Training Handbook – implementation of UNFCCC principles and use of notation keys in reporting national GHG inventory

This handbook provides practical understanding of the implementation of some requirements in "UNFCCC Annex I inventory reporting guidelines" respectively decision *24/CP.19*[1] *Revision of the UNFCCC reporting guidelines on annual inventories for Parties included in Annex I to the Convention*. Particularly, it refers to practical implementation of *reporting principles* (section B of the Annex[2]) and the use of *notation keys* (art. 37). It also provides an overview of the methodological approach for the *analysis of the uncertainty* (following the guidance in *Chapter 3: Uncertainties of the Volume 1: General Guidance and Reporting of the 2006 IPCC Guidelines for National Greenhouse Gas Invent*ories).

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Overview of UNFCCC reporting guidelines on annual inventories for Parties included in Annex I to the Convention

Decision 24/CP.19 adopts UNFCCC reporting guidelines on annual greenhouse gas inventories and the revised common reporting format tables following implementation of 2006 IPCC Guidelines, and the global warming potential values. It encourages Annex I Parties to use *2013 supplement to the 2006 IPCC guidelines for national greenhouse gas inventories: wetlands* in preparing their annual inventories. Main purpose of this decision is to assist Annex I parties to report national inventories of anthropogenic emissions by sources and removals by sinks and improve their inventories, as well as to assist them to communicate information related to implementation of the obligations under the convention and contribute to ensuring the transparency of emission reduction commitments.

Decision 24/CP.19 gives guidance on national inventory arrangements needed to additionally ensure a timely preparation and submission of information which is fundamental to facilitate the process of considering annual national GHG inventories, including the preparation of synthesis documentation and technical review. For that, Annex I Parties should setup institutional, legal and procedural arrangements to estimate, report and archive inventory information.

It also states that Annex I Parties shall use the methodologies provided in the 2006 IPCC Guidelines, and that they should make every effort to use the recommended method to estimate the key categories or pools. Otherwise, they are required to explain what prevented the implementation of the recommended method.

Implementation of UNFCCC reporting principles

Decision 24/CP.19 defines **five principles that govern reporting information on annual national GHG inventory**: Transparency, Consistency, Comparability, Completeness, Accuracy. Assessment on their implementation is based on Party's official submission to UNFCCC: National Inventory Report (main report and annexes) and Common Reporting Format tables.

Here is a rapid assessment on the implementation of reporting principles by Turkey most recent UNFCCC submission (2017):

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[1] Decision 24/CP19 available at: http://unfccc.int/resource/docs/2013/cop19/eng/10a03.pdf

[2] Decision 24/CP19: Annex I Guidelines for the preparation of national communications by Parties included in Annex I to the Convention, Part I: UNFCCC reporting guidelines on annual greenhouse gas inventories

Principle	Purpose/meaning	Practical implementation and possible issues
Transparency	Data sources, assumptions and methodologies clearly described and explained, allowing full replicability of estimates	• data reported in various tables of NIR should be at the level of aggregation used in the inventory calculation (e.g. on land subcategories and divisions); • explain the consistency of land activity data used with reporting requirements (e.g. how various land classes are grouped into reporting categories; if area for land conversions is "gross" or result as a "net" change at the end of year compared to previous year in which case the assumptions and reasoning behind calculations are explicitly provided); • explain consistency of C stock change data with reporting requirements, i.e. how $BCEF_{I,V,S}$ values used in calculations reflect actual need of conversion from standing or harvested volume to entire aboveground biomass, including any deviation from formulas given in the IPCC (e.g. if BEF and country specific WD are used instead of BCEF); • provide explicit definitions and references for land categories and C pools, e.g. for land and soil management practices identified as input activity data, according to basic sources of information; • explain the assumptions behind any expert guess contribution (e.g. which parameter is based on expert guess: C stock size, time needed for C stock to reach that level, proxy used); • explain if the allocation of certain source or sink does not follow the IPCC recommendations (e.g. if allocated under different subcategory then generally expected); • information on methodological or data gaps should be presented in a transparent manner, including why categories for which exist methodology in IPCC 2006 Guidelines exist are not reported, if any; • country specific C stock change factors are referenced (including to research reports/studies in national language or best enforced by related peer-review publications); • calculation spreadsheets simplified and unified in a unique file (e.g. excel) or calculation framework (in which case transparent procedures on plug-in of the contributions should be available for all relevant partners)
Consistency	Compatible methodologies and data used across GHG inventory sectors, categories and gases in time within national territory, all elements used in the calculations fully correspond to each other	• methodological tier used for reporting corresponds to the key category employed; • time series for country specific activity data and C stock change factors are collected and processed using the same methodology, or at least entire time series is reconstructed according to the most recent methodology; • C stock change factor is fully relevant for the concerned activity data or source data (e.g. gain in forest is estimated for the exact same area of forest reported as activity data in CRF tables); • GHG emission factor is fully relevant for the concerned activity data or source, especially when default factors are used (e.g. default CO2 emission factor from organic soils is consistently used if definition of organic soils match that adopted in the IPCC Guidelines 2006). Otherwise the inconsistency should be transparently highlighted in the NIR, and an associated improvement plan in case of key category; • CO2 and non-CO2 emitted from the same source should have a constant ratio as estimated from default values (e.g. CO2 and direct N2O emissions from mineralization of organic matter in managed mineral soils corresponds to a ratio of 3500; or in forest fires ratio of N2O to CH4 emissions is around 18, or ratio of direct to indirect N2O emissions from the same source is about 10); • area for the estimation of N2O emissions from cultivation of histosoils reported under Agriculture (Table 3D.a.6) should be equal to that used to estimate CO2 from cultivation/management of croplands and grasslands categories on organic soils (subcategories added together: 4B1, 4B2, 4C1, 4C2); • whenever used, the notation keys should be consistent across NIR and CRF tables (for cells dedicated to activity data and C stock changes) or among reported categories (e.g. if country specific estimate for C stock change in litter includes dead wood, then to report "IE" (included elsewhere) for dead wood)

Comparability	Use of methodologies and formats agreed to make emission and removals estimations and reporting inventories	• allocation of sources and sinks under suggested IPCC categories (otherwise a reason for it should be provided, e.g. are olive groves reported under Cropland or Forestland along entire time series); • GHG emissions reported under suggested IPCC categories (i.e. CO2 from wildfire or controlled burning is implicitly included under C stock change in living biomass pool); • estimate all correlated CO2 and non-CO2 emissions from sources; • consistent use of notation keys
Completeness	Identification and inclusion of all sources and sink categories, as well as related gases, for which methodologies are provided in the 2006 IPCC Guidelines[3]	• no source or sink for which a method is provided in the 2006 IPCC Guidelines is missing from the inventory. All sink and sources should be calculated as first step at least under Tier 1, then should move to higher tiers for the key categories (or continue to use Tier 1 but explain the reason for not moving to higher tiers as of para 11 of decision 24/CP19); • for emissions from drained organic soils, additional methods are provided in 2013 Wetland supplement (e.g. default factors to estimate CH4 from drained organic soils under Cropland and Grasslands) • if there is a disproportionate effort for collecting activity data, provision on insignificant emissions can be employed according to art. 37 in decision 24/CP19, while assumptions involved to be transparently reported. This can be only applied to GHG sources that were never reported before (i.e. implicitly a category which was reported in previous submissions shall continue to be reported in the future); • estimates are reported for each disaggregated subcategory/division (which is not apparent in CRF tables, so explicit description and tables to be provided in NIR, e.g. for all N2O sources); • emissions or removals may be aggregated but transparent information should be reported to indicate which and where in the inventory the emissions or removals have been included (e.g. C stock change in litter, dead wood and mineral soils are aggregated under Tier 3); • all cells in the CRF tables must be filled in either with estimates or notation keys; • apply easy QAQC tools, e.g. calculation spreadsheet or to include calculation of IEFs (implied emission factors as ratio of total emission from the source divided to corresponding activity data, this allows checks to be performed before uploading data in UNFCCC CRF reporting tool)
Accuracy	Estimates 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 activity data and C stock change/emission factors should be used, including with reference to recommended methodological tier, in accordance with the 2006 IPCC Guidelines; • best available data in the country should be used; • acknowledge the UNFCCC reviewers' comments and observations about dimensions of some country specific factors used in inventory, including comparison with default values and/or values from neighbouring countries or from same ecological region

Additional to the reporting principles, there is an additional strong requirement, namely timeliness, which regards the schedule of the official submission of the national GHG inventory to UNFCCC.

Use of notation keys

Annex I Party's inventories must report emission or removal estimates or notation keys in their tables (e.g. implicitly, an empty cell means an incomplete reporting). Use of notation keys reflect the improvement status of the inventory and facilitate the assessment of its completeness. Here is a

[3] Three overview tables on C pools and categories to be reported are attached to this handbook: a) "Mandatory categories and carbon pools to be reported under the convention", b)" Wetlands pools to be reported under Tier 2" and c) "Wetlands pools to be reported under Tier 2". These overview tables are extracted from "Basic course of the review of greenhouse gas inventories of Parties included in Annex I to the Convention" provided by the UNFCCC, to which full credit is given.

rapid assessment on the implementation of notation keys by Turkey in its most recent submission to UNFCCC (2017):

Notation key	Purpose/meaning	Practical implementation and possible issues
"NO" (not occurring)	categories or processes under a source or sink category that do not occur within the reporting country	• if a land use category or conversion does not occur in a country territory; • for "Rewetted organic soils", "Rewetted mineral soils" or "Peat extraction lands" in Table IV, if such soil management do not occur within the country; • for emissions from wildfires in years when statistics do not report occurrence of fire; • for controlled burning, if such practice does not exist in the country
"NE" (not estimated)	activity data and/or emissions and/or removals have not been estimated (but they exist within the reporting country)	• for missing activity data; • when estimates are not provided because of the changes and improvement in the compiling procedures, institutional arrangements, etc, in which case transparent information should be also added in the improvement plan; • when a particular type of emission or removal occurs in the Party but the 2006 IPCC Guidelines do not provide methodologies to estimate it; • for not yet estimated direct N2O emissions from "Grasslands converted to forest land" for which there is a method in 2006 IPCC Guidelines, additionally this should be added on the list of improvements as far as at least Tier 1 method can be used at least; • for not estimated direct N2O emissions from nitrogen mineralization associated with loss of soil organic matter in post-harvest soil preparation for forest regeneration; • for an emission which is likely to be insignificant under the provision according to art. 37 in decision 24/CP19
"NA" (not applicable)	activities occur within the Party but do not result in emissions or removals of a specific gas	• for CO2 emissions from "Drained organic soils in Table II" if CO2 emissions were reported under land category 4A-4F; • shaded cells are "NA" by default, e.g. C stock changes in "Other land remaining Other land" category where by definition emissions or removals cannot exist; • reporting under lower tiers of direct N2O emissions by N immobilization associated with loss/gain of soil organic matter resulting from change of land use or management of mineral soil
"IE" (included elsewhere)	emissions and removals of GHGs are estimated but included elsewhere in the inventory instead to be included under the expected source/sink category	• when litter is included with dead wood, and/or soils, as a unique pool (under higher tiers); • if stock difference is used, IE should be reported for "loss" when the (sub)category is a sink, or for "gain" when (sub)category is a source

Adequate use of notation keys by national compilers would result from a long-term practice of reporting, views exchange with more experienced compilers and by giving full consideration of findings annually identified by the UNFCCC reviewers.

Analysis and estimation of the overall uncertainty of the inventory

National GHG inventory incorporates uncertainty caused by (1) conceptualisation which refers to the assumptions and structure of sinks and sources included (e.g. completeness) and associated methodological choices; (2) using models which represent the calculation(s) involved to derive estimates from existing/measured/available parameters (e.g. from simple multiplication of activity data with emission factors to country specific model based estimates), and (3) input data and assumptions (e.g., refers strictly to random errors with respect to the mean estimate of the emission factor and activity data).

For a consistent analysis of the uncertainty it is necessary a transparent assessment and reporting of the uncertainty associated to each of the three sources mentioned above. Good practice requires implementing QAQC procedures to ensure reported uncertainty is caused by random errors, while any bias is avoided.

For a consistent estimation of the overall inventory uncertainty, every input, e.g. parameter or data used, needs a quantified percentage uncertainty (%, as the percentage given by two standard deviations to the mean value corresponding to 95% confidence interval) and its underlining probability density function (PDFs). For most applications the assumption of normal distribution of the input parameters is quite realistic (at least as first-hand assessment). Using default values implies using reported uncertainty attached to those parameters in the IPCC 2006 Guidelines.

IPCC 2006 Guidelines provides two approaches for combining the uncertainty of the input data into overall or sector inventory. Approach 1 implies error propagation as a relatively simple spreadsheet-based aggregation procedure (i.e. assuming that inputs are normally distributed and there is no correlation among them). The approach relays on following formulas:

for MULTIPLICATION or PRODUCT of input data or parameters	for ADDITION AND SUBTRACTION of input data or parameters
$U_{total} = \sqrt{U_1 + U_2 \dots \dots + U_n}$	$U_{total} = \frac{\sqrt{(U_1 * X_1)^2 + \cdots + (U_n * X_n)^2}}{\lvert X_1 + X_2 + \cdots X_n \rvert}$
U_{total} = the percentage uncertainty (half of the 95% confidence interval divided by the average, expressed as a percentage). U_i = the percentage uncertainties associated with each of the input quantities, x_i = the uncertain INPUT quantities. $\lvert X_1 + X_2 + \cdots \cdot X_n \rvert$ - absolute of the sum of input values (may lead to values close to zero when emissions and removals are involved in which case both percentage uncertainty and amounts representing the 95% variation range of the estimate must be reported and discussed)	

Approach 2 involves Monte Carlo simulation technique and requires additional effort (e.g. either by direct use of commercially available softs plugged in to inventory spreadsheets or using programming skills in open-source softs). This is useful when combine highly uncertain inputs, or inputs with various types of distributions or correlated (e.g. parameters measured in systematic sampling grids).

For either approach, the uncertainty estimation should follow the calculation pathways of the inventory estimation. However, the uncertainty may be plugged in at higher aggregation in calculations when breakdown on constituent sources or sinks may lead to unrealistically representation of actual uncertainty.

Effort to reduce uncertainty should focus on inputs with important contribution to the overall uncertainty of the inventory, e.g. key categories or key pools. Improvements assume effort related to conceptualization, models and input data.