Development of a QA/QC program

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Why develop QA/QC system

- Quality control should be an integral part of every national inventory system (different level)

- To **improve quality** of national inventories by :
  - improving TCCCA (transparency, consistency, comparability , completeness, accuracy)
  - reducing uncertainty, and
  - i.e. increase confidence in emission estimates

- **Increase sustainability** of national inventory system

Elements of national QA/QC system

Based on:

- ***IPCC Good Practice Guidance, Ch8; and***
- ***EMEP/EEA Emission Inventory Guidebook, Part B, Chapter GPG***

- **Inventory agency responsible for coordinating of QA/QC activities** (MoEU in Turkey)

- **A QA/QC plan (program) – written document**
  - General QC procedures (Tier 1)
  - Source category specific QC procedures (Tier 2)
  - QA review procedures (external review)

- **Reporting, documentation and archiving procedures**

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QA/QC plan (Document)

- An **internal** document to plan and implement QA/QC activities
- Should include:
  - definition of **responsibilities** (QA/QC manager)
  - a scheduled **time frame** that follows inventory preparation process in any year
  - an outline of the processes and schedule to review all source categories
  - **guidance** for documentation

- Once developed, can be referenced and used in subsequent inventory cycles – **needs annual update!**
- Should be available for external review
- If possible refer to the ISO standards and guidelines

QA/QC Procedures

- QC should be performed throughout the inventory development and document preparation.
- QA/QC is not separate from, but is an **integral part of preparing the inventory**.
- QA should occur at **2 stages: an expert review and a public review.**
- QA/QC procedures should include **feedback loops** and provide for corrective actions to improve the inventory over time.
- Based on a **overall and sectoral** QA/QC plans, **source-specific** QA/QC plans could be developed for a limited number of categories and /or point sources

QA/QC Procedures

- QA/QC procedures guide the process of ensuring inventory quality by:
  - ✓ **describing** data and methodology checks,
  - ✓ **developing processes** governing peer review and public comments, and
  - ✓ **developing guidance** on conducting an analysis of the uncertainty surrounding the emission estimates.

Definition of QA/QC procedures

- **Quality Control** is a system of routine technical activities, to measure and control the quality of the inventory as it is being developed. The QC system should :
  - Provide routine and consistent checks to ensure data integrity , correctness and completeness
  - Identify and address errors and omissions
  - Document and archive inventory material and also record all QC activities
- **Quality assurance** is includes a planed system of review procedures conducted by personnel not directly involved in inventory compilation/ development process. Reviews :
  - verify that data quality objectives were met
  - ensure that inventory represents the best possible estimates of emissions and removals

General QC procedures

- Focus on processing, handling, documenting, archiving and reporting procedure that are common to all inventory source categories
- **List of routines to be performed by Inventory agency during (annual) preparation of inventory** (crosschecks, visual control,….)
- Set up priorities

Source specific QC

- Requires source specific knowledge
- Performed during the whole inventory preparation by inventory agency
- List of routines to be performed for specific source category

- Focus on **key categories**
  - Emission data QC
  - Activity data QC
  - EFs QC
  - (QC of uncertainty parameters)

QA procedures (unbiased review)

- Objective review to assess the quality of inventory, and identify areas for improvement.
- **Review per sector**:
  - activity data and appropriateness of emission factors, methods
  - calculations
  - documentation and relevant IIR chapter
  - trends
- **Review of national totals and cross cutting elements**
  - KCA, uncertainty estimates, trends, recalculations...
  - Compare with previous submission
  - Compare with indicators (e.g. GDP development, ...)
- Good practise is if inventory agency conducts peer review prior inventory submission

Practical consideration when developing national QA/QC plan

- **Allocate resources** (experts and budget) for all source categories (prioritisation is important)
- **Plan enough time** to conduct reviews and implement results of checks , develop time schedule
- **Ensure access to all information** needed for QC (Documentation & archiving is inevitable)
- **Determine techniques and routines** to be applied depending on national circumstances
- **Elaborate check list**

Documentation & archiving

Documentation and archiving – differences & „definitions“

- **Documentation (References)**
  - Descriptions of sources of the used data and methods and „background“ leading to conclusions in a way that third person can find them
  - The way how to persuade a reader or reviewer of a report that my data and conclusion are correct
- **Archiving**
  - Storage of all relevant documents and materials used in inventory preparation
    - to enable a follower to check all my steps and learn from my achievements and failures
    - to enable any recalculations

GPG: 8.10 DOCUMENTATION, ARCHIVING AND REPORTING

8 .10.1 Internal documentation and archiving

As part of general QC procedures, it is *good practice* to document and archive all information required to produce the national emissions inventory estimates. This includes:

- Assumptions and criteria for selection of activity data and emission factors;
- Emission factors used, including references to the IPCC document for default factors or to published references or other documentation for emission factors used in higher tier methods;
- Activity data or sufficient information to enable activity data to be traced to the referenced source;
- Information on the uncertainty associated with activity data and emission factors;
- Rationale for choice of methods;
- Methods used, including those used to estimate uncertainty;
- Changes in data inputs or methods from previous years;
- Identification of individuals providing expert judgment for uncertainty estimates and their qualifications to do so;
- Details of electronic databases or software used in production of the inventory, including versions, operating manuals, hardware requirements and any other information required to enable their later use;
- Worksheets and interim calculations for source category estimates and aggregated estimates and any recalculations of previous estimates;
- Final inventory report and any analysis of trends from previous years;
- QA/QC plans and outcomes of QA/QC procedures.

It is *good practice* for inventory agencies to maintain this documentation for every annual inventory produced and to provide it for review. It is *good practice* to maintain and archive this documentation in such a way that every inventory estimate can be fully documented and reproduced if necessary. Inventory agencies should ensure that records are unambiguous; for example, a reference to 'IPCC default factor' is not sufficient. A full reference to the particular document (e.g. *Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories*) is necessary in order to identify the source of the emission factor because there may have been several updates of default factors as new information has become available.

Records of QA/QC procedures are important information to enable continuous improvement to inventory estimates. It is *good practice* for records of QA/QC activities to include the checks/audits/reviews that were performed, when they were performed, who performed them, and corrections and modifications to the inventory resulting from the QA/QC activity.

Documentation and archiving – differences and connecting points

- Documentation and archiving are **closely connected**
- Inventory documented without any archive can be assumed trustworthy
- Inventory not documented is not trustworthy, provision of ex-post documentation from archived material requires effort comparable to elaboration of inventory itself
- Documentation and archiving:
  a **balance between extent and accessibility**

Examples of Documentation
(References)

1. EF used for manure management is 12 Gg (CH4/t manure)
   The value was measured by Frank Zappa in „Report from 1998 field experiment of Pink Floyd“, page 11, Akademy of Sciences, vol. 1, published by Bear @ Fox, Free-Town, Tumanya, 2001

2. In year 1994 12000 Mt of gasoline was sold
   The value is not available in Energy Balance 1994 and it was estimated as an average of 1993 and 1995 values from: Fuel sold statistics, Table 82, Custom Office Annual Report, Questionystan, 1996

3. The Reference Approach Method only was used for calculation of emissions from Fuel Combustion.
   According to suggestion in „Communication by Frank Thinker to David Inventor, 30/2/2008“, Archive of Commission for GHG Inventory, vol. 12,

Documentation

- More is better! But reasonably: e.g. 1+1=2 need not to be documented - assume university education without special experience in Inventory/Mitigation
- Refer to publicly available materials or include the source to an attachment
- Prefer published and per-reviewed materials
- Avoid logical loop backs
- Value more differing from defaults requires better documentation

Archiving

- More is better! But „heap-like“ archive complicates access to individual documents
- Make an easily understandable system
- Archive **all** „source materials“ (books, journals, reports, communications!!,.)
- Exception may be books and journals available in many public libraries

Archiving systems

- **simple and cheap:**
  - paper folders with a content at beginning
  - CD (DVD) with a „standard“ file system
  - **Free systems like CollectER + local library**
  - CD starting with contents and hypertext connections
  - Back-up servers
  - Mixed system (partly paper, partly CD/PC) can be dangerous (document may exist in both or in none)
- **sophisticated and expensive:**
  - simpler tools programmable by common user e.g. Lotus Notes (?)
  - proprietary programmed databases in different environments (MS SQL, Oracle, Informix, Sybase, SAP)
  - all documents scanned (or in e.g. REF format)

Archiving systems, advantages and disadvantages

- criteria for selection
  - **understandability** for a „newcomer“
  - **accessibility** without special equipment
  - time for access the archive and mean time to reach certain information
  - parallel accessibility at different places
  - **budget needs** for building and maintenance
  - long time perspective : durability of HW&SW formats (e.g. CD) both moral and technical