**Template for QA/QC Procedures**

**Staff member responsible for populating the template - Contact Information**

|  |  |  |  |
| --- | --- | --- | --- |
| Name: |  | Organization name: |  |
| Title/Position: |  | Organization postal address: |  |
| Phone number: |  | Organization web address: |  |
| Email: |  | Organization phone number: |  |

***Introduction to Template 4. QA/QC Procedures***

The purpose of this template is to help countries develop a quality assurance and quality control (QA/QC) plan for current reporting under the United Nations Framework Convention on Climate Change (UNFCCC) (e.g., Biennial Update Reports) and future required reporting under the Enhanced Transparency Framework[[1]](#footnote-1) (ETF) for National GHG Inventories. It includes a series of tables in which you may record country-specific information about QA/QC activities in order to create a QA/QC plan. It also includes three QA/QC checklists you may use to track progress of the QA/QC work done.

The planning and implementation of QA/QC procedures are important parts of the development of national greenhouse gas inventories. A QA/QC plan helps identify improvement options to enhance transparency, accuracy, consistency, comparability, completeness in national GHG inventories. A QA/QC plan also builds confidence in national GHG inventories. The template can help improve countries’ understanding of elements of a QA/QC plan to improve inventory management and reporting over time.

To complete this template, the National Inventory Coordinator (NIC) and QA/QC Coordinator, with support from other key inventory team members as required, should carry out the steps enumerated below by following the instructions above each table in this template.

***When the tables are complete, delete the green text and green tables throughout this template.***

**Quality Assurance/Quality Control (QA/QC) Procedures**

This section explains how to compile an effective QA/QC plan. It is important to understand the basic principles before developing and implementing a QA/QC plan.

**Background**

Quality control and quality assurance measures are two distinct types of activities. The IPCC defines them as follows:

* **Quality Control (QC)** – a system of routine technical activities implemented by the inventory compilers to measure and control the quality of the inventory as it is prepared.
* **Quality Assurance (QA)** – a planned system of review procedures conducted by personnel not involved in the inventory development process. QA procedures are performed upon a completed inventory following the implementation of QC procedures and preferably by independent third parties. A basic expert peer review is part of this process.

This means that QC is part of the inventory compiler’s day-to-day work. In contrast, external staff who are not involved in the inventory compilation perform QA as an additional quality check. Verification activities may be constituents of both QA and QC, depending on the methods used and the stage at which independent information is used.

QC is further divided into general and category-specific QC procedures. General QC procedures include generic quality checks related to calculations, data processing, completeness, and documentation that are applicable to all inventory source and sink categories. Category-specific QC procedures complement general inventory QC procedures. Category-specific QC is directed at specific types of data used in the methods for individual source or sink categories. These procedures require knowledge of the specific category, the types of data available, and the parameters associated with emissions or removals, and are performed in addition to the general QC checks.

QA and QC are critical components of an inventory management system because when they are implemented effectively, they drive inventory improvement. Therefore, a fundamental element of the inventory management system is a written QA/QC plan. This plan outlines QA/QC activities to be performed, the personnel responsible for these activities, the schedule for completing these activities, and a list of future planned QA/QC improvements. An effective QA/QC plan includes the following elements:

* Personnel responsible for coordinating QA/QC activities;
* General QC procedures;
* Category-specific QC procedures;
* QA review procedures;
* Reporting, documentation, and archiving procedures; and,
* A prioritized QA/QC improvement list, which should be reviewed regularly and used to guide improvements.

## Document QA/QC roles

* Identify the QA/QC coordinator. This is the main person responsible for developing, maintaining and implementing the QA/QC plan. In this role, the QA/QC coordinator:
	+ Clarifies and communicates QA/QC responsibilities to inventory members.
	+ Develops and periodically reviews and updates the QA/QC checklists appropriate to various inventory team member roles (or ensures that these tasks are accomplished). (See Table 4-3 and Table 4-4 for examples).
	+ Manages and delivers documentation of QA/QC activities to the NIC and archive coordinator.
	+ Coordinates external reviews of the inventory document and ensures that comments are incorporated into the inventory.
* Complete Table 4-1 below with the names and contact information of the appropriate staff.
	+ Insert as many rows within the table as necessary to include all personnel who will be responsible for QA/QC activities, and all QA/QC responsibilities.
	+ The responsibilities associated with each of the roles are suggested in the “QA/QC responsibility” field. You may modify them as needed.
	+ Note that the roles are flexible and may overlap. Inventory staff may have a joint inventory compilation-QA/QC role.

Table 4-1. Personnel Responsible for QA/QC Activities

| **Title of role** | **QA/QC Responsibility** | **Name** | **Organization** | **Contact Information** |
| --- | --- | --- | --- | --- |
| Inventory Lead | All aspects of the inventory program, cross-cutting QA/QC |  |  |  |
| NIC  | Implement the overall QA/QC plan |  |  |  |
| Sector or Category Lead(s) | Implement general, sector-specific (as appropriate) and/or category specific (as appropriate) QA/QC procedures listed in Tables 4-2 and 4-3 below. Focus on Key Categories |  |  |  |

## General QC Procedures for Sectors / Categories

Table 4-2: General QC Activities

| **QC Activity** | **Procedures** | **Task Completed** | **Corrective Measure Taken****(if applicable)** | **Supporting Documents** |
| --- | --- | --- | --- | --- |
| **Name/****Initials** | **Date** |
| **Data Gathering, Input, and Handling Checks** |
| Check that assumptions and criteria for the selection of activity data, emission factors, and other estimation parameters are documented. | * Cross check descriptions of activity data and emission factors with information on categories and ensure that these are properly recorded and archived.
* Record if there are multiple sources of the same activity data, and if possible document the reasons for any differences.
 |  |  |  |  |
| Check for transcription errors in data input and references | * Confirm that bibliographical data references are properly cited in the internal documentation (see completed Template 3, Methods and Data Documentation, if applicable).
* Cross check a sample of input data from each category (either measurements or parameters used in calculations) for transcription errors. Record the findings of these cross checks. Pay particular attention to systematic differences. Identify steps to reduce the error rate in the future. Add these improvement steps to the QA/QC development plan.
* Utilize electronic data where possible to minimize transcription errors.
* Check that spreadsheet features are used to minimize user/entry error:[[2]](#footnote-2)
	+ Do not “hardwire” factors into formulas.
	+ Create automatic look-up tables for common values used throughout calculations.
	+ Use cell protection so fixed data cannot accidentally be changed.
	+ Build in automated checks, such as computational checks for calculations, or range checks for input data, mass balance checks, internal consistency checks within and between spreadsheets.
	+ Ensure spreadsheets have clear instructions for updating and a description of how the spreadsheet works.
	+ Ensure spreadsheets include a record of how they have been implemented and checked.
 |  |  |  |  |
| Check that emissions/removals are calculated correctly | * Reproduce a representative sample of emissions/removals calculations.
* If higher-tier methods or models are used, selectively reproduce complex model calculations with abbreviated calculations to judge relative accuracy. This could be done using IPCC Tier 1 methods.
* In all cases, record the work done and the findings. Record any improvements identified (in the appropriate Templates, if applicable).
 |  |  |  |  |
| Check that parameter and emission/removal units are correctly recorded and that appropriate conversion factors are used | * Check that units are properly labeled in calculation sheets and the completed Template 3, Methods and Data Documentation, if applicable.
* Check that units are correctly carried through from beginning to end of calculations.
* Check that conversion factors are correct.
* Check that temporal and spatial adjustment factors are used correctly.
 |  |  |  |  |
| Check the integrity of database files | * Confirm that the appropriate data processing steps are correctly represented in the database.
* Confirm that data relationships are correctly represented in the database.
* Ensure that data fields are properly labeled and have the correct design specifications.
* Ensure that adequate documentation of database and model structure and operation are archived.
 |  |  |  |  |
| Check for consistency in data between categories | * Identify parameters (e.g., activity data, constants) that are common to multiple categories and confirm that there is consistency in the values used for these parameters in the emissions/removals calculations.
* If using Excel, establish a “master set” of constants that all spreadsheets refer to rather than a set of constants in each spreadsheet.
 |  |  |  |  |
| Check that the movement of inventory data among processing steps is correct | * Check that emissions/removals data are correctly aggregated from lower reporting levels to higher reporting levels when preparing summaries.
* Check that emissions/removals data are correctly transcribed between different intermediate products.
 |  |  |  |  |
| Check that confidential data are appropriately protected | * Check that only the GHG inventory compilation team can handle/access confidential data.
* Check that such data are reported in compliance with requirements agreed on with the data source (if applicable).
 |  |  |  |  |
| Check that uncertainties inemissions and removals areestimated and calculated correctly. | * If using expert judgement, check that qualifications of individuals providing expert judgement for uncertainty estimates are appropriate.
* Check that qualifications, assumptions and expert judgements are recorded.
* Check that calculated uncertainties are complete and calculated correctly.
* If necessary, duplicate uncertainty calculations on a small sample of the probability distributions used by Monte Carlo analyses (for example, using uncertainty calculations according to Approach 1).
 |  |  |  |  |
| **Data Documentation** |  |
| Review internal documentation and archiving | * Check that there is detailed internal documentation to support the estimates and enable duplication of calculations, using completed Template 3, Methods and Data Documentation, if applicable.
* Check that every primary data element has a reference for the source of the data (via cell comments or another system of notation).
* Check that inventory data, supporting data, and inventory records are archived and stored to facilitate detailed review.
* Check that the archive is closed and retained securely following completion of the inventory.
* Check integrity of any data archiving arrangements of outside organizations involved in inventory preparation.
 |  |  |  |  |
| **Calculation Checks** |  |
| Check methodological and data changes resulting in recalculations | * Check for temporal consistency in time series input data for each category.
* Check for consistency in the algorithm/method used for calculations throughout the time series.
* Reproduce a representative sample of emission/removal calculations to ensure mathematical correctness.
 |  |  |  |  |
| Check time series consistency | * Check for temporal consistency in time series input data for each category.
* Check for consistency in the algorithm/method used for calculations throughout the time series.
* Check methodological and data changes resulting in recalculations.
* Check that the effects of mitigation activities have been appropriately reflected in time series calculations. Higher IPCC methodologies might be needed to accurately capture the effects of mitigation activities
 |  |  |  |  |
| Check completeness | * Confirm that estimates are reported for all categories and for all years from the appropriate base year over the period of the current inventory.
* For subcategories, confirm that the entire category is being covered.
* Confirm that if an emissions or removal estimate is omitted for any given category, documentation to explain or clarify the omission is included, and notation keys are used for that category. (This may include categories that were also omitted from the previous inventory.)
* Provide clear definitions of “Other” type categories.
* Check that known data gaps that result in incomplete category emissions/removals estimates are documented, including qualitative evaluation of the importance of the estimate in relation to total net emissions (e.g., subcategories classified as “not estimated”).
 |  |  |  |  |
| Trend checks | * For each category, compare current inventory estimates to previous estimates, if available (e.g., archived Template 2). If there are significant changes or departures from expected trends, re-check estimates and explain any differences. Significant changes in emissions or removals from previous years may indicate possible input or calculation errors.
* Check value of implied emission factors (aggregate emissions/removals divided by activity data) across time series to confirm that changes in emissions or removals are being reported.
* Check if there are any unusual or unexplained trends in activity data or other parameters across the time series.
 |  |  |  |  |
| Source: This list has been adapted from IPCC Good Practice Guidance and the 2006 IPCC Guidelines for National GHG Inventories. |  |

## Category Specific QC Procedures

This section provides a list of checks useful at the sectoral and category level. Category-specific QC is directed at specific types of data used in the methods for individual categories. Ideally, the checks provided in Table 4-4 below are further tailored to suit the specific needs of the sectors / categories in question.

* *Category-specific QC should be performed at least for key categories (see Template 5. Key Category Analysis). It should be performed for additional categories as resources allow.*
* *Table 4-3, below, lists the category-specific QC procedures that should be performed.*
	+ *The Procedures column includes a description of activities that could be done as part of each QC activity. It is not necessary to complete all of these tasks, but you are encouraged to ensure that as many of them as possible are completed. Volume 1, Chapter 6.6 of the 2006 IPCC Guidelines provides further useful guidance.*
	+ *Modify these activities and their associated procedures as needed, and add as many rows as necessary.*
	+ *Replicate the table for as many categories as required.*
	+ *For each procedure, record the name of the person responsible for the item and the date of completion.*

Table 4-3: Category-specific QC Procedures

|  |  |
| --- | --- |
| Category code and name: Note “KC” if it is a key category |  |
| **QC Activity** | **Procedures** | **Task Completed** | **Corrective Measure Taken****(if applicable)** | **Supporting Documents** |
| **Name/****Initials** | **Date** |
| **Emission Factor QC** |
| Assess the applicability of IPCC default emission factors | * Evaluate whether national conditions are similar to those used to develop the IPCC default factors.
* Compare default factors to site or plant-level factors.
* Consider options for obtaining country-specific factors.
* Document results of this assessment.
 |  |  |  |  |
| Review country-specific emission factors | * QC the background data used to develop the country-specific factor to assess adequacy of the emission factors and the QA/QC performed during their development
	+ E.g., if based on measurement studies, did measurement program included QC procedures
	+ E.g., understand characteristics of data (e.g. completeness, etc.)
* Assess whether secondary studies used to develop country-specific factors used (at a minimum) general QC activities.
* Compare country-specific factors to IPCC defaults; document any significant discrepancies.
* Compare country-specific factors to site or plant-level factors.
* Compare to factors from other countries (using UNFCCC review tools, reported factors in inventory submissions, and/or IPCC Emission Factor Database).
* Conduct reference calculations that use stoichiometric ratios and conservation of mass and land.
* Document results of this assessment.
 |  |  |  |  |
| Review measurements | * Determine if national or international (e.g., ISO) standards were used in measurements.
* Ensure measurement equipment is calibrated and maintained properly.
* Compare direct measurements with IPCC or other published default factors; document any significant discrepancies.
 |  |  |  |  |
| **Activity Data QC** |
| Review national-level activity data | * Determine the level of QC performed by the data collection agency. If inadequate, consider alternative data sources such as IPCC defaults and international activity data sets (e.g., IEA, FAO). Adjust the relevant uncertainty accordingly.
* Compare activity data from multiple references (e.g., other independently compiled data) if possible (e.g., IEA, FAO, etc.), including data time series
 |  |  |  |  |
| Review site-specific activity data | * Determine if national or international (e.g., ISO) standards were used in collecting or generating data.
* Compare aggregated site-specific data (e.g., production) to national statistics/data.
* Compare data across similar sites.
* Compare top-down and bottom-up estimates for similar orders of magnitude.
 |  |  |  |  |
| Trend checks of activity data | * Compare data to previous year’s data and review any sharp increases or decreases.
	+ If national activity data for any year diverge greatly from the historical trend, they should be checked for errors.
	+ If a calculation error is not detected, the reason for the sharp change in activity should be confirmed and documented.
 |  |  |  |  |
| QC uncertainty estimates | * Apply QC techniques to uncertainty estimates.
* Review uncertainty calculations.
* Document uncertainty assumptions and qualifications of any experts consulted.
 |  |  |  |  |
| **GHG Estimate QC/Verification** |
| Verify GHG estimates | * Compare estimates to other independently compiled national estimates as available.
* If using higher-tier methods or models, apply lower-tier methods (e.g., Energy sector comparison of reference and sectoral approach).
* Compare intensity indicators between countries
* Document, report, and archive verification findings and any further actions (e.g., additional QC, improvement plans).
 |  |  |  |  |

## QA/QC Checklists for finalisation of the GHG inventory

The below two checklists are intended for an overall review, once all of the GHG estimations have been finalised and the inventory report has been compiled. Ideally, these checks are carried out by the team member leading the GHG inventory team. This should happen before the review by external experts (QA).

Table 4-4: Cross-cutting checks for overall inventory quality

|  |  |
| --- | --- |
| **QC procedures** | **Task Completed** |
| **Responsible (Name/Initials)** | **Date** |
| **Emission Calculations Across GHG Emission and Removal Categories** |
| * *Identify parameters that are common across categories (e.g. conversion factors, carbon content coefficients, etc.) and check for consistency*
 |  |  |
| * *Check that using same data inputs (e.g. animal population data) report comparable values (i.e., analogous in magnitude)*
 |  |  |
| * *Check across categories that same electronic data set is used for common data (e.g., linking animal population data to the enteric fermentation and manure management calculations)*
 |  |  |
| * *Check that the number of significant digits or decimal places for common parameters, conversion factors, emission factors, or activity data is consistent across categories*
 |  |  |
| * *Check that total emissions are reported consistently (in terms of significant digits or decimal places) across categories*
 |  |  |
| * *Check that emissions data are correctly aggregated from lower reporting levels to higher reporting levels*
 |  |  |
| * *Other (specify):*
 |  |  |
| **Documentation** |
| * *Check if internal documentation practices are consistent across categories*
 |  |  |
| * *Other (specify):*
 |  |  |
| **Completeness** |
| * *Check for completeness across categories and years*
 |  |  |
| * *Check that data gaps are identified and reported as required*
 |  |  |
| * *Compare current national inventory estimates with previous years’*
 |  |  |
| * *Other (specify)*
 |  |  |
| **Maintaining Master Inventory File: Spreadsheets and Inventory Document** |
| * *Follow file control procedures*
 |  |  |
| * *Other (specify):*
 |  |  |

Table 4-5 Detailed checklist for inventory report

|  |  |
| --- | --- |
| **Activities** | **Task Completed** |
| **Name** | **Date** |
| **Front Section** |
| * *Cover page has correct date, title, and contact address*
 |  |  |
| * *Tables of contents/tables/figures are accurate: titles match document, page numbers match; numbers run consecutively and have correct punctuation*
 |  |  |
| * *The Executive Summary and Introduction are updated with appropriate years and discussion of trends*
 |  |  |
| * *Other (specify):*
 |  |  |
| **Tables and Figures** |
| * *All numbers in tables match numbers in spreadsheets*
 |  |  |
| * *Check that all tables have correct number of significant digits*
 |  |  |
| * *Check alignment in columns and labels*
 |  |  |
| * *Check that table formatting is consistent*
 |  |  |
| * *Check that all figures are updated with new data and referenced in the text*
 |  |  |
| * *Check table and figure titles for accuracy and consistency with content*
 |  |  |
| * *Other (specify):*
 |  |  |
| **Equations** |
| * *Check for consistency in equations*
 |  |  |
| * *Check that variables used in equations are defined following the equation*
 |  |  |
| * *Other (specify):*
 |  |  |
| **References** |
| * *Check consistency of references, and that in text citations and references match*
 |  |  |
| * *Other (specify):*
 |  |  |
| **General Format** |
| * *All acronyms are spelled out first time and not subsequent times throughout each chapter*
 |  |  |
| * *All fonts in text, headings, titles, and subheadings are consistent*
 |  |  |
| * *All highlighting, notes, and comments are removed from document*
 |  |  |
| * *Size, style, and indenting of bullets are consistent*
 |  |  |
| * *Spell check is complete*
 |  |  |
| * *Other (specify):*
 |  |  |
| **Other Issues** |
| * *Check that each section is updated with current year (or most recent year that inventory report includes)*
 |  |  |
| * *Other (specify):*
 |  |  |

## QA Procedures

* Quality Assurance involves expert reviewers not involved in preparing the inventory, and a peer review process. QA activities follow QC activities and complement QC activities.
* *Expert review offers the opportunity to uncover technical issues related to the application of methodologies, selection of activity data, and development and choice of emission factors. The comments of the expert reviewers should be reviewed and addressed, as appropriate, prior to the submission of the Inventory, and documented/archived appropriately to ensure transparency and for reference of future compilation teams.*
* Experts should be independent of the inventory agency, and affiliated with other national agencies, research facilities, international organizations, or other organizations with relevant expertise in GHG emission estimation methodologies, activity data, or other parameters. If third party reviewers are unavailable, staff from another part of the inventory agency not involved in the portion of the inventory under review can fulfill this role.
* Key categories (as outlined in Template Key Category Analysis) should be given priority for review, as well as source categories where significant changes in methodology or data have been made.
* The annex to this template provides a template you may use to instruct external reviewers, i.e., for expert elicitation.
* Using Table 4-6, below, identify the experts who are reviewing the GHG inventory. In the Comment Summary column, summarize experts’ recommendations regarding specific improvements that could be made to the GHG inventory as a result of experts’ QA activities. Add major improvements identified by expert reviewers to the GHG inventory improvement plan in Template national inventory Improvement Plan.

Table 4-6: External Reviewers

| **Name** | **Organization** | **Area of Expertise** | **Contact Information** | **Date Comments Received** | **Comment Summary** |
| --- | --- | --- | --- | --- | --- |
|  |  |  |  |  |  |
|  |  |  |  |  |  |
|  |  |  |  |  |  |
|  |  |  |  |  |  |

### **Propose GHG inventory improvements as a result of QA/QC activities**

* An important part of QA/QC activities is to use the results of these activities to identify how to improve the quality of the GHG inventory.
* In Table 4-6, below, describe all such potential improvements to the inventory.
	+ Add as many rows as necessary to accommodate all potential improvements.
	+ Instructions by column follow:
		- Topic: Describe the topic this improvement relates to, for example, Institutional Arrangements, Methodology/Data, QA/QC, Communication and awareness, Other - please specify.
		- Category Code and Name: If the topic is “Methodology and data,” please state the code and name of the category to which this improvement relates.
		- Issue: Concisely describe why an improvement is needed.
		- Relevant Inventory Quality Principle: State the relevant inventory quality principle (e.g., transparency, accuracy, completeness, consistency, or comparability).
		- Improvement Option: Describe the action to be taken, and how it should resolve the issue.
	+ When this table is complete, copy its contents into Template 6, National Inventory Improvement Plan.

Table 4-7: Potential Improvements to the GHG inventory

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Topic | Category Code and Name | Issue | Relevant Inventory Quality Principle  | Improvement Option |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |

1. See 18/CMA.1, Modalities, Procedures and Guidelines (MPGs), Annex Chapter II, [Section A. Definitions, Section C.6 Methods, and Section E.1 Reporting guidance](https://unfccc.int/sites/default/files/resource/CMA2018_03a02E.pdf) for National Greenhouse Gas Inventory Report (available at <http://unfccc.int/decisions>). If you have capacity constraints related to developing a QA/QC plan, this template may help address constraints and facilitate steps towards preparing a QA/QC plan consistent with future reporting requirements and the 2006 IPCC guidelines. [↑](#footnote-ref-1)
2. The guidance at <https://www.gov.uk/government/collections/quality-assurance-tools-and-guidance-in-decc> may prove useful [↑](#footnote-ref-2)