National greenhouse gas inventories: application of the principles of transparency, consistency, comparability, completeness and accuracy

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ABSTRACT

The submission of annual national greenhouse gas (GHG) inventories is a requirement under the United Nations Framework Convention on Climate Change (UNFCCC) for Parties included in Annex I to the Convention. These national GHG inventories should be transparent, consistent, comparable, complete and accurate. The application of these principles allows for more reliable data on GHG inventories and GHG emission trends, which are to be provided to the Conference of the Parties to the UNFCCC.

The review of the inventory submissions from different Parties indicates varying levels of adherence to these principles, though the quality of the national inventories has been continuously improving as a result of the experience gained by national experts in preparing inventories, the refinements of the methodological and reporting guidelines provided to Parties, and the results of the intensive review activities that took place in the period 2000-2002, coordinated and supported by the UNFCCC secretariat.

The paper describes improvements in national GHG inventories in adhering to the principles of transparency, consistency, comparability, completeness and accuracy achieved during the period 2000-2002. It also summarizes the sector-by-sector improvements carried out in the national inventories resulting from the findings of the various stages of the review activities. In addition, it provides information as to how the review procedures, the performance of expert review teams and the UNFCCC secretariat have been streamlined in the course of the trial period, in particular with regard to the application of quality assurance/quality control procedures in processing submitted inventory information.

INTRODUCTION

The main goal of the United Nations Framework Convention on Climate Change (UNFCCC) is "to achieve stabilization of atmospheric concentrations of greenhouse gases (GHG) at levels that would prevent dangerous anthropogenic (human-induced) interference with the climate system…" [1]. This goal requires emission limitation and reduction at national and international levels. Therefore the estimation of the GHG emission levels through GHG inventories is needed and Parties included in Annex I to the Convention (developed countries) are requested to prepare and submit national GHG inventories annually to the Conference of the Parties (COP) through the UNFCCC secretariat.

The methodological basis for the development of the inventories is the Revised 1996 Intergovernmental Panel on Climate Change (IPCC) Guidelines for National Greenhouse Inventories (IPCC Guidelines) [2]. These guidelines were further elaborated by the IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories (IPCC good practice guidance) [3], which was recommended to be used by Annex I Parties (hereinafter also referred to as Parties) as far as possible for inventories due in 2001 and 2002, and should be used for inventories in 2003 and onwards. Good practice guidance assists countries in producing inventories that are accurate in the sense of being neither over nor underestimated as far as can be judged, and in

which uncertainties are reduced as far as practical. Good practice guidance further supports the development of inventories that are transparent, documented, consistent over time, complete, comparable, assessed for uncertainties, subject to quality control and assurance, efficient in the use of the resources available to inventory agencies, and in which uncertainties are gradually reduced as better information becomes available.

These requirements are also integrated in the UNFCCC guidelines, which relate to the two sequential processes established for Annex I Parties: the annual reporting of national GHG inventories and the review of the inventories. The UNFCCC reporting guidelines on annual inventories [4] and the UNFCCC guidelines for the technical review of GHG inventories (UNFCCC review guidelines) [5] were adopted in 1999 for a trial period of three years. The UNFCCC reporting guidelines require inventory submissions to have two parts, the national inventory report (NIR) and the common reporting format (CRF). The NIR descries the methodologies used in preparing the inventory estimates. The CRF is a standardized set of tables for providing data on GHG emissions by source and removals by sinks, as well as information on the activity data used and calculated implied emissions factors (IEF). It also includes tables with information on, inter alia, emission trends, completeness of the estimates, methods used, recalculations made, and uncertainty assessment, as requested by the UNFCCC reporting guidelines. The tables in a CRF are on a year basis. Each inventory submission should include a CRF for each year from the base year under the Convention (usually 1990) to the most recent year available.

Reporting guidelines facilitate the process of considering annual inventories, including a technical analysis of GHG inventory data and review of the inventories. They require that the annual national GHG inventories be transparent, consistent, comparable, complete and accurate. Application of these principles allows for more reliable data on GHG inventories and emission trends to be provided to the UNFCCC.

Both UNFCCC reporting and review guidelines were revised in 2002 [6, 7] taking into account the experience from the trial period and requirements of the IPCC good practice guidance, defining structure and content of the NIRs, and the timing of review activities steps and including other modifications. As of the year 2003, all Annex I Parties' inventories will be subject to an individual review according to the revised review guidelines.

One of the elements that contribute to the overall improvement of the inventories is that both IPCC and UNFCCC guidelines include the principles of transparency, consistency, comparability, completeness and accuracy (TCCCA) as guiding principles in preparing and reporting inventories. This paper describes what has been achieved by Parties in preparing and reporting GHG emissions in adherence to these principles in the period 2000-2002.

In the context of the UNFCCC reporting guidelines the terms transparency, consistency, comparability, completeness and accuracy are defined as follows:

Transparency means that the assumptions and methodologies used for an inventory should be clearly explained to facilitate replication and assessment of the inventory by users of the reported information. The transparency of inventories is fundamental to the success of the process for the communication and consideration of information;

Consistency means that an inventory should be internally consistent in all its elements with inventories of other years. An inventory is consistent if the same methodologies are used for the base and all subsequent years and if consistent data sets are used to estimate emissions or removals from sources or sinks;

Comparability means that estimates of emissions and removals reported by Parties in inventories should be comparable among Parties. For this purpose, Parties should use the

methodologies and formats agreed by the COP for estimating and reporting inventories. The allocation of different source/sink categories should follow the split of the IPCC Guidelines, at the level of its summary and sectoral tables;

Completeness means that an inventory covers all sources and sinks, as well as all gases, included in the IPCC Guidelines as well as other existing relevant source/sink categories which are specific to individual Parties and, therefore, may not be included in the IPCC Guidelines. Completeness also means full geographic coverage of sources and sinks of a Party; and

Accuracy is a relative measure of the exactness of an emission or removal estimate. Estimates should be accurate in the sense that they are systematically neither over nor under true emissions or removals, as far as can be judged, and that uncertainties are reduced as far as practicable. Appropriate methodologies should be used, in accordance with the IPCC good practice guidance, to promote *accuracy* in inventories.

METHODS OF ASSESSING THE ADHERENCE TO THE PRINCIPLES OF TCCCA

This paper focuses on the specific methods and procedures for reviewing GHG inventories under the Convention in the years 2000-2002 and their efficiency in assessing the adherence to the TCCCA principles (for a more in-depth discussion of the procedures for inventory reporting and review requirements and procedures see *Technical Review of the National Greenhouse Gas Inventories* [8]). It uses the compilation of the findings included in the review reports from the 2000-2002 review activities and the assessment on the way these findings were addressed. For the sake of brevity, the findings from the waste sector are used as illustrations (see annex I).

The annual inventory review process under the Convention is conducted by inventory experts nominated by Parties that have recognized competence in the areas to be reviewed. The process is facilitated by the UNFCCC secretariat, that is responsible for data processing and the coordination of the review activities.

The review process is conducted in three stages as outlined below.

The initial checks stage is intended to assess whether the submissions are complete and in the correct format. This stage of the review process checks coverage of years, gases, tables, reported recalculations and is mainly based on the CRF. The output of the initial check is a status report in tabular format and is available at the web site of the secretariat [9].

In addition, during the initial check stage the secretariat conducts consistency checks of inventory data. These computerized procedures check the internal consistency of the inventory and are made as data is imported into the secretariat's database. Consistency checks highlight possible problems such as different entries in the cells where the entries are expected to be the same, wrong sums, and overwritten formulas. In 2002, which was the first year this tool was used, 23 consistency check reports were sent to Parties, which resulted in resubmissions of CRF of 14 Parties. This allows improved accuracy of the data handled at the next stages of the review process.

The synthesis and assessment comprises the second stage of the review process. It mainly compares inventory data across Parties and identifies issues for further consideration during the individual reviews. The results of this stage are published on the UNFCCC web site as a synthesis and assessment report (S&A report). Part I of the S&A report has a tabular format and comprises a compilation and comparison of IEFs and other inventory information across Parties, across different years, and compares activity data provided by Parties with international statistics. Part II of the S&A report highlights preliminary issues identified for each Party's inventory for further consideration during the individual review. It provides comparisons with previous submissions, identifies areas for further consideration or clarifications, addresses cross-cutting issues as uncertainties, QA/QC,

consistency. S&A reports mainly provide for checking the comparability and consistency of the estimates, but also assist in evaluating the completeness, transparency and accuracy of the inventories.

Individual reviews of greenhouse gas inventories are the final stage of the review process, and provide for a detailed examination of inventory estimates, procedures and methodologies. The reviews focus on the information in NIRs and any other information noted as part of the inventory submission together with the data provided in the CRF. The reviews examine the consistency of the inventories with the UNFCCC reporting guidelines and IPCC Guidelines (e.g. use of appropriate methodologies, data quality), compare submissions, identify missing sources, assess the extent to which issues from S&A reports and previous reviews are addressed and resolved, and identify areas for further improvements. Therefore, this stage is the most important to assess questions of accuracy, consistency, completeness, comparability, and transparency of national inventories.

The secretariat has developed a number of procedures and tools to enhance the efficiency and effectiveness of the individual review stage, namely:

- standardized procedures for all steps in the review process (a predefined set of checks, standards for documents);
- a Review Handbook, review protocols and standard review report templates to provide guidance to the reviewers;
- a compilation of all previously identified problems classified according to the source category and comments of Parties to assist experts in focusing the review;
- software tools for data analysis (data search tool, table generator, outlier detection), as described in [10];
- a database to archive inventory review information;
- selection of expert review teams (ERT) and provision of background materials well in advance of the reviews to facilitate participation of the reviews;
- training program for new reviewers.

These activities are enhancing the efficiency of the review process. They help to ensure that the inventories of all Parties are treated in the same manner regardless of the experience of the ERT. They also enhance transparency in the review process and allow for comparable results of the review activities and better assessing of the efficiency of the review process. Archiving of the review findings and keeping track of them is a way to ensure the consistency in the review process. The secretariat's activities help to improve the performance of the Parties since the results of these checks are communicated to the respective Party.

Three operational approaches for conducting the individual reviews were tested in the trial period. Desk reviews imply sending inventory submissions to reviewers working at their offices, while centralized reviews gather reviewers at a single location to conduct the review of inventory submissions of several Parties. In-country visits take place in the country subject to review and rely on the direct contact between national experts and ERTs. Each team in the desk and centralized reviews consist of 12 members (two experts per sector plus two generalists). The in-country review team consists of 6 experts (one expert per sector plus one generalist). One of the goals of the ERTs is to help improving the national GHG inventories and making them in line with the principles of TCCCA, indicating the existing problems with estimating and reporting the inventories. The experience in the last year shows that the reviews become more focused on the potential problems and recommendations for follow-up.

The numbers of the reports from the review activities conducted in the period 2000 -2002 are given in table 1. All reports are available at the web site of the secretariat [9].

Table 1. Review activities in the period 2000-2002

Year	Status reports	S&A reports[(a)]	Individual review reports
2000	23	1	13
2001	29	1	26
2002	32	1	12

[(a)] Part II of the S&A report includes a separate section for each reporting Party.

RESULTS

As a result of the reporting and review process the adherence of the Parties to the TCCCA principles in their national GHG inventories is improving. The remainder of the paper discusses improvements in the adherence to the TCCCA principles in the national GHG inventories during the trial period. Under each of the principles, a few examples of improvement are provided. The final section summarises the complex effect of the provided indicators to more than one of the TCCCA principles. Annex I provides concrete examples of the changes made by Parties to better adhere to the TCCCA principles based on findings in the waste sector.

Transparency

An efficient assessment of inventory estimation requires clear explanations of methods to allow full understanding of the methodologies and data behind the emission estimates provided. This requirement is strongly related to the transparency of the reporting and can be subdivided into several elements: provision of NIRs and references to other supporting materials; provision of information in the sectoral background data tables, additional information boxes and documentation boxes of the tables in the CRF; and proper use of notation keys. The lack of these elements hinders the readability of the CRF and may lead to improper comparisons and interpretation of data.

The submission of NIRs is the most important source of methodological information in a submission and the increase in the number of Parties submitting an NIR is a good indication of the improved transparency of reporting: 7 NIRs submitted in 2001, 15 in 2001 and 19 in 2002.

The transparency of the inventory is also affected by the provision of the background data tables, since these background tables provide more information about how an estimate is derived. These tables should provide numerical information on activity data, IEFs, and, in most cases, emission estimates at the lowest level of aggregation required by the CRF. As indicated in table 4, the number of Parties providing these tables is increasing. In addition, information should be provided in the additional information boxes and documentation boxes to the CRF tables (see illustration 1 and 2, Annex I). The information requested in this part of the CRF is indispensable for the transparency and comparability of the information and good background to check the accuracy of the national estimates.

The use of the notation keys is also related to transparency of reporting. Notation keys are supposed to be used as an explanation when numerical data is not provided. An empty cell could cover problems related to transparency or comparability (in case it stays for emissions not occurring (NO) or included elsewhere (IE)) or completeness (not estimated (NE) emissions). The lack of use of the notation keys is indicated as a reporting gap in the status reports. For 11 Parties the number of gaps in using the notation keys were reduced over the period.

Consistency

Within the framework of the UNFCCC, consistency in time series requires the use of similar methods and data sets in the base year and all subsequent years. This requirement is one of the reasons for recalculating inventories, since Parties should apply new methodologies and include new source categories over time. Recalculations should result in improvements in the accuracy and completeness of the inventory and should ensure consistency in the time-series.

The checks of the inventory submissions for 2000-2002 indicate (table 2) that the number of recalculated inventories is increasing over the years, as well as the number of countries that submit revised versions of the entire time series each next year in order to improve their national inventories.

Table 2. Recalculations over the 2000-2002 period

	2000	2001	2002
Recalculations reported of which:	10	16	23
for 2 and more years	7	15	20
for 1 year	3	1	3

The main reasons for recalculations are provided by Parties in table 8(b) of the CRF. The reasons for recalculations, their relation to the TCCCA and their contributions in the recalculations reported by Parties in the 2002 submissions are summarised in table 3 (also see illustration 3). The review of the CRFs provided by Parties indicates that in most cases explanations for the reasons of recalculations are provided (except for 1 or 2 Parties).

Table 3. Reasons for recalculations and their relation to TCCCA principles

Reasons for recalculations	Improvement of:					Contribution to the number of reported recalculations [%]
	Transpa-rency	Consist-ency	Compara bility	Complete ness	Accuracy	
Revisions of activity data					√	45
Revision of emission factors		√			√	23
Changes in methodologies		√	√		√	15
Inclusion of new source/sink category				√		10
Reallocation of source categories			√			7

Comparability

Comparability of inventories calls for application of similar approaches in estimating, allocating and reporting GHG emissions by source and removals by sink. The UNFCCC reporting guidelines request the use of the IPCC Guidelines to ensure this comparability of methodologies. However, the IPCC Guidelines allow Parties great flexibility in estimating GHG emissions. Parties may use default methods or more accurate and advanced methods either from the IPCC Guidelines and IPCC good practice guidance or from other comparable methodologies, providing they document the methods. The choice of emission factors (EFs) is also flexible. The IPCC Guidelines provide default EF but encourage use of country specific factors, which may be more appropriate for different national contexts. Although over the entire period of submitting national GHG inventories, Parties declared to follow or use the IPCC Guidelines to prepare their GHG inventories, the interpretations range widely from following the IPCC default methods and EFs in all cases to using the IPCC Guidelines only as an organizational and reporting framework, but using national methods and EFs.

The methodological flexibility together with the reporting variety called attention to the need for a standardized reporting that was adopted with the CRF. It allows easier follow up of the applied methods and used EFs. The IEFs (the ratio between the estimated emissions and standard activity data) allow cross-country comparisons between Parties using different methodologies and different aggregation levels in their estimates. IEFs that are too high or too low compared to the other Parties' IEFs indicate a potential problem in the method used. Summary of the status of the 1998-2002 submissions of national inventories and the submissions in the CRF is provided in table 4.

Table 4: Reporting of national inventories in the period 2000-2002 (number of Parties)

	1998	2000	2001	2002
Submitted inventories	21	32	32	34
of which in CRF		23	29	32
Inventories submitted in time (by 15 April)	4	9	19	22
CRF for entire time series		7	12	15
CRF only for some years of the time series		14	12	12
Background data tables reported		21	24	27
Table on methodologies reported		18	25	29
Table on uncertainty reported		16	24	29
Table on completeness reported		14	22	25
NIR submitted		7	15	19

A clear tendency is shown in the increasing number of submissions and the using of the CRF for data reporting. The timing of the reporting is also important since the timely reporting of the CRFs allows the submission to be considered in the development of the S&A tables. The deadline for submitting national inventories is 15 April. The number of Parties that submitted their inventories in a timely manner has more than doubled. The increase is even greater when comparing to the period before 2000.

Comparability heavily depends on the data provided in the CRF and the coverage of the background data tables that provide for activity data comparable with international data and IEF comparable across Parties. It also benefits from the provisions of the tables on methods and EFs used, on uncertainties of the inventories, on recalculations made by Parties and on the use of notation keys and allocation of the sources (completeness table). Thus, for example the allocation of sources to sectors is facilitating the comparability among inventories. To be comparable, Parties should report their estimates according to the IPCC categorisation, and each deviations from that categorization should be reported in the completeness table of the CRF (use of notation key IE).

Comparability of methodologies used by Parties can be examined at the stage of assessing the data in the CRF against the brief methodological information provided in the CRF table on methods and emissions factors used (Summary 3 of the CRF). These tables allow for quick assessment of what methodology has been used by the Party, as reported, for mainly distinguishing between IPCC and country specific (CS) methodologies. During the trial period, the reporting of the table increased, as shown in table 4. The information reported in the tables is summarised in the S&A reports, where methods applied for each of the key source categories could be easily compared across Parties (see illustration 4). The information facilitates the consideration of the data and assessing the consistency of the methodology with the IPCC guidelines. Details on the comparability of methods and their improvements can be found in the review reports.

Completeness

Completeness of the inventories has several key aspects: coverage of gases, coverage of source and sink categories, geographical coverage, coverage of years in the time series. All of them are addressed in the different stages of the review activities, starting with general information in the status reports and going to the underlying principles for omissions of specific source categories during the individual reviews.

National GHG inventories shall contain information on the following greenhouse gases: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), perfluorocarbons (PFCs), hydrofluorocarbons (HFCs) and sulphur hexafluoride (SF_6). Parties should also provide information on the following indirect greenhouse gases: carbon monoxide (CO), nitrogen oxides (NO_X) and non-methane volatile organic compounds (NMVOCs), as well as sulphur oxides (SO_x). The coverage of gases in the 2000-2002 submissions (in CRF) is shown in table 5.

Table 5. Coverage of gases in annual inventories

Gases	2000	2001	2002
CO_2, CH_4, N_2O	23	29	32
PFCs	21	23	25
HFCs	20	24	26
SF_6	21	25	28
CO, NOx, NMVOC, SOx	20	28	31

As can be seen, the number of Parties reporting all requested gases is increasing over the years. However, there are Parties still having difficulties in reporting HFCs, PFCs and SF_6. One indicator on the completeness of reporting is the coverage of HFC and PFC gases and whether both actual and potential emissions are estimated as requested by the UNFCCC reporting guidelines. The reviews during the trial period indicate the following improvements in this area: while in 2000 only six Parties were reporting in line with the UNFCCC reporting guidelines, this number increased to 10 in 2002. Ten Parties keep the same way of reporting over the years, which is not fully in line with the requirements. For 14 Parties the reporting over the period improved, by e.g. including new gases in the inventories or estimating both potential and actual emissions.

In addition to increased number of Parties using the CRF and completing background data tables in the submitted CRFs, the completeness of the reporting also relates to the coverage of the time series in a submission (see table 4).

The inclusion of new sources represents measures that Parties are taking to adhere to the principle of completeness of the inventories. The most reliable source for assessing the changes in completeness of the inventories is the comparison of the submissions and the review reports for subsequent years. The information on recalculations indicated that 10 per cent of the recalculations submitted in 2002 were due to the inclusion of new sources. Some examples in this field are shown in illustration 5.

The missing sources in an inventory should be indicated with the notation key NE (not estimated) and therefore the use of notations keys NE and IE is also relevant to the completeness of the inventory. Each use of notation keys should be explained in the completeness table in the CRF. The review of the provision of this table indicates increased number of Parties submitting it (see table 4). This table provides good information on the completeness of the inventory and the reasons for missing estimates. Not estimated sources are usually explained with a lack of methodology or activity data.

Accuracy

Last, but not least of the TCCCA principles is accuracy. Good practice guidance aims to provide for emission and removal estimates, that should not be over or underestimated systematically. Comparisons of activity data against international data sources, checks of the IEF across countries and checks of the activity data, IEF and emission trends for each Party help to find problems in the accuracy of a inventory for a given year or for entire time series for a given source.

The recalculations are a measure of the improved accuracy of the inventories due to availability of new data or refinement of the methodologies and EFs, derived on the base of studies

or as a reaction to the recommendations of the review reports. Therefore recalculations are a good indicator of the attempts that Parties carry out to ensure higher accuracy of the estimates, along with consistency of the time series and improved completeness. In addition to the recalculations for mainly methodological reasons, a large number of revisions are taking place because of the need for correcting identified mistakes through the review process. Such revisions clearly result in improved accuracy of reporting (see illustration 6).

An indicator to measure the improved accuracy of the inventories is the reduction of uncertainties of the estimates. Even though in this paper it is not possible to assess the decrease in the uncertainty given the short period under review, it is evident that Parties are improving the way they estimate and report uncertainties. Over the years the approaches to estimate uncertainties generally follow the following sequence: qualitative assessment of the uncertainties using expert judgements, use of appropriate values within the default uncertainty ranges from the IPCC good practice guidance, development of national quantitative uncertainty analysis, concentration of the work in the areas defined as having the highest uncertainty levels and particularly those relating to key source categories. As shown in table 4 the number of Parties accounting and reporting uncertainties is increasing substantially over the period. Twelve Parties report quantitative uncertainty estimates, which indicates an advanced stage in the process of addressing uncertainties and suggests that over time Parties are using uncertainty analysis to prioritise improvements in their inventories.

QA/QC programs in place in the countries contribute improving transparency, consistency, comparability, completeness, and accuracy and therefore in attaining confidence of emissions estimates in national inventories. They can be considered as a part of the improved performance of the Party in achieving the complex principles of TCCCA.

QA/QC procedures have to be undertaken when preparing national inventories and these procedures should be documented in the NIR. From those countries that included information on the QA/QC procedures in their NIRs, it could be summarized that there is ongoing work to improve the performance with regard to this indicator (see table 6).

Table 6. Level of development of QA/QC procedures reported by Parties

	2000	2001	2002
QA/QC elements	6 Parties	10 Parties	8 Parties
Plans for QA/QC programs	-	5 Parties	5 Parties
QA/QC programs in place	-	3 Parties	5 Parties

Summary of tools and indicators relating to TCCCA

The analysis of the findings from the review reports from the trial period indicates that the technical review process is able to identify the gaps and problems in national GHG inventories related to the adherence to the TCCCA principles and to provide valuable recommendations for solving deficiencies and improving of estimates and reporting of inventory data and information. The stages of the review process are complementary in reviewing the observation of the principles. Each stage looks at the national inventory from a different perspective and increases the level of detail in the assessment of the quality of the inventories, starting with the screening procedures at the data entrance checking for accuracy and consistency in reporting and reaching the detailed level of the individual reviews that investigate in details each one of the TCCCA principles. The main focus of each stage of the review process and its subsequent reports in assessing the adherence to the principles of TCCCA is indicated in table 7.

Table 7. Stages of review process assessing the adherence to TCCCA principles

Review activities	Transpa-rency	Consist-ency	Compa-rability	Comple-teness	Accuracy
Consistency checks		√			√
Status Reports	√	√		√	
S&A part I			√	√	√
S&A part II	√	√	√	√	√
Review reports	√	√	√	√	√

The experience in reviewing GHG inventories indicates that some reporting elements included in the UNFCCC reporting guidelines, such as the provision of CRF and NIR, have become useful tools to promote adherence of reporting of national GHG inventories to the principles of TCCCA. The experience also shows that specific information reported by Parties such as recalculations, QA/QC and uncertainties has become an indicator on how the adherence to the principles of TCCCA is improving in the national GHG inventories of Parties. Table 8 summarizes the tools and indicators used in assessing the adherence to the TCCCA performance in GHG inventories.

Table 8: Tools and indicators relating to the TCCCA performance in national inventories.

Tools and indicators	Transpa-rency	Consist-ency	Compa-rability	Comple-teness	Accuracy
Submission of CRF		√	√	√	
- full time series		√	√	√	
- background data tables	√		√	√	
- table on methodologies used	√		√		
- completeness table	√		√	√	
- notation keys	√			√	
NIR	√	√	√		√
Coverage of gases				√	
Recalculations		√	√	√	√
Uncertainties					√
QA/QC programs	√	√	√	√	√

CONCLUSIONS

The review of the findings related to the adherence to the TCCCA principles in national GHG inventories shows substantial improvements that could be readily observed for each one of the principles. The refinements in the national methodologies, experience gained by Parties in applying the guidelines, as well as the ongoing development in both the IPCC and UNFCCC guidelines are reflected in the overall improvement of the national inventories.

The review activities have also become an efficient tool for improvements in inventory performance. They benefit from the supporting activities in the secretariat and the experience gained by the inventory experts during the review trial period both as reviewers and as reviewed experts. The reviews are becoming a continuous process storing and elaborating the results of each review stage and from each year of the review process together with the information on the actions taken by Parties to address the problems. Thus the review activities note the status of the identified problems for each next review step and allow for assessment of the improvements made with regard to the adherence to the TCCCA principles in national inventories. The annual reviewing of the inventories as of 2003 will further elaborate the usefulness and streamlining of the review process.

The inputs of the review activities, as well as the follow-up activities undertaken by Parties following the recommendations by the ERTs have led to better adherence to the TCCCA principles in the national inventories that has marked first achievements in the period 2000-2002. These

examples bring confidence in the efficiency of the reporting and review procedures and lead to development of high quality and reliable national GHG inventories.

The adherence to the TCCCA principles is highly related to the application of the IPCC good practice guidance and UNFCCC reporting guidelines. Parties that follow these principles are closer to the requirements of these guidelines, and, vice versa, the application of the IPCC good practice guidance and UNFCCC reporting guidelines ensures adherence to the principles of TCCCA.

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The views and opinions of the authors expressed in this paper do not state or reflect those of the secretariat of the United Nations Framework Convention on Climate Change or those of the Parties to the United Nations Framework Convention on Climate Change.

KEY WORDS

Greenhouse gas inventories
Reporting of greenhouse gas data
Review of greenhouse gas data
Accuracy
Transparency
Consistency
Comparability
Completeness

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ANNEX I

The secretariat has initiated an assessment of the status of the identified problems from the review activities from the trial period. The process will provide updates on the changes undertaken in countries following the recommendations of the ERTs. For the sake of brevity, the findings from the waste sector are used as illustrations for some of the indicators used to demonstrate the improvements with regard to the TCCCA principles. Those findings represent 1100 identified problems for the sector from review activities during the trial period. In other sectors the number of the findings is significantly higher. The examples in each illustration are not reflecting all identified improvements.

Illustration 1. Transparency issues in waste sector (Transparency)

Most of the problems identified in the review activities relating to the waste sector belong to transparency issues (43 percent of the listed findings). In most cases the findings are categorised as transparency issues but in combination with methodological or completeness issues. Some examples of transparency issues listed in the reviews of 2000 GHG inventory submissions that have been resolved in the 2002 submissions are given below.

Party	2000 submission	2002 submission
Austria	In the background data table for wastewater handling emissions from sludge were reported as IE, but the exact location was not provided in the NIR or CRF.	There was an explanation in the documentation box of the table that the emissions were reported under the emissions of wastewater.
Belgium	A small quantity of undocumented CH_4 emissions were reported under category 6.D Other.	Belgium explained in its NIR that the emissions were from sludge spreading and composting.
Norway	Information in the additional information boxes was sufficient, but original sources of annual waste data were not indicated.	The references were provided in the NIR.
Greece	No explanation was provided for the use of a lower MCF (0.6) than the IPCC default (0.8) for unmanaged deep solid waste disposal.	Explanation was provided in the documentation box to the table.
Sweden	No background data was provided for wastewater handling and waste incineration.	Explanations were given in the NIR. The tables were filled in with appropriate notation keys.

Illustration 2. Improved reporting in waste sector (Transparency)

With regard to the use of the notation keys in the CRF tables, completion of the documentation boxes and additional information boxes for the tables in the waste sector the improvements registered for 26 Parties (with submissions both in 2000 and 2002) in their 2002 submissions are as follows:

	2000 submission	2002 submission
Provision of background data tables on waste sector	18 Parties	24 Parties
Use of notation keys in the tables	10 Parties	20 Parties
Provision of documentation boxes to the tables	14 Parties	22 Parties
Provision of additional information boxes	13 Parties	21 Parties
Parties with improved reporting-		*14 Parties*

Illustration 3. Recalculations in waste sector (Consistency)

Twelve Parties have recalculated their emissions from waste sector in 2002. Most of the recalculations were attributed to revised activity data. However in a few cases the reason is stated to be a revision of the EF (Japan), methodological change (New Zealand - change to more complex methodology), change in emission allocation (Netherlands, USA), new source included (Australia, Japan, Spain). Although the overall impact of these recalculations on the overall emissions in these Parties is negligible, the recalculations in the sector improved the accuracy, completeness, comparability and consistency of the estimates.

Illustration 4. Methodologies used by Parties in waste sector (Comparability)

The methods used in waste sectors as reported by Parties and summarized in the S&A reports are the following:

	IPCC default	Tier 2	Models	CS methods
6.A Solid waste disposal on land	9 Parties	7 Parties	7 Parties	8 Parties
6.B Wastewater handling	12 Parties	CORINAIR 2 Parties	2 Parties	6 Parties
6.C Waste incineration	-	3 Parties	-	6 Parties

This summary is an input for the comparability analysis of the inventories. It shows the use of CS methods, which need careful investigation during the reviews to assess the consistency of the method with the IPCC Guidelines and its comparability with the methods used by other Parties.

Illustration 5. Completeness issues in waste sector (Completeness)

The completeness issues constitute 24% of all review findings for the waste sector. A review of the findings from the year 2000 submissions reviews compared to the 2002 submissions was carried out to check the changes made by the Parties. Some examples of improvements relating to the completeness of the inventories in response to the review activities in 2000 are given below:

Party	2000 submission	2002 submission
Australia	No N_2O emissions were reported from wastewater handling.	Emissions were reported.
Canada	No CH_4 and N_2O emissions from waste incineration were reported.	Emissions were reported.
Hungary	No CH_4 and N_2O emissions from waste incineration were reported.	N_2O emissions were reported.
Japan	No emissions from industrial wastewater were reported.	Emissions were reported.
UK	No emissions from incineration of clinical and hazardous wastes were reported.	Emissions from clinical wastes incinerations were estimated and reported.
USA	No CH_4 from industrial wastewater handling were reported.	Emissions were reported.

As shown in the table, the improvements carried out by Parties have increased the completeness of the estimates both in terms of sources covered and in terms of gases estimated per given source. The changes were consistently applied over the entire time series.

Illustration 6. Corrected mistakes in national inventories (Accuracy)

The review findings indicate mistakes in filling data accounting for 5% of the overall identified problems. At the same time the percent of solving of these problems is very high. Generally all of them are removed in the Party's next submission. Some examples of such improvements are included below:

Party	2000 submission	2002 submission
Italy	The value of 0.9 was used for the CH_4 fraction in landfill gas, which appeared high. This value is normally 0.5 but can vary between 0.4 and 0.6 depending on several factors.	In its response to the desk review report Italy stated it was an incorrect data input. In the 2002 submissions, CH_4 fraction in landfill gas was reported as equal to 0.5.
Hungary	According to table 6.C CH_4 IEF was too low and no N_2O IEF was given.	The problem with the unit was removed and the CH_4 IEF was in the range reported by other Parties. N_2O IEF was available.
Netherlands	The IEF of solid waste disposal systems was four orders of magnitude higher than in other Parties.	Value was corrected in next submissions.