Training Workshop on the National System for the GHG Inventory
Rome 25-28 January 2011

KEY CATEGORY ANALYSIS

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Scope of presentation

- Help countries define a plan for the compilation of their national emission inventory

- Prioritize and guide efforts to improve the qualities (Transparency, Accuracy, Consistency, Comparability and Completeness) of actual/future inventories by category/gas

Outline of presentation

→ Inventory planning

→ How to set priorities

→ Methods to be applied for Key categories identification

→ Uncertainty analysis

2006 IPCC Guidelines for National Greenhouse Gas Inventories (IPCC, 2006)

Inventory planning

When compiling an emission inventory all the measures to guarantee high quality of the estimates should be undertaken

It may be necessary to :

- consider (more) accurate methodologies
- develop country-specific emission factors
- collect (more) detailed activity data

These activities require additional resources, and it is not possible to make improvements for every category

Inventory planning

FCCC/AWGLCA/2010/L.7 (COP16 decision)

B. Nationally appropriate mitigation actions by developing country Parties

- 60. *Decides* to enhance reporting in national communications, including inventories, from Parties not included in Annex I to the Convention (non-Annex I Parties) on mitigation actions and their effects, and support received; with additional flexibility to be given to the least developed country Parties and small island developing states:

  …

  c) Developing countries, consistent with their capabilities and the level of support provided for reporting, should also submit biennial update reports, containing updates of national greenhouse gas inventories including a national inventory report and information on mitigation actions, needs and support received; …

Inventory planning

C. Policy approaches and positive incentives on issues relating to reducing emissions from deforestation and forest degradation in developing countries; and the role of conservation, sustainable management of forests and enhancement of forest carbon stocks in developing countries

71. *Requests* developing country Parties aiming to undertake activities referred to in paragraph 70 above, in the context of the provision of adequate and predictable support, including financial resources and technical and technological support to developing country Parties, in accordance with national circumstances and respective capabilities, to develop the following elements:

(a) A national strategy or action plan;

(b) A national forest reference emission level and/or forest reference level[6] or, if appropriate, as an interim measure, sub-national forest reference emission levels and/or forest reference levels, in accordance with national circumstances, and with provisions contained in decision 4/CP.15, and with any further elaboration of those provisions adopted by the Conference of the Parties; …

[6] In accordance with national circumstances, national forest reference emission levels and/or forest reference levels could be a combination of sub-national forest reference emissions levels and/or forest reference levels

Setting priorities

- Priorities should be set when establishing a national inventory (improvement) plan
- More detailed methods can then be selected to estimate emissions for specific categories which are relevant to the overall inventory (*key categories*)
- National key categories should be identified in a systematic and objective manner

Key category: Definition

A *key category* is one that is prioritised within the national inventory system because it is significantly important for one or a number of gases in terms of:

- magnitude in any one year (Level)
- change in emissions year to year (Trend)
- high uncertainty

Key categories: Identification

- 2006 IPCC Guidelines for National Greenhouse Gas Inventories
- Quantitative analysis in terms of both the level and the trend :
  - Approach 1
  - Approach 2 which accounts for uncertainties
- Qualitative criteria

Key categories: Analysis

- The analysis should be performed at the appropriate disaggregation level of the IPCC categories or subcategories

  (Table 4.1 of the IPCC 2006 Guidelines)

- Disaggregation to very low levels should be avoided since it may split an important aggregated category into many small subcategories that are no longer key

Key categories: Analysis

- Each greenhouse gas from each category should be considered separately, unless there are specific methodological reasons for treating gases collectively

- For LULUCF, CO_2, CH_4 and N_2O should be considered separately, because the methods, emission factors and related uncertainties differ for each gas

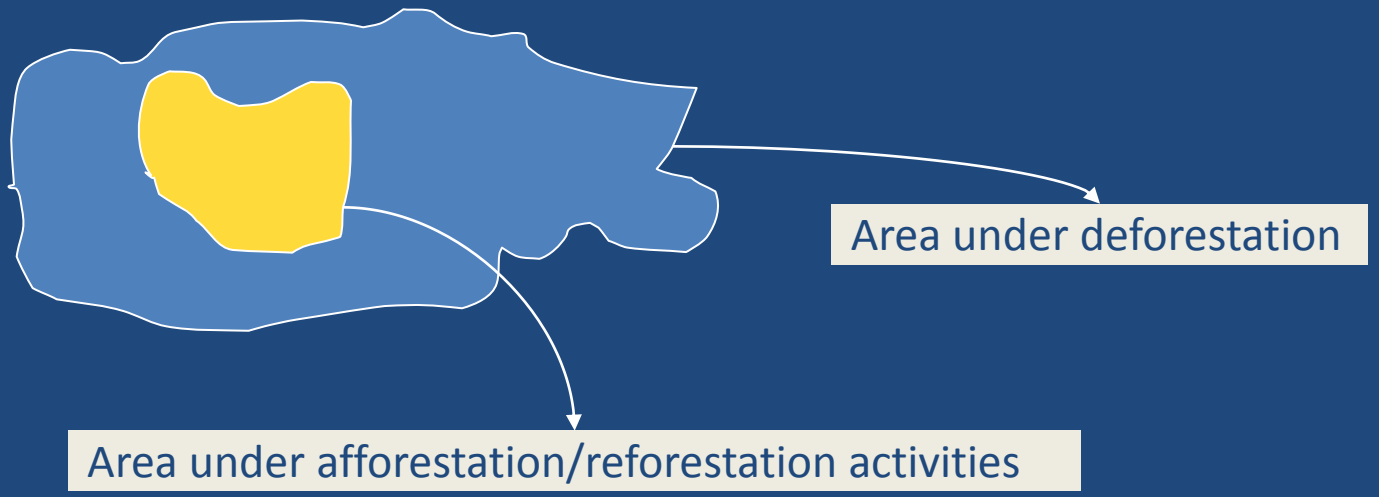
- If data are available, the analysis should be performed for emissions and removals separately within a given category

Key categories: Analysis

- The land use categories and the pool estimates can include emissions and removals that may cancel out at the aggregated level for the categories
- In this case, the outcomes of the category by category description should be analysed in order to identify if there is the need to perform the key category analysis with further disaggregated subcategories

Key categories: Analysis

- The category by category description identifies two different areas, in the territory under investigation, where :
  - carbon stock decreases (deforestation or fires)
  - carbon stock increases (afforestation/reforestation activities)
- In this case, the inventory compiler should decide to perform the key category analysis disaggregating the category into the two areas



Key categories: Analysis

- Another method to identify whether it may be necessary to split the key category into subcategories is:

  - rank the subcategories according to their contribution to the aggregate *key category*

  - subcategories that contribute together more than 60% to the *key category* can be treated as particularly significant

Key category identification: Approach 1

- key categories are identified by assessing the influence on the level and, possibly, the trend of the national greenhouse gas inventory means of a pre-determined cumulative emissions threshold usually fixed at 95% of the total

Key categories identification: Approach 1 Level assessment

- The contribution of each source or sink category to the total national inventory level is calculated by:

$$L_{x,t} = \frac{\left|E_{x,t}\right|}{\sum_{y}\left|E_{y,t}\right|}$$

where

$L_{x,t}$ = level assessment for source or sink *x* in year *t*

$|E_{x,t}|$ = absolute value of emission and removal estimate of source or sink category *x* in year *t*

$\Sigma_y|E_{x,t}|$ = total contribution, which is the sum of the absolute values of emissions and removals in year *t*

Performing Approach 1 Level assessment

TABLE 4.2
SPREADSHEET FOR THE APPROACH 1 ANALYSIS – LEVEL ASSESSMENT

A	B	C	D	E	F	G
IPCC Category Code	IPCC Category	Greenhouse Gas	Latest Year Estimate $E_{x,t}$ [in CO_2-equivalent units]	Absolute Value of Latest Year Estimate $\lvert E_{x,t} \rvert$	Level Assessment $L_{x,t}$	Cumulative Total of Column F
Total				$\sum_y \lvert E_{y,t} \rvert$	1	

level 95%

Key categories are those that, when summed together in descending order of magnitude, add up to 95% of the sum of the total in column G

Key categories identification: Approach 1 Trend assessment

- The purpose of the trend assessment is to identify categories that may not be large enough to be identified by the level assessment, but whose trend is significantly different from the trend of the overall inventory

Key categories identification: Approach 1 Trend assessment

$$T_{x,t} = \left|E_{x,0}\right| \Big/ \sum_{y} \left|E_{y,0}\right| \cdot \left| \left[\left(E_{x,t} - E_{x,0}\right) \Big/ \left|E_{x,0}\right| \right] - \left[\left(E_{t} - E_{0}\right) \Big/ \sum_{y} \left|E_{y,0}\right| \right] \right|$$

category level

category trend

total trend

where

$T_{x,t}$ = trend assessment, which is the contribution of the source or sink trend to the overall inventory trend

$|E_{x,0}|$ = absolute value of emission and removal estimate of source or sink *x* in the base year (year *0*)

$\Sigma_y|E_{y,0}|$ = total contribution, which is the sum of the absolute values of emissions and removals in year *0*

$E_{x,t}$, $E_{x,0}$ = real values of estimates of source or sink *x* in years *t* and 0

$E_t = \Sigma_y E_{y,t}$ $E_0 = \Sigma_y E_{y,0}$ total inventory estimates in years *t* and 0

Key categories identification: Approach 1 Trend assessment

- Where the base year emissions for a given category are zero, the expression may be reformulated as:

$$T_{x,t} = \left| E_{x,t} \middle/ \left| E_{x,0} \right| \right|$$

Performing Approach 1 Trend assessment

TABLE 4.3
SPREADSHEET FOR THE APPROACH 1 ANALYSIS – TREND ASSESSMENT

A	B	C	D	E	F	G	H
IPCC Category Code	IPCC Category	Greenhouse Gas	Base Year Estimate $E_{x,0}$	Latest Year Estimate $E_{x,t}$	Trend Assessment $T_{x,t}$	% Contribution to Trend	Cumulative Total of Column G
Total					$\sum_{y} T_{y,t}$	1	

trend 95%

Key categories are those that, when summed together in descending order of magnitude, add up to 95 % of the total of column H

Key categories identification: Approach 2

- Approach 2 implies the assessment of the uncertainty
- The results of Approach 1 are multiplied by the relative uncertainty of each category
- Key categories are those that represent 90% of the uncertainty contribution

Uncertainty analysis

- Uncertainty estimates are an essential element of a complete inventory

- Uncertainties should be addressed to avoid the potentially severe consequences of inaccurate information and ensure the monitoring against targets (i.e accurate and comparable)

- When focusing efforts to reduce uncertainty, priority should be given to those inputs that have the most impact on the overall uncertainty of the inventory but also a relevant contribution

Uncertainty analysis

FCCC/AWGLCA/2010/L.7

.. to develop the following elements:

(c) A robust and transparent national forest monitoring system for the monitoring and reporting of the activities referred to in paragraph 70 above, with, if appropriate, sub-national monitoring and reporting as an interim measure,[7] in accordance with national circumstances, and with the provisions contained in decision 4/CP.15, and with any further elaboration of those provisions agreed by the Conference of the Parties;

[7] Including monitoring and reporting of emissions displacement at the national level, if appropriate, and reporting on how displacement of emissions is being addressed, and on the means to integrate sub-national monitoring systems into a national monitoring system

Uncertainty analysis

- The IPCC 2006 Guidelines define two approaches to estimating uncertainties:

  - Approach 1: error propagation equations
  - Approach 2: Monte Carlo simulations

- When measurements are not available to quantify uncertainties every approach is highly affected by expert judgement
- Approach 1 is simple enough and transparent for the purpose of an emission inventory

Sources of uncertainty

Activity data

- Gaps in time series
- Use of surrogate or proxy variables
- Lack of references (calculation or estimation methods, representativeness at local or national level)

Emission Factors

- Scarcity of quantitative information (measurements, sample representativeness)

Uncertainty analysis – Approach 1

General approach:

- set values within a range low, medium and high according to the confidence the expert has on the value (expert judgement)

- consider:
  - information provided in the IPCC Guidelines
  - information by national statistical or other institutes
  - standard deviations (when measurements are available)

Uncertainty analysis – Approach 1

Activity data

- low uncertainty (e.g. 3-5%) to activity data derived from national forest inventories;
- medium-high uncertainty (20-50%) related to the data from official statistics derived from administrative surveys or estimated data

Italian GHG Inventory 1990-2008

Uncertainty			
	Growing stock	**E_{NFI}**	**3.2%**
	Current increment	**E_{NFI}**	**51.6%**
	Harvest	**E_H**	**30%**
	Fire	**E_F**	**30%**
	Drain and grazing	**E_D**	**30%**
	Mortality	**E_M**	**30%**

Uncertainty analysis – Approach 1

Emission factors

IPCC default uncertainty values are used when the emission factor is a default value or no information on the country specific value is available

Italian GHG Inventory 1990-2008

Uncertainty	Bef	E_{BEF1}	30%
	R	E_{BEF2}	30%
	DCF	E_{DEF}	30%
	Litter	E_{L}	161%
	Soil	E_{S}	152%
	Basic density	E_{BD}	30%
	C Conversion factor	E_{CF}	2%

Uncertainty values are high if emission factors are deduced from model assumptions (i.e. litter or soils)

Uncertainty analysis – Approach 1

If uncertain quantities are to be combined by multiplication (i.e. ADxEF)

$$U_{total} = \sqrt{U_1^2 + U_2^2 + \ldots + U_n^2}$$

where:

U_{total} = percentage uncertainty in the product of the quantities

U_i = percentage uncertainty associated with source/sink *i*

If uncertain quantities are to be combined by addition or subtraction, as when deriving the overall uncertainty in national estimates:

$$U_E = \frac{\sqrt{(U_1 \cdot E_1)^2 + (U_2 \cdot E_2)^2 + \ldots + (U_n \cdot E_n)^2}}{|E_1 + E_2 + \ldots + E_n|}$$

where:

U_E = percentage uncertainty of the sum

U_i = percentage uncertainty associated with source/sink *i*

E_i = emission/removal estimate for source/sink *i*

Key categories identification: Approach 2

- The category uncertainties are incorporated by weighting the Approach 1 level and trend assessment results by the category's relative uncertainty

Key categories identification: Approach 2

LEVEL ASSESSMENT including uncertainty

$$LU_{x,t} = \left(L_{x,t} \cdot U_{x,t}\right) \Big/ \sum_{y} \left[\left(L_{y,t} \cdot U_{y,t}\right)\right]$$

TREND ASSESSMENT including uncertainty

$$TU_{x,t} = \left(T_{x,t} \cdot U_{x,t}\right)$$

Key category identification: Qualitative approach

The results of quantitative approaches may not identify all categories that should be prioritised in the inventory system

- Mitigation activities: categories where emissions have decreased or removals increased through the use of mitigation activities
- Expected growth: categories which are likely to show increase of emissions or decrease of removals
- No quantitative assessment of uncertainties: categories with potential high uncertainty
- Completeness: potential key categories that are not yet estimated
- Inventory of other countries with similar circumstances

Reporting and documentation

It is *good practice* to:

- clearly document the results of the key category analysis in the inventory report
- Specify the criteria by which each category was identified as *key* (e.g., level, trend, or qualitative), and the method used to conduct the quantitative key category analysis (e.g., Approach 1 or Approach 2)

TABLE 4.4
SUMMARY OF KEY CATEGORY ANALYSIS

Quantitative method used: Approach 1/Approach 1 and Approach 2

A	B	C	D	E
IPCC Category Code	IPCC Category	Greenhouse Gas	Identification criteria	Comments

Reporting and documentation

- Describe individual improvements identified for each key category (methodologies, more accurate activity data etc.)
- Prioritize the most important improvements
- Identify and describe projects that would lead to inventory improvements

Conclusions

- The establishment of high quality inventories is resource and time consuming in all countries
- The identification of key categories in national inventories enables the (limited) resources available for preparing inventories to be prioritised
- Key categories should be estimated by appropriate (higher tiered) methods and should undertake specific QA/QC and Verification procedures

Conclusions

- Any key category where the good practice method cannot be used should have priority for future improvements
- Such a process will lead to improved inventory quality as well as greater confidence in the resulting estimates
- Ensure adequate quality of the inventory (i.e. Transparent, Accurate, Complete, Consistent and Comparable) to enable the development of future policies and to monitor performance against targets

Conclusions

- 64. *Also decides* that information considered should include information on mitigation actions, the national greenhouse gas inventory report, including a description, analysis of the impacts and associated methodologies and assumptions, progress in implementation and information on domestic measurement, reporting and verification and support received; discussion about the appropriateness of such domestic policies and measures are not part of the process. Discussions should be intended to provide transparency on information related to unsupported actions;

Example of a Key category analysis

- see Excel file

How to track Key category analysis documentation

- see Word template file