implementation period
Ratio of below-ground to above-ground biomass $R_{i,j}$ (tonnes dry matter below-ground biomass per tonne dry matter above-ground biomass)	IPCC 2006 GL,[a] Table 4.4	Carbon stock change calculation	Once per type

TABLE **10.3,** continued

Monitoring parameters

Parameter and unit	Potential sources of data	Parameter type	Suggested monitoring frequency
Forest land remaining forest land: stock-difference method			
Forest carbon stock at time t_1 C_{t_1} (tonnes C)	Measured samples for tree attributes, such as diameters and heights, and applying species-specific allometric equations or biomass tables, from national forest inventory or country-specific research studies Estimated using IPCC 2006 GL,[a] equation 2.8	Carbon stock change calculation Key performance indicator	Once at the beginning of a time interval The time interval may correspond to the policy implementation period or a shorter interval within the policy implementation period.
Forest carbon stock at time t_2 C_{t_2} (tonnes C)	Measured samples for tree attributes, such as diameters and heights, and applying species-specific allometric equations or biomass tables, from national forest inventory or country-specific research studies Estimated using IPCC 2006 GL[a] equation 2.8	Carbon stock change calculation Key performance indicator	Once at the end of a time interval The time interval may correspond to the policy implementation period or a shorter interval within the policy implementation period.
Merchantable growing stock volume $V_{i,j}$ (m^3 per hectare)	National forest inventory GHG inventory reports Harvest or timber sale records	Carbon stock change calculation (parameter in IPCC 2006 GL,[a] equation 2.8) Key performance indicator	Twice, in conjunction with estimating C_{t_1} and C_{t_2} One or more time intervals may be monitored within the policy implementation period.
Biomass conversion and expansion factor $BCEF_{S_{i,j}}$ (tonnes above-ground biomass grown per m^3 of growing stock volume)	IPCC 2006 GL,[a] Table 4.5	Carbon stock change calculation (parameter in IPCC 2006 GL,[a] equation 2.8)	Once per type
Forest land remaining forest land: gain–loss method			
Above-ground biomass growth rate $G_{W_{i,j}}$ (tonnes dry matter per ha)	Measured samples for tree attributes, such as diameters and heights, and applying species-specific allometric equations or biomass tables, from national forest inventory or country-specific research studies GHG inventory reports IPCC 2006 GL,[a] Table 4.12 Derived from mean annual increment (default values available in IPCC 2006 GL,[a] Tables 4.11A and 4.11B) and IPCC 2006 GL,[a] equation 2.10	Carbon stock change calculation Key performance indicator	Periodically

TABLE **10.3,** continued

Monitoring parameters

Parameter and unit	Potential sources of data	Parameter type	Suggested monitoring frequency
Annual above-ground biomass C loss due to wood removals $L_{wood-removals}$ (tonnes C per year)	Estimated using IPCC 2006 GL,[a] equation 2.12 National forest inventory Harvest or timber sale records	Carbon stock change calculation Key performance indicator	Periodically
Annual above-ground biomass C loss due to fuelwood removals $L_{fuelwood}$ (tonnes C per year)	Estimated using IPCC 2006 GL,[a] equation 2.13 National forest inventory	Carbon stock change calculation Key performance indicator	Periodically
Annual above-ground biomass carbon losses due to disturbances $L_{disturbance}$ (tonnes C per year)	Estimated using IPCC 2006 GL,[a] equation 2.14 National forest inventory	Carbon stock change calculation Key performance indicator	Periodically

[a] IPCC 2006 GL, volume 4, *Agriculture, Forestry and Other Land Use*

10.2 Create a monitoring plan

A monitoring plan is important to ensure that the necessary data are collected and analysed. It is a *key recommendation* to create a plan for monitoring key performance indicators and parameters. A monitoring plan is the system for obtaining, recording, compiling and analysing data and information important for tracking performance and estimating GHG impacts. Where possible, a monitoring plan should be developed before policy implementation. Doing so can ensure that the data needed to assess the effectiveness of the policy are collected.

In some reporting or decision-making cases, assessment objectives may require an estimate or description of assessment uncertainty. This could include documentation of the method or approach used to assess uncertainty and/or sensitivity of the results as a function of parameters, scenarios or models used. Qualifying or quantifying uncertainty can help users to choose assessment methods, prioritize data-collection efforts, interpret or compare estimation results, and/or identify estimation improvement efforts over time. Chapter 12 of the *Policy and Action Standard* provides methodological guidance for qualifying or quantifying uncertainty associated with an estimate of a policy's GHG impact.

The elements below should be described in the monitoring plan.

10.2.1 Monitoring period

The policy implementation period is the time for which the policy is in effect. The assessment period is the time for which the GHG impacts resulting from the policy are assessed. The monitoring period is the time for which the policy is monitored.

At a minimum, the monitoring period should include the policy implementation period. Users can have multiple monitoring periods for separate assessment periods. A monitoring period can also include monitoring of relevant activities before implementation of the policy and after the policy implementation period.

Users should strive to align the monitoring period with those of other assessments being conducted

using other ICAT methodologies. For example, if assessing sustainable development impacts using the ICAT *Sustainable Development Guide* in addition to assessing GHG impacts, the monitoring periods should be the same.

10.2.2 Institutional arrangements for coordinated monitoring

Information on key performance indicators and parameters can be dispersed among different institutions. Given the wide variety of data needed for impact assessment and the range of stakeholders involved, strong institutional arrangements serve an important function. They play a central role in coordinating monitoring. A technical coordinator, coordinating team or body is often assigned to lead monitoring, reporting and verification (MRV) processes in which responsibilities have been delegated to different institutions. The coordinating body oversees the procedures for data collection, management and reporting.

Countries may already have institutions in place as part of a national MRV system. In this case, users can consider expanding the national MRV system to also monitor the impact of the policy. Where strong institutional arrangements do not yet exist, users can determine the governmental body with the adequate capacity and authority to be responsible for the MRV system and to establish the necessary legal arrangements. Institutional mandates help to strengthen the procedures and the system, and may also help secure funding from the government to ensure the continuity of the process.

Users can refer to the UNFCCC *Toolkit for Non-Annex I Parties on Establishing Institutional Arrangements for National Communications and Biennial Update Reports*,[31] as well as other sources, for support on establishing or improving the institutional arrangements for a robust MRV system.

10.2.3 Considerations for a robust monitoring plan

To ensure that the monitoring plan is robust, consider including the following elements in the plan:

- **Roles and responsibilities.** Identify the entity or person that is responsible for monitoring key performance indicators and parameters, and clarify the roles and responsibilities of the personnel conducting the monitoring.
- **Competencies.** Include information about any required competencies and any training needed to ensure that personnel have necessary skills.
- **Methods.** Explain the methods for generating, storing, collating and reporting data on monitored parameters.
- **Frequency.** Key performance indicators and parameters can be monitored at various frequencies, such as monthly, quarterly or annually. Determine the appropriate frequency of monitoring based on the needs of decision makers and stakeholders, cost, and data availability. In general, the more frequently data are collected, the more robust the assessment will be. Frequency of monitoring can be consistent with measurement conducted under the national MRV system.
- **Collecting and managing data.** Identify the databases, tools or software systems that are used for collecting and managing data and information.
- **Quality assurance and quality control (QA/QC).** Define the methods for QA/QC to ensure that the quality of data leads to confidence in the assessment results. QA is a planned review process conducted by personnel who are not directly involved in data collection and processing. QC is a procedure or routine set of steps performed by the personnel compiling the data to ensure the quality of the data.
- **Record keeping and internal documentation.** Define procedures for clearly documenting the procedures and approaches for data collection, as well as the data and information collected. This information is beneficial for improving the availability of information for subsequent monitoring events, documenting improvements over time and creating a robust historical record for archiving.
- **Continual improvement.** Include a process for improving the methods for collecting data, taking measurements, running surveys, monitoring impacts, and modelling or analysing data. Continual improvement of

[31] Available at: http://unfccc.int/files/national_reports/non-annex_i_natcom/training_material/methodological_documents/application/pdf/unfccc_mda-toolkit_131108_ly.pdf.

monitoring can help reduce uncertainty in GHG estimates over time.

- **Financial resources.** Identify the cost of monitoring and sources of funds.

10.3 Monitor indicators and parameters over time

It is a *key recommendation* to monitor each of the indicators and parameters over time, in accordance with the monitoring plan. The frequency of monitoring is dependent on stakeholder resources, data availability, feasibility, and the uncertainty requirement of reporting or estimation needs. The monitoring plan should include an iterative process for balancing these dependencies.

11 Reporting

Reporting the results, methodology and assumptions used is important to ensure that the GHG impact assessment is transparent, and gives decision makers and stakeholders the information they need to properly interpret the results. This chapter presents a list of information that is recommended for inclusion in an assessment report.

Checklist of key recommendations

- Report information about the assessment process and the GHG impacts resulting from the policy (including the information listed in Section 11.1)

11.1 Recommended information to report

It is a *key recommendation* to report information about the assessment process and the GHG impacts resulting from the policy (including the information listed below[32]). Where two or more assessment guides are applied to the policy, the general information and policy description only need to be reported once. For guidance on providing information to stakeholders, refer to the ICAT *Stakeholder Participation Guide* (Chapter 7).

General information

- The name of the policy assessed
- The person(s) or organization(s) that did the assessment
- The date of the assessment
- Whether the assessment is an update of a previous assessment, and, if so, links to any previous assessments

Chapter 2: Objectives of estimating GHG impacts

- The objective(s) and intended audience(s) of the assessment

Chapter 4: Steps and assessment principles

- Opportunities for stakeholders to participate in the assessment

Chapter 5: Describing the policy

- A description of the policy, including the recommended information in Table 5.1 and the additional information in Table 5.2
- Whether the assessment applies to an individual policy or a package of related policies; if a package is assessed, which policies are included in the package
- Whether the assessment is ex-ante, ex-post, or a combination of ex-ante and ex-post

Chapter 6: Identifying impacts: how forest policies reduce emissions or enhance removals

- A causal chain, including a table describing all intermediate effects
- A list of all GHG sources and carbon pools that are included in the GHG assessment boundary
- A list of potential GHG sources and carbon pools that are excluded from the GHG assessment boundary, with justification for their exclusion
- The assessment period

Chapter 7: Estimating the baseline scenario and emissions

- The method chosen (emissions approach or activity data approach) for estimating the policy's expected GHG impacts
- A description of the baseline scenario and justification for why it is considered the most likely scenario
- A list of the intended policy outcomes and associated target drivers

[32] The list does not cover all chapters in this document because some chapters provide information or guidance that is not relevant to reporting.

- Total annual and cumulative baseline emissions and removals over the GHG assessment period
- The methodology and assumptions used to estimate baseline emissions, including the emissions estimation methods (including any models) used
- Justification for the choice of whether to develop new baseline assumptions and data or to use published baseline assumptions and data
- A list of policies, actions and projects included in the baseline scenario
- A list of implemented or adopted policies, actions or projects that are expected to affect the GHG sources or carbon pools included in the GHG assessment boundary but are excluded from the baseline scenario, with justification for their exclusion
- Whether the baseline scenario includes any planned policies and, if so, which planned policies are included
- A list of non-policy drivers included in the baseline scenario
- A list of non-policy drivers that were considered for inclusion but are excluded from the baseline scenario, with justification for their exclusion
- The baseline values for key parameters (such as activity data, emission factors and global warming potential [GWP] values) in the baseline emissions estimation method(s)
- The methodology and assumptions used to estimate baseline values for key parameters, including whether each parameter is assumed to be static or dynamic, and assumptions regarding other policies/actions and non-policy drivers that are included in the baseline and affect each parameter
- All sources of data used to estimate key parameters, including activity data, emission factors, GWP values and assumptions
- The method or approach used to assess uncertainty
- An estimate or description of the uncertainty and/or sensitivity of the results, to help users of the information properly interpret the results

Chapter 8: Estimating GHG impacts ex-ante

- An estimate of the maximum implementation potential of the policy and a description of how it was estimated
- A description and justification for how policy design and national circumstances affect the maximum implementation potential of the policy, and a refined estimate of the implementation potential after accounting for policy design and national circumstances
- A description and justification for how financial feasibility affects the implementation potential of the policy, and a refined estimate of the implementation potential after accounting for the financial feasibility of the policy
- A description and justification for how other barriers affect the implementation potential of the policy, and a refined estimate of the implementation potential after accounting for other barriers
- Total annual and cumulative policy scenario emissions and removals over the GHG assessment period, if feasible based on the method used
- Year of expected fully realized GHG impact, if the policy implementation period or assessment period is shorter than the policy impact period
- An ex-ante estimate of the total net GHG impacts of the policy over the assessment period, and an estimate disaggregated by each GHG source and carbon pool included in the GHG assessment boundary
- Any methodologies and assumptions used to estimate policy scenario emissions, including the emissions estimation methods (including any models) used
- The policy scenario values for key parameters (e.g. activity data, emission factors, GWP values) in the emissions estimation method(s)
- The methodology and assumptions used to estimate policy scenario values for

key parameters, including whether each parameter is assumed to be static or dynamic

- All sources of data used to estimate key parameters, including activity data, emission factors, GWP values and assumptions
- The method or approach used to assess uncertainty
- An estimate or description of the uncertainty and/or sensitivity of the results, to help users of the information properly interpret the results

Chapter 9: Estimating GHG impacts ex-post

- The performance of the policy, including whether the inputs, activities and intermediate effects that were expected to occur, according to the causal chain, actually occurred
- Total annual and cumulative policy scenario emissions and removals over the GHG assessment period
- Year of expected fully realized GHG impact, if the policy implementation period or assessment period is shorter than the policy impact period.
- The methodology and assumptions used to estimate policy scenario emissions, including the emissions estimation methods (including any models) used
- All sources of data to estimate key parameters, including activity data, emission factors, GWP values and assumptions
- An estimate of the total cumulative GHG impacts of the policy over the assessment period, and disaggregated by each GHG source and carbon pool included in the GHG assessment boundary
- The method or approach used to assess uncertainty
- An estimate or description of the uncertainty and/or sensitivity of the results, to help users of the information properly interpret the results

Chapter 10: Monitoring performance over time

- A list of the key performance indicators used to track performance over time and the rationale for their selection
- Sources of key performance indicator data and monitoring frequency
- Additional information to report (if relevant)
- How the policy is modifying longer-term trends in GHG emissions and removals
- The economic, social and environmental (sustainable development) impacts of the policy
- The type of technical review undertaken (first, second or third party), the qualifications of the reviewers and the review conclusions. More guidance on reporting information related to technical review is provided in Chapter 9 of the ICAT *Technical Review Guide*