INITIATIVE FOR
Climate Action
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Greenhouse Gas Management Institute, Verra

Agriculture Guidance

Guidance for assessing the greenhouse gas impacts of agriculture policies

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How to monitor indicators over time and report results

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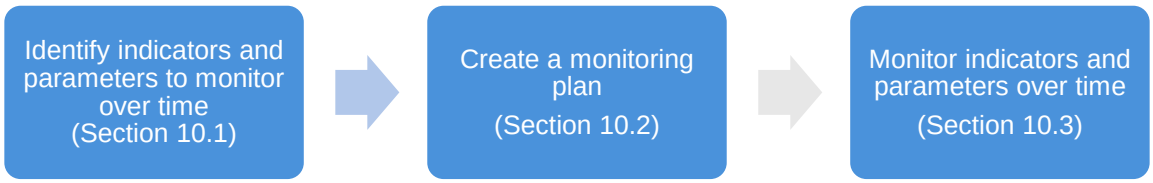
10. Monitoring Performance Over Time

Monitoring during the policy implementation period serves two objectives. It allows the user 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. Monitoring also allows the user to collect the information needed for the quantification of the GHG impacts during or after policy implementation. This chapter identifies data and parameters to monitor over time and provides guidance on how to develop a monitoring plan.

Figure 10.1: Overview of steps in the chapter



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 emission ex-post.

Key performance indicators

The following table defines and provides examples of the types of key performance indicators: inputs, activities, intermediate effects, GHG impacts and sustainable development impacts.

Table 10.1: Key performance indicators to monitor

Key performance indicators	Definition	Example key performance indicator
Inputs	Resources that go into implementing a policy	Budget allocation to agriculture extension service
Activities	Administrative activities involved in implementing the policy	Number offered and attendance at agriculture extension training sessions
Intermediate effects	Changes in behaviour, technology, processes or practices	Increase in rate of livestock weight gain
GHG impacts	Changes in GHG emissions by sources or removals by carbon pools that result from the intermediate effects of the policy	Decreased rate of enteric fermentation emissions per head of livestock
Sustainable development impacts	Changes in relevant environmental, social or economic conditions that result from the policy	Improved food security

Parameters

Table 10.2defines and describes the three types of parameters: assumptions, activity data and GHG emission factors.

Table 10.2: Parameters to monitor

Parameters	Definition	Data Example
Assumptions	Data that influence the estimated parameters	GDP
Activity data	A quantitative measure of a level of activity that results in GHG emissions. Activity data is multiplied by an emissions factor to derive the GHG emissions associated with a process or an operation.	Livestock population
GHG emission factors	The average emission rate of a given GHG for a given source, relative to units of activity and the data needed to choose or derive emission factors.	CH_4 per head of livestock

Table 10.3and Table 10.4further elaborate specific parameters for enteric fermentation and soil carbon, respectively. In some cases parameters may also be used as key performance indicators, as noted in the tables. Parameters are organised by those needed for either an IPCC Tier 1 or Tier 2 estimation of GHG emissions. Parameters that are needed for all types of GHG estimation methods, regardless of tier level, are listed under “All.” Parameters needed for estimating 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 desired level of certainty.

Table 10.3: Enteric fermentation monitoring parameters

Parameter and unit	Potential sources of data	Parameter type	Suggested monitoring frequency
All			
Livestock population categorisation: defining livestock groups according to species and diet (unitless)	Agriculture or livestock census Extrapolation from sample surveys	Assumption	Once Can be updated in conjunction with collecting data on average annual livestock population (see next parameter)
Average annual livestock population in each category (head per year)	Agriculture or livestock census Extrapolation from sample surveys Derived from economic forecasts of milk and beef demand	Activity data Key performance indicator	Periodically
100-yr GWP of CH_4 (ratio of the mass of CO_2 to the mass of CH_4)	IPCC Assessment Report	Convert CH_4 to CO_2e emissions	Once
Tier 1			
Average animal weight per category (kg)	Agriculture or livestock census Extrapolation from sample surveys or measurements	GHG emission factor (needed to choose Tier 1 emission factor) Key performance indicator	Once per category
Average animal growth rate (weight gain) per category (kg per day)	Agriculture or livestock census Extrapolation from sample surveys or measurements	GHG emission factor (needed to choose Tier 1 emission factor) Key performance indicator	Once per category
Average animal milk production per category (kg per head per day)	Agriculture or livestock census Extrapolation from sample surveys or measurements Extrapolated from milk production economic statistics	GHG emission factor (needed to choose Tier 1 emission factor) Key performance indicator	Once per category
CH_4 emission factor (kg CH_4 per head per year)	Tier 1: IPCC 2006 GL* Tables 10.11, 10. A.1 and 10 A.2	GHG emission factor	Once per category
Tier 2			

Average animal weight per category (kg)	Agriculture or livestock census Extrapolation from sample surveys or measurements	GHG emission factor (needed to derive feed intake parameter) Key performance indicator	Periodically
Average animal growth rate (weight gain) per category (kg per day)	Agriculture or livestock census Extrapolation from sample surveys or measurements	GHG emission factor (needed to derive feed intake parameter) Key performance indicator	Periodically
Mature weight (kg)	Agriculture or livestock census Extrapolation from sample surveys or measurements	GHG emission factor (needed to derive feed intake parameter) Key performance indicator	Periodically
Average number of hours worked per day (draft animals only) (hours per day)	Agriculture or livestock census Extrapolation from sample surveys or measurements	GHG emission factor (needed to derive feed intake parameter)	Periodically
Feeding situation (unitless)	Agriculture or livestock census Extrapolation from sample surveys or measurements	Assumption	Periodically
Activity coefficient by feeding situation (unitless)	IPCC 2006 GL* Table 10.5	GHG emission factor (needed to derive feed intake parameter)	Once per feeding situation
Mean winter temperature (°C)	Weather data	GHG emission factor (needed to derive feed intake parameter)	Periodically
Average daily milk production (milking ewes, dairy cows and buffalo only) (kg per day)	Agriculture or livestock census Extrapolation from sample surveys or measurements	GHG emission factor (needed to derive feed intake parameter) Key performance indicator	Periodically
Fat content of milk (for lactating cows, buffalo and sheep producing milk for human consumption) (percent)	Agriculture or livestock census Extrapolation from sample surveys or measurements	GHG emission factor (needed to derive feed intake parameter)	Periodically
Percent of females that give birth in a year (for mature cattle, buffalo and sheep) (percent)	Agriculture or livestock census Extrapolation from sample surveys or measurements	GHG emission factor (needed to derive feed intake parameter)	Periodically
Number of offspring produced per year (for	Agriculture or livestock census Extrapolation from sample surveys or measurements	GHG emission factor (needed to derive feed intake parameter)	Periodically

female livestock having multiple births per year) (head per year)			
Feed digestibility (percent)	IPCC 2006 GL* Table 10.2 (example values as a guideline) Measured values for the dominant feeds or forages being consumed by livestock Local scientific data or data from representative research studies	GHG emission factor (needed to derive feed intake parameter)	Once per feed type per livestock type
Average annual wool production (sheep only) (kg per head per year)	Agriculture or livestock census Wool sales records	GHG emission factor (needed to derive feed intake parameter)	Periodically
Feed intake in terms of gross energy per livestock category (MJ per day or kg dry matter per day)	Estimated	GHG emission factor (needed to derive Tier 2 emission factor) Key performance indicator	Periodically
Methane conversion factor (Ym) (% of gross energy in feed converted to methane)	IPCC 2006 GL* Table 10.12 or 10.13 Estimated with published data	GHG emission factor (needed to derive Tier 2 emission factor)	Periodically
CH_4 emission factor (kg CH_4 per head per year)	Published Tier 2: published data Derived Tier 2: calculated using equation 10.21	GHG emission factor	Periodically

Table 10.4: Soil carbon monitoring parameters

Parameter and unit	Potential sources of data	Parameter type	Suggested monitoring frequency
All			
Land stratification by climate region, soil type and soil management practices (unitless)	Agriculture census Soil surveys Soil classifications (e.g., IPCC 2006 GL* Figure 3 A.5.3 and 3 A.5.4 Climate zone map in IPCC 2006 GL* Figure 3 A.5.1 and classification scheme in Figure 3 A.5.2	Assumption	Once May be updated in conjunction with collecting data on the area of land in each strata (see next parameter)
Area of land in each strata (ha)	Agriculture census Soil surveys	Activity data Key performance indicator	At least twice, at beginning and end of

	International land cover data sets or other land cover maps Remote sensing data Ground based surveys		policy implementation period. Or, periodically during the policy implementation period.
Tier 1			
Reference carbon stock (tonnes C per ha)	Tier 1: IPCC 2006 GL* Table 2.3	GHG emission factor (needed to derive strata-specific soil carbon density)	Once per stratum type
Management factors for land-use (F_{LU}), management practices (F_{MG}), and inputs (F_I) (unitless fraction)	IPCC 2006 GL* Table 5.5, 6.2	GHG emission factor (needed to derive strata-specific soil carbon density)	Once per stratum type
Land-category (strata) specific soil carbon density (tonnes C per ha)	Calculate using IPCC 2006 GL* Equation 2.25 for SOC	GHG emission factor (needed to derive soil carbon stock flux)	Once per stratum type
Tier 2			
Land-category (strata) specific soil carbon density (tonnes C per ha)	Published data	GHG emission factor (needed to derive soil carbon stock flux)	Once if using country-specific research studies to derive a representative carbon density. Periodically if using field studies to measure soil carbon on land affected by the policy during the policy implementation period.

*IPCC 2006 GL, Volume 4, AFOLU

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 be a helpful tool for users in choosing assessment methods, prioritising data collection efforts, interpreting or comparing estimation results, and/or identifying

estimation improvement efforts overtime. Methodological guidance for qualifying or quantifying uncertainty of a policy GHG impact estimation can be found in Chapter 12 of the *Policy and Action Standard*.

The elements below should be described in the monitoring plan.

Monitoring period

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

At 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 prior to 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 guidance documents. For example, if assessing sustainable development impacts using the ICAT *Sustainable Development Guidance* in addition to assessing GHG impacts, the monitoring periods should be the same.

Institutional arrangements for coordinated monitoring

Information on key performance indicators and parameters can be dispersed among a number of different institutions. Given the wide variety of data needed for impact assessment and a range of different 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. Since data can be widely dispersed between institutions, the coordinating body oversees the procedures for data collection, management and reporting.

Countries may already have institutions in place as part of the national MRV system. Where this is the 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.

Refer to the UNFCCC *Toolkit on Establishing Institutional Arrangements for National Communications and Biennial Update Reports*, as well as other sources, for support on establishing or improving the institutional arrangements for a robust MRV system.[1]

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

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 frequent that data is 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 the quality of data enhance the confidence of the assessment results. Quality assurance is a planned review process conducted by personnel who are not directly involved in the data collection and processing. Quality control is a procedure or routine set of steps that are 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 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, according to 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 the GHG impacts 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[2]). For guidance on providing information to stakeholders, refer to the *ICAT Stakeholder Participation Guidance* (Chapter 7).

General information

- The name of the policy assessed
- The person(s)/organisation(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, and 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

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

Chapter 6: Identifying impacts: how agriculture 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, estimates approach or activity data approach, for estimating the policy's expected GHG impact;
- A description of the baseline scenario and justification for why it is considered the most likely scenario
- 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 are 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 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 in order 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 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
- 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 (such as activity data, emission factors and 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 in order 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
- 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 net 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 in order 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)

- 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 Guidance*.