

Capacity Building Initiative for Transparency - Global Support Programme (CBIT-GSP) : Asia Region

Time Series, Quality Control and Quality Assurance

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- An inventory is not just an estimate of a single year. It includes estimates for a number of years (time series of estimates)
 - Information on historical emissions trend
 - Tracking the effects of strategies to reduce emissions at the national level
- Annual estimates should be comparable
 - Should reflect the real annual fluctuations in emissions and removals
- Therefore, emissions and removals in time series should be estimated consistently
 - Use of the same method and data sources in all years, where possible
- However, it is not always possible to use the same method and data sets for the entire time series due to a lack of data

- Splicing: combining or joining of more than one method or data series to form a complete time series
 - Methodological change and refinement
 - Data gaps
- The 2006 IPCC Guidelines provide several splicing techniques
 - Overlap
 - Surrogate
 - Interpolation
 - Extrapolation
- Selecting a technique requires an evaluation of the specific circumstances and a determination of the best option for the particular case

- Each technique can be appropriate in certain situation. It is good practice to perform the splicing using more than one technique before making a final decision

Approach	Applicability	Comments
Overlap	Data necessary to apply both the previously used and the new method must be available for at least one year, preferably more.	<ul style="list-style-type: none"> Most reliable when the overlap between two or more sets of annual estimates can be assessed. If the trends observed using the previously used and new methods are inconsistent, this approach is not <i>good practice</i>.
Surrogate Data	Emission factors, activity data or other estimation parameters used in the new method are strongly correlated with other well-known and more readily available indicative data.	<ul style="list-style-type: none"> Multiple indicative data sets (singly or in combination) should be tested in order to determine the most strongly correlated. Should not be done for long periods.
Interpolation	Data needed for recalculation using the new method are available for intermittent years during the time series.	<ul style="list-style-type: none"> Estimates can be linearly interpolated for the periods when the new method cannot be applied. The method is not applicable in the case of large annual fluctuations.
Trend Extrapolation	Data for the new method are not collected annually and are not available at the beginning or the end of the time series.	<ul style="list-style-type: none"> Most reliable if the trend over time is constant. Should not be used if the trend is changing (in this case, the surrogate method may be more appropriate). Should not be done for long periods.
Other Techniques	The standard alternatives are not valid when technical conditions are changing throughout the time series (e.g., due to the introduction of mitigation technology).	<ul style="list-style-type: none"> Document customised approaches thoroughly. Compare results with standard techniques.

- Comparison of the results of multiple approaches where it is possible to use more than one approach
 - Plotting and comparing the results of splicing techniques on a graph is useful
 - If alternative splicing methods produce different results, should consider which result is most realistic
- Comparison of recalculated estimates with previous estimates can be a useful check on the quality of a recalculation
 - However, higher tier methods may produce different trends than lower tier methods because they more accurately reflect actual conditions
- All recalculations and measures taken to improve time series consistency should be documented and reported
 - Reason of the recalculation
 - Effect of the recalculation on the time series
 - Splicing techniques used

- **We need consistent estimates of emissions/ removals for all years**
 - Same method and data sources should be applied to all years, if possible

- **Where this is not possible, inventory compilers should follow the time series consistency guidance to provide consistent estimates for all years**
 - Overlap/ Surrogate / Interpolation / Extrapolation /etc.

- **We need to ensure quality of time series**
 - Quality checks are applied to entire time series

- **All decisions, methods and reasons should be documented**

- Overall: a high-quality inventory of anthropogenic emissions and removals of greenhouse gases that is credible & convincing

- Indicators of quality:
 - Transparency
 - Completeness
 - Consistency
 - Comparability
 - Accuracy

- There is sufficient and clear documentation such that individuals or groups other than the inventory compilers can understand how the inventory was compiled and can assure themselves it meets the *good practice* requirements for national greenhouse gas emissions inventories.

- *Relevant chapters in the 2006 IPCC Guidelines*
 - Chapter 8, Reporting Guidance and Tables, of Volume 1
 - Chapter 6, QA/QC and Verification, of Volume 1
 - respective chapters (sectoral guidance) of Volumes 2-5

- Estimates are reported for all relevant categories of sources and sinks, and gases. Geographic areas within the scope of the national greenhouse gas inventory are recommended in these *Guidelines*. Where elements are missing their absence should be clearly documented together with a justification for exclusion.

- *Relevant chapters in the 2006 IPCC Guidelines*
 - Chapter 8, Reporting Guidance and Tables, of Volume 1
 - respective chapters (sectoral guidance) of Volumes 2-5.

- Estimates for different inventory years, gases and categories are made in such a way that differences in the results between years and categories reflect real differences in emissions. Inventory annual trends, as far as possible, should be calculated using the same method and data sources in all years and should aim to reflect the real annual fluctuations in emissions or removals and not be subject to changes resulting from methodological differences.

- Relevant chapters in the 2006 IPCC Guidelines
 - Chapter 2: Approaches to Data Collection, of Volume 1
 - Chapter 4: Methodological Choice and Identification of Key Categories, of Volume 1
 - Chapter 5: Time Series Consistency, of Volume 1

- The national greenhouse gas inventory is reported in a way that allows it to be compared with national greenhouse gas inventories for other countries. This comparability should be reflected in appropriate choice of key categories and in the use of the reporting guidance and tables and use of the classification and definition of categories of emissions and removals.
- *Relevant chapters in the 2006 IPCC Guidelines*
 - Chapter 8, Reporting Guidance and Tables, of Volume 1

- The national greenhouse gas inventory contains neither over- nor under-estimates so far as can be judged. This means making all endeavours to remove bias from the inventory estimates
- *Relevant chapters in the 2006 IPCC Guidelines*
 - Chapter 2, Approaches to Data Collection, of Volume 1
 - Chapter 3, Uncertainties, of Volume 1 and respective chapters (sectoral guidance) of Volumes 2-5.

- National inventories of anthropogenic greenhouse gas emissions and removals consistent with good practice are those,
 - which contain neither over- nor under-estimates so far as can be judged, and
 - in which uncertainties are reduced as far as practicable.

- A good QA/QC system

- Tools to focus resources on where we get the maximum benefit
 - Key Category Analysis
 - Uncertainty Management

- An inventory plan covering QA/QC, timing, deliverables and stakeholder involvement

- Consistent management to achieve this

- System of routine technical activities to assess and maintain the quality of the inventory as it is being compiled

- Performed by personnel compiling the inventory

- QC system is designed to:
 - Provide routine and consistent checks to ensure data integrity, correctness, and completeness
 - Identify and address errors and omissions
 - Document and archive inventory material and record all QC activities

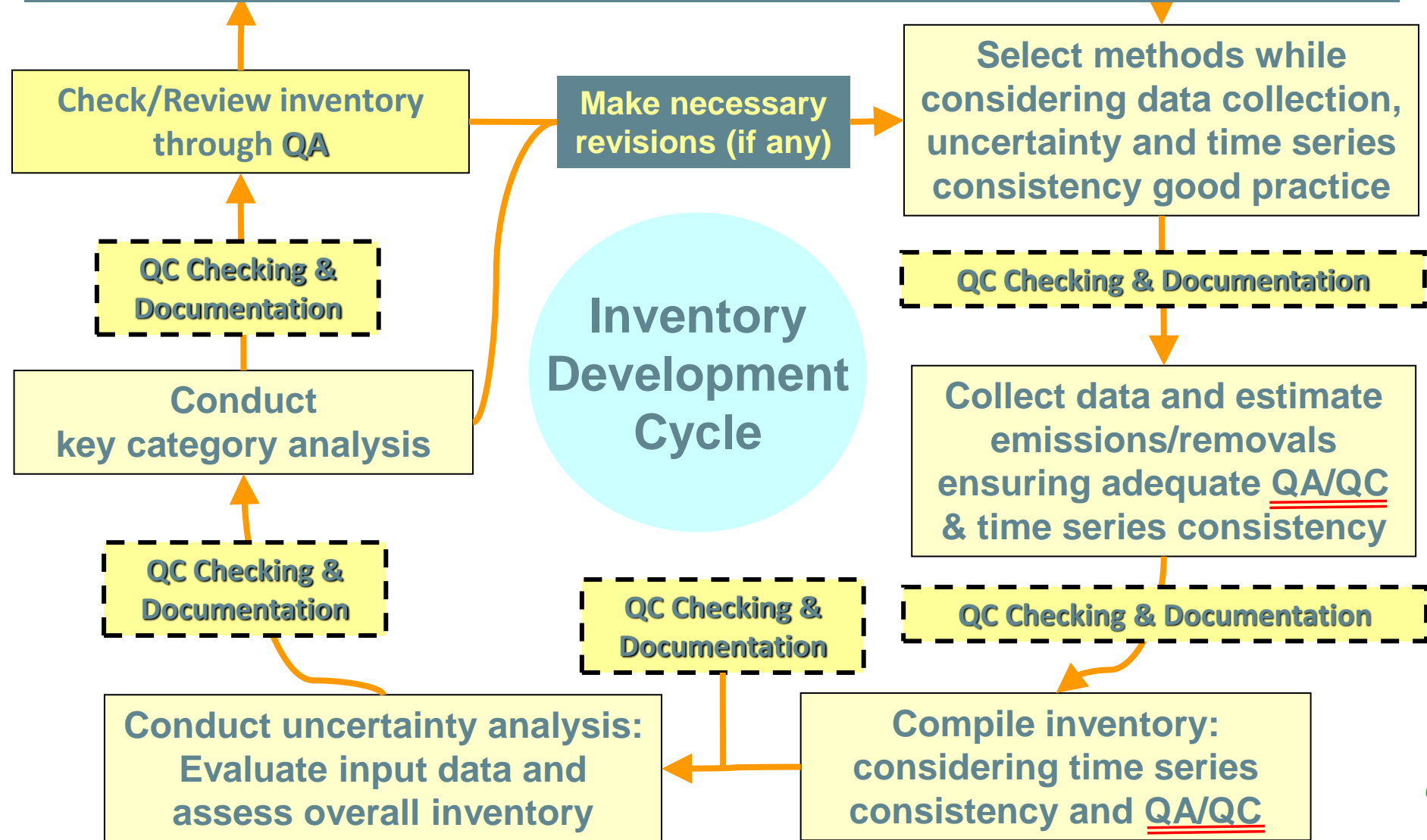
- Planned system of review procedures conducted by personnel not directly involved in the inventory compilation/development process (preferably by independent third parties)

- Performed upon a completed inventory following the implementation of QC procedures
 - Verify that measurable objectives were met
 - Ensure that the inventory represents the best possible estimates given the current state of scientific knowledge and data availability
 - Support the effectiveness of the QC program

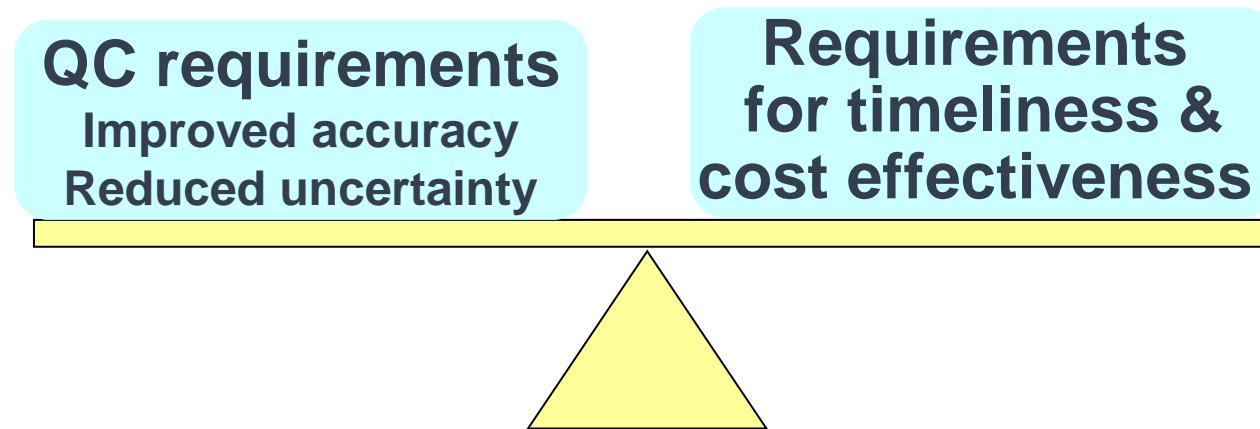
- Collection of activities and procedures conducted during the planning and development, or after completion of an inventory that can help to establish its reliability for the intended applications of the inventory
- Methods that are external to the inventory and apply independent data, including comparisons with inventory estimates made by other bodies or through alternative methods
- May be constituents of both QA and QC

Start new estimate, building on experience

QA/QC and verification activities should be integral parts of the inventory process



- Seek to achieve the balance of both requirements



- Also seek to enable continuous improvement of inventory estimates

- Try to identify where to focus more intensive analysis and review. To that end, some questions should be asked, for example:
 - Is this source/sink a key category?
 - Has the category been designated as key for qualitative reasons? For example:
 - ✓ Is there considerable uncertainty associated with the estimates for this category?
 - ✓ Have there been significant changes in the characteristics of this category, such as technology changes or management practices?
 - Does the methodology use complex modelling steps or large inputs from outside databases?
- No difference between confidential and publicly available data; both should carry descriptions of the measurement and calculation procedures and the steps taken to check and verify the values reported.

- Participation of an inventory compiler who is also responsible for:
 - coordinating QA/QC and verification activities, and
 - definition of roles/responsibilities within the inventory
- A QA/QC plan
- General QC procedures that apply to all inventory categories
- Category-specific QC procedures
- QA and review procedures
- QA/QC system interaction with uncertainty analyses
- Verification activities
- Reporting, documentation, and archiving procedures

- The inventory compiler should:
 - Be responsible for coordinating the institutional and procedural arrangements for inventory activities.
 - Define specific responsibilities and procedures for the planning, preparation, and management of inventory activities.

- Fundamental element of the system
- Should include a scheduled time frame for the QA/QC activities
- A key component – List of data quality objectives (preferably measurable)
- Important to accommodate procedural changes and a feedback of experience
 - The periodic review and revision of the QA/QC plan is an important element to drive the continued inventory improvement.
- It may be useful to refer to relevant standards and guidelines published by outside groups involved in inventory development.
 - For example, the International Organization for Standardization (ISO) introduced specifications for quantification, monitoring, and reporting of greenhouse gas emissions and removals (ISO 14064) in organizations.

- Generic quality checks applicable to all source and sink categories, related to:

- Calculations
- Data processing
- Completeness
- Documentation

See Table 6.1 in Chapter 6 in Volume 1.

The checks suggested in this table should be applied irrespective of the types of data used to develop the inventory estimates.

See also Appendix 6A.1 “QC checklists” in Chapter 6, Volume 1.

- Automated checks are encouraged where possible – to effectively check large quantities of input data
- In the cases where estimates are prepared by outside consultants or agencies, the inventory compiler should ensure:
 - the consultants/agencies are aware of the QC procedures, and
 - these procedures are performed and recorded.

**TABLE 6.1
GENERAL INVENTORY QC PROCEDURES**

QC Activity	Procedures
Check that assumptions and criteria for the selection of activity data, emission factors, and other estimation parameters are documented.	<ul style="list-style-type: none"> • Cross-check descriptions of activity data, emission factors and other estimation parameters with information on categories and ensure that these are properly recorded and archived.
Check for transcription errors in data input and references.	<ul style="list-style-type: none"> • Confirm that bibliographical data references are properly cited in the internal documentation. • Cross-check a sample of input data from each category (either measurements or parameters used in calculations) for transcription errors.
Check that emissions and removals are calculated correctly.	<ul style="list-style-type: none"> • Reproduce a set of emissions and removals calculations. • Use a simple approximation method that gives similar results to the original and more complex calculation to ensure that there is no data input error or calculation error.
Check that parameters and units are correctly recorded and that appropriate conversion factors are used.	<ul style="list-style-type: none"> • Check that units are properly labelled in calculation sheets. • 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.	<ul style="list-style-type: none"> • Examine the included intrinsic documentation (see also Box 6.4) to: <ul style="list-style-type: none"> - 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 labelled and have the correct

- Complements general QC procedures
- Directed at specific types of data used in the methods for individual source or sink categories
- Applied on a case-by-case basis focusing on:
 - key categories
 - categories where significant methodological and data revisions have taken place

See also Appendix 6A.1 “QC checklists” in Chapter 6, Volume 1.

- Activities outside the actual inventory compilation, performed preferably by third party reviewers who are independent from the inventory compiler
 - Expert peer review
 - Audits
- Priority should be given to:
 - key categories
 - categories where significant methodological and data revisions have taken place

- Provide valuable feedback to each other on critical components of the inventory estimates and data sources that:
 - Contribute to both the uncertainty level and inventory quality
 - Should therefore be a primary focus of inventory improvement efforts

- Uncertainty analysis can provide insights into:
 - Weaknesses in the Estimate
 - Sensitivity of the estimate to different variables
 - The greatest contributors to uncertainty

- Activities to provide information for countries to improve their inventories
 - Comparisons of national estimates
 - Applying different tier methods
 - Comparisons with independently compiled estimates
 - Comparisons of intensity indicators between countries
 - Comparisons with atmospheric measurements

- Document and archive all information relating to the planning, preparation, and management of inventory activities
 - Records of QA/QC procedures are important information to enable continuous improvement to inventory estimates.
- Report a summary of implemented QA/QC activities and key findings as a supplement to each country's national inventory

- How much is required?
- With a very limited budget what can be done?
- How can the 2000+ pages of the 2006 Guidelines be implemented with few resources, experienced people or budget?

If resources are limited :

- Roughly 15-20 categories account for 95% of emissions
 - Identify these and concentrate resources on them (Key Category Analysis)
- Other sources use “Tier 1” methods
- Main effort is collecting activity data – use defaults for emission factors
- Look for national statistics already collected, co-operate in collecting new data
- International data sources can be used (IEA, FAO, ICAO etc.)

- Inventories need to be credible and believable: they need to be of high quality.
- Good Practice helps to produce quality inventories.
- Keep in mind the indicators of quality “TACCC”.
- QA/QC and verification activities should be integral parts of the inventory process.
- Seek to achieve the balance of:
 - QC requirements
 - Requirements for timeliness & cost effectiveness
- Initial planning and good management is essential.
- Limited resources is not a barrier to Greenhouse Gas Inventory compilation.

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Please reach out to us for any question, comments or suggestions!



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