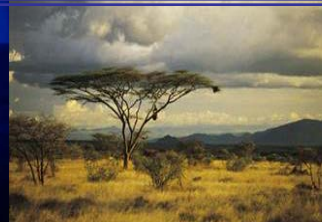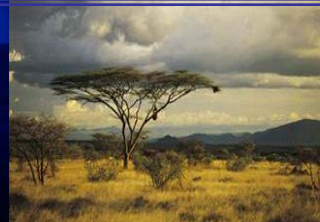# QA/QC Activities for CC Enabling Activities under UNEP Global Support Programmes

Conrado S. Heruela
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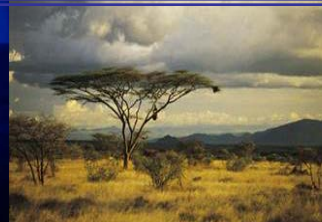# PART1: QA/QC Activities in NATCOMs – ASEAN Countries

GEF-UNEP Support Programmes for preparation of National Communications

- Three Global Programmes

- Include four ASEAN Countries:
  - Cambodia
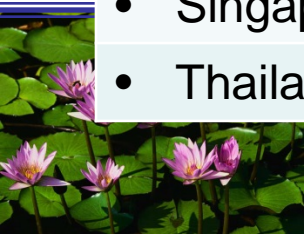 - Lao PDR
  - Myanmar
  - Viet Nam

Status of NATCOMs

Country	INC	SNC	TNC
UNEP Countries			
• Cambodia	8 Oct 2002	submitted	under prep'n
• Lao PDR	2 Nov 2000	24 Jun 2013	under prep'n
• Myanmar	26 Dec 2012	under prep'n	
• Viet Nam	2 Dec 2003	7 Dec 2010	under prep'n
Other ASEAN			
• Brunei			
• Indonesia	27 Oct 1999	19 Jan 2012	Under prep'n
• Malaysia	22 Aug 2000	14 Apr 2011	Approved by GEF
• Philippines	19 May 2000	Under prep'n	
• Singapore	21 Aug 2000	12 Nov 2010	
• Thailand	13 Nov 2000	24 Mar 2011	Under prep'n

QA/QC Activities in NATCOMs

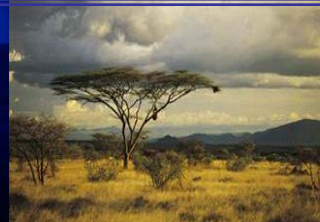| Countries	Activity/ies mentioned in the NATCOMs
UNEP Countries	
• Cambodia	Sub-sub-section: Comparison of data with other countries
• Lao PDR	Sub-Section: QA/QC activities done & needed
• Myanmar	none
• Viet Nam	none
Other ASEAN	
• Indonesia	Brief discussion of what is needed to be done in next NATCOM
• Malaysia	Brief discussions under capacity building needs
• Philippines	none
• Singapore	none
• Thailand	Mentioned that QC/QA were done, but no discussions

QA/QC Activities in Lao PDR NATCOM

- Re-calculation of LUCF and agricultural emissions and removals

- Peer review in cooperation with GIO/NIES

- External Review by UNDP-NCSP and GHGI

- External Review of National Steering Committee & independent experts

QA/QC Considerations in Indonesia NATCOM

At present there is no system in place for QA/QC for the GHG emissions. However, the Bureau of Statistics and several other agencies that are responsible for collecting data from local governments and private companies have set up procedures for data quality checking. In the future, sectors that are responsible for developing the National GHG Inventory will develop QA/QC systems. The Ministry of Environment has proposed SIGN (Sistem Inventarisasi Gas Rumah Kaca Nasional) or a National GHG Inventory System to BAPPENAS (National Agency for Planning and Development) to be one of Indonesia's priority climate change programmes.

Priority Areas:

1. Improvement of methodologies, activity data and emission factors;

2. Strengthening institutional arrangements, their functions, and operations of archiving, updating and managing of greenhouse gas inventories; and

3. Increasing awareness of local governments on the importance of the National GHG Inventory for developing mitigation strategies. Increasing the capacity of designated personnel of the GHG Inventory within each sector for developing and managing the GHG inventory.
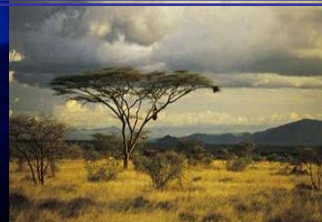
QA/QC Capacity Building Needs Malaysia NATCOM

7.2.1 GHG Inventory

(i) Constraints and Gaps

The main constraints are related to lack of quality data and information, and the lack of expertise in the respective sectors. Due to the unavailability of relevant data, assumptions were made and data obtained from secondary sources.

QA/QC Capacity Building Needs Malaysia NATCOM

(ii)   Actions Identified to Address Constraints and Gaps

The understanding of recent IPCC guidelines, such as the Good Practice Guidance (2003) and IPCC 2006 Guidelines is important for future inventory preparation. In order to apply these guidelines, national capacity-building and technical assistance are required. These include training on uncertainty analyses and quality assurance/quality control procedures. In addition, capacity building is also required to ensure that data providers are able to provide relevant information.
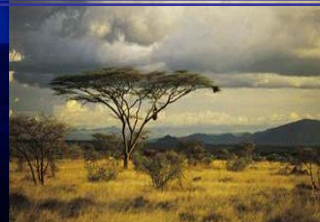
- **GREENHOUSE GAS INVENTORIES**
  - Assess options for new and improved GHG inventories
    - Outline QA/QC procedures, inventory uncertainty assessments and documentation of procedures and centralized archiving processes initiated
  - The National GHG Inventory Chapter should be prepared, should include and not be limited to the following GHG reporting requirement:
    - Assess quality of inventories regarding Key category analysis; Uncertainty Management; and Quality assurance/quality control (QA/AC)
    - Describe institutional arrangements established to sustain the greenhouse gas inventory process (e.g. documentation, QA/QC, archiving system and inventory improvement plan);
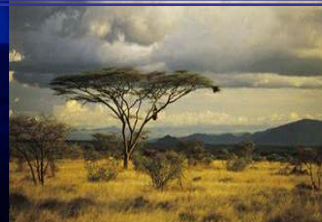
PART 2: CGE Training on QA/QC

United Nations Framework Convention on Climate Change
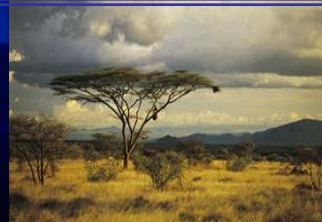
CGE Training Materials
National Greenhouse Gas Inventories

Quality Assurance/Quality Control

Version 2, April 2012

Consultative Group of Experts (CGE)

Training Materials for National Greenhouse Gas Inventories

Definitions

❑ **Quality assurance** (**QA**), performed by personnel not directly involved in the inventory compilation/development process, is a planned system of review procedures.

❑ **Quality control** (**QC**), performed by personnel compiling the inventory, is a system of routine technical activities to assess and maintain the quality of the inventory as it is being compiled.

❑ **Verification** refers to the 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:

❖ Verification activities may be constituents of both QA and QC, depending on the methods used and the stage at which independent information is used.

Objectives

❑ **QA**, **QC** and **verification** are essential components of a good GHG inventory:

❑ Rationale and objectives

❑ Roles and responsibilities

❑ Procedures

❑ Documentation.

QA/QC Goals

❑ A QA, QC and verification system contributes to the objectives of good practice in inventory development, namely to improve:

- ❖ **Transparency**
- ❖ **Accuracy**
- ❖ **Consistency**
- ❖ **Comparability**
- ❖ **Completeness.**

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

Practical Considerations

❑ To take into account:

- ❖ **Resources and time** allocated to QA/QC plan

- ❖ **Frequency** of QA/QC checks and reviews

- ❖ **Appropriate level** of QA/QC for each category

- ❖ **Availability and access to information**

- ❖ Need to acquire/collect **additional data**

- ❖ Procedures to ensure **confidentiality**

- ❖ **Requirements** for documenting and archiving information

- ❖ Whether **increased effort** on QA/QC will result in improved estimates and reduced uncertainties

- ❖ Whether **sufficient independent data and expertise** are available to conduct verification activities.

QA/QC Elements

❑ Inventory compiler:

   ❖ Coordinates QA/QC activities and defines roles

❑ A QA/QC plan

❑ General QC procedures:

   ❖ 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.

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❑ **Inventory compiler**:

    ❖ Defines specific responsibilities and procedures for the QA/QC and verification activities:

        ✦ Planning, preparation, and management

            • QA/QC procedures may be delegated to other agencies or organizations (e.g. central statistical agency)

    ❖ Responsible for ensuring that the QA/QC plan is developed and implemented.

❑ It is *good practice* for the inventory compiler to designate a QA/QC coordinator.

QA/QC Plan

❑ The **QA/QC and verification plan** should outline:

    ❖ QA/QC and verification activities to be implemented
        ◇ Inclusive of scheduled time frame
    ❖ Institutional arrangements and responsibilities for implementation.

❑ A key component of the plan is the **list of data quality objectives**:

    ❖ Concrete targets to be achieved in the inventory preparation:
        ◇ Appropriate and realistic
        ◇ Measurable
        ◇ Enable improvements in the inventory.

❑ Incorporate periodic revisions and revisions of the plan.

❑ Refer to external standards and guidelines (e.g. ISO).

General QC Procedures

❑ Although **general QC procedures** are designed to be implemented for all categories *and* on a routine basis, it may not be necessary or possible to check all aspects of the inventory input data, parameters and calculations every year.

❑ **Checks may be performed on selected sets of data and processes**:

   ❖ A representative sample of data and calculations from every category may be subjected to general QC procedures each year.

❑ In establishing criteria and processes for selecting sample data sets and processes, it is *good practice* for the inventory compiler to plan to undertake QC checks on all parts of the inventory over an appropriate period of time as determined in the QA/QC plan.

❑ In some cases, estimates are prepared for the inventory compiler by outside consultants or agencies:

  ❖ The inventory compiler should ensure that the consultants/agencies are aware of the **QC procedures outlined in the IPCC GPG.**

❑ Particular attention should be given to parts of the inventory development that rely on external, and shared databases:

  ❖ Due to the quantity of data that may need to be checked for some categories, **automated checks are encouraged** where possible.

General QC Procedures (cont.)

Checklist for general QC checks (complete table for each category):

Item		Check completed			Corrective action		Supporting documents (provide reference)
		Date	Individual (first initial, last name)	Errors (Y/N)	Date	Individual (first initial, last name)	
DATA GATHERING, INPUT, AND HANDLING ACTIVITIES: QUALITY CHECKS							
1.	Check a sample of input data for transcription errors						
2.	Review spreadsheets with computerised checks and/or quality check reports						
3.	Identify spreadsheet modifications that could provide additional controls or checks on quality						
4.	Other (specify):						
DATA DOCUMENTATION: QUALITY CHECKS							
5.	Check project file for completeness						
6.	Confirm that bibliographical data references are included (in spreadsheet) for every primary data element						
7.	Check that all appropriate citations from the spreadsheets appear in the inventory document						
8.	Check that all citations in spreadsheets and inventory are complete (i.e., include all relevant information)						
9.	Randomly check bibliographical citations for transcription errors						

Example of check list for general QC.

TABLE 5.5.1
TIER 1 GENERAL INVENTORY LEVEL QC PROCEDURES

QC Activity	Procedures
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, emission factors and other estimation parameters with information on source and sink categories and ensure that these are properly recorded and archived.
Check for transcription errors in data input and reference.	• Confirm that bibliographical data references are properly cited in the internal documentation. • Cross-check a sample of input data from each source category (either measurements or parameters used in calculations) for transcription errors.
Check that emissions and removals are calculated correctly.	• Reproduce a representative sample of emission or removal calculations. • Selectively mimic complex model calculations with abbreviated calculations to judge relative accuracy.
Check that parameter and units are correctly recorded and that appropriate conversion factors are used.	• 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.	• 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 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, and constants) that are common to multiple categories of sources and sinks, and confirm that there is consistency in the values used for these parameters in the emissions calculations.
Check that the movement of inventory data among processing steps is correct.	• Check that emission and removal data are correctly aggregated from lower reporting levels to higher reporting levels when preparing summaries. • Check that emission and removal data are correctly transcribed between different intermediate products.
Check that uncertainties in emissions and removals are estimated or calculated correctly.	• 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 error calculations on a small sample of the probability distributions used by Monte Carlo analyses.

Generic quality checks related to calculations, data processing, completeness and documentation that are applicable to all inventory source and sink categories.

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	TABLE 5.5.1 (CONTINUED) TIER 1 GENERAL INVENTORY LEVEL QC PROCEDURES
Undertake review of internal documentation.	• Check that there is detailed internal documentation to support the estimates and enable reproduction of the emission and removal and uncertainty estimates. • Check that inventory data, supporting data, and inventory records are archived and stored to facilitate detailed review. • Check integrity of any data archiving arrangements of outside organisations involved in inventory preparation.
Check time series consistency.	• Check for temporal consistency in time series input data for each category of sources and sinks. • Check for consistency in the algorithm/method used for calculations throughout the time series. • Check recalculation method.
Undertake completeness checks.	• Confirm that estimates are reported for all categories of sources and sinks and for all years from the appropriate base year to the period of the current inventory. • Check that known data gaps that result in incomplete emissions estimates are documented.
Compare estimates to previous estimates.	• For each category, current inventory estimates should be compared to previous estimates, if available. If there are significant changes or departures from expected trends, re-check estimates and explain any difference.

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QA and Review

❑ This comprises activities outside the actual inventory compilation.

❑ Procedures may be taken at different levels (internal/external).

❑ The inventory may be reviewed as a whole or in parts.

❑ It is important to use QA reviewers who have not been involved in preparing the inventory:
  ❖ **Expert peer review**: review of calculations and assumptions by experts, to ensure that the inventory's results, assumptions and methods are reasonable, as judged by those knowledgeable in the specific field
  ❖ **Audits**: evaluate how effectively the inventory compiler complies with the minimum QC specifications outlined in the QC plan. In-depth analysis of procedures and documentations.

❑ **QA goals:** to assess the quality of the inventory, determine the conformity of the procedures taken and identify areas where improvements could be made.

QA/QC and Uncertainty Assessment

❑ The QA/QC process and uncertainty analyses provide **valuable feedback** to one another:

  ❖ They can **identify critical components** that contribute to both the uncertainty level and inventory quality.

❑ It is *good practice* to apply QC procedures to uncertainty estimation to confirm that calculations are correct and data and calculations well documented.

  ❖ The assumptions on which uncertainty estimation has been based should be documented for each category.
  ❖ Calculations of category-specific and aggregated uncertainty estimates should be checked and any errors addressed.
  ❖ The qualifications of experts should also be checked and documented, as should the process of eliciting expert judgment.

Verification

❑ **Comparison of national estimates:**

    ❖ Applying lower tier methods

    ❖ Applying higher tier methods (partial estimates for subcategories or sources)

    ❖ Comparisons with independently compiled estimates

    ❖ Comparisons of intensity indicators between countries.

❑ **Comparison with atmospheric measurement:**

    ❖ Inverse modeling

    ❖ Continental plumes

    ❖ Use of proxy emissions databases

    ❖ Global dynamic approaches.

Internal Documentation and Archiving

❑ It is *good practice* to **document and archive all information** relating to the planning, preparation and management of inventory activities:

- ❖ Responsibilities, institutional arrangements and procedures

- ❖ Assumptions and criteria for the selection of activity data and emission factors

- ❖ Emission factors and other estimation parameters used

- ❖ Activity data or sufficient information to enable tracing to the referenced source

- ❖ Information on the uncertainty associated with activity data and emission factor

- ❖ Rationale for choice of methods.

Internal Documentation and Archiving

❑ It is *good practice* to **document and archive all information** relating to the planning, preparation and management of inventory activities:

❖ Methods used, including to estimate uncertainty and for recalculations

❖ Changes in data inputs or methods from previous inventories (recalculations)

❖ Identification of individuals providing expert judgment and qualifications

❖ Details of electronic databases or software used

❖ Worksheets and interim calculations for category and aggregated estimates

❖ Final inventory report and any analysis of trends from previous years;

❖ QA/QC plans and outcomes of QA/QC procedures;

❖ Secure archiving of complete datasets, to include shared databases that are used in inventory development.

Reporting

❑ It is **_good practice_** to report a summary of implemented QA/QC activities and key findings as a supplement to each country's national inventory:

❖ Reference to a QA/QC plan, its implementation schedule and the responsibilities

❖ Describe which activities were performed internally and what external reviews were conducted
   ◇ For each source/sink category and on the entire inventory

❖ Present the key findings
   ◇ Describing major issues regarding quality of input data, methods, processing, or estimates for each category
   ◇ Showing how they were addressed or plan to be addressed in the future

❖ Explain significant trends in the time series.

Useful Supporting Material

❑ *IPCC Good Practice Guidance and Uncertainty Management in National GHG Inventories*

  ❖ http://www.ipcc-nggip.iges.or.jp/public/gp/english/

❑ US-EPA: *Template Workbook for Developing a National GHG Inventory System*

  ❖ http://epa.gov/climatechange/emissions/ghginventorycapacitybuilding/templates.html

Thank You!

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