Hand-on Training on National GHG Inventories

LULUCF Sector Writers Workshop

October 2016
Ankara, Turkey

Marina Vitullo
(ISPRA - Italy)

Iordanis Tzamtzis
(ACCEL – I.Tzamtzis Co & G.P. - Greece)
Objective

To gain hand-on experience in NIR transparency and documentation for the LULUCF sector as given by the IPCC Guidelines in conjunction with international good practice.
Transparency

Dec. 24/CP.19, Annex I, para. 4(a):

*Transparency* means that the data sources, assumptions and methodologies used for an inventory should be clearly explained, in order to facilitate the 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 the information. The use of the common reporting format (CRF) tables and the preparation of a structured national inventory report (NIR) contribute to the transparency of the information and facilitate national and international reviews.
Transparency

Steps:
• Include all the necessary information in the NIR;
• Include what you are already doing;
• Develop a well-organized and well-structured NIR;
• Use a common language in the NIR and be specific;
• Use effective ways to present the information (charts, histograms, etc.);
• Fill in CRF tables, use of notation keys;
• Keep consistency of information;
• ........
Transparency

Check:

• Is all the necessary information reported in the NIR?
• Is this information presented in a structured way and in a way to facilitate the communication?
• Is the information there, but may be lost due to inefficient presentation?
• Is the information available but not included?
• Have all the CRF tables been filled-in?
• Have appropriate notation keys been used?
• Are there any inconsistencies within NIR, CRF tables, between NIR-CRF tables?
• ......

Remember!!

• Transparency is not correlated with the size of the NIR;
• YOU know better than everyone your GHG inventory, NIR and the necessary steps for improvement;
• Follow the outline in Dec. 24/CP.19, annex I (ARR 2014, para. 115)
Wildfires - Non CO₂ greenhouse gas emissions

The carbon stock change method used to estimate emissions and removals from lands and forests under art. 3.4 activity Forest Management – encompasses the loss of carbon affected by wildfires. For this reason, no extra emissions of CO₂ from biomass火灾 are reported. The implication of the use of this method on the normalization of the net emissions/ removals of CO₂ from the LULUCF

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>-469</td>
<td>-447</td>
<td>-311</td>
<td>-337</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The total carbon in biomass is calculated according to the equation:

\[
C_b = [V_b \cdot D \cdot BDF] \cdot (1 + R) \cdot CF
\]

Where, \( C_b \) is the total carbon in biomass calculated at time \( t \), \( C_{t_0} \) is the total carbon in biomass calculated at time \( t_0 \), \( C_{t_0} \) is the total carbon in biomass calculated at time \( t_0 \), \( V_b \) is the merchantable volume at time \( t \) (m³ ha⁻¹), \( D \) is the basic wood density of merchantable volume (t dry matter per m³), \( BDF \) is the basic forest density factor.

\[
\Delta C_{LCF} = A_{Conversion} + (L_{Conversion} + \Delta C_{Growth})
\]

\[
L_{Conversion} = C_{After} - C_{Before}
\]
The “sector overview” should aimed to give a quick & precise snapshot of the LULUCF sector in the country.

The key drivers for the rise in removals are improvements in sustainable forest management, afforestation, rehabilitation of degraded forests, reforestations on forest land and conversion of coppices to productive forests in forest land remaining forest land, efficient forest fire management and protection activities, conversions to perennial croplands from annual croplands and grasslands, and conversions to grasslands from annual croplands. The key drivers for the decrease in removals are related to drought and biomass burning as wildfire (e.g. in 2008; 29,749 ha forest area burned),...

- Is that so? In figure 6.4 latter on area of anCL is increasing & total CL is decreasing.
- In 1992 a notable trough,
6.1. Sector Overview

The following subcategories have been reported as removals:

- Forestland remaining Forestland
- Land converted to Forestland
- Cropland remaining Cropland
- Land converted to Grassland
- Harvested Wood Products

And the following subcategories have been reported as emissions:

- Land converted to Cropland
- Forestland converted to Grassland
- Grassland remaining Grassland
- Land converted to Settlements
- Land converted to Wetlands (no conversion for 2013)

To avoid double counting, CO₂ emissions were not considered here.

✓ It’s preferable to talk about the last inventory year.
Including in the NIR information on emissions/removals trend in tabular form or with graphs may increase transparency and general readability.
### 6.1. Sector Overview

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Forest Land remaining Forest Land</td>
<td>CO₂</td>
<td>Key, (L,T)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Land converted to Forest Land</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cropland remaining Cropland</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Land converted to Cropland</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grassland remaining Grassland</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Land converted to Grassland</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wetlands remaining Wetlands</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Land converted to Wetlands</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Settlements remaining Settlements</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Land converted to Settlements</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other Land remaining Other Land</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Land converted to Other Land</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HWP</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Include the outcomes of the KC analysis for LULUCF, for each subcategory/gas/year;
- An overview table of methodologies applied is helpful (e.g. Summary 3s).
- The table could be more effective & informative adding a column (pool) and separating among mandatory and not mandatory categories/subcategories.

- Ensure that it covers only issues of completeness (e.g. NE used for zero net change ≠ completeness issue).

- NO when is justified is not a completeness issue. However, if reported, increases transparency. (Turkey already does so).

<table>
<thead>
<tr>
<th>Sink/source category</th>
<th>pool</th>
<th>GHG</th>
<th>reported as</th>
<th>mandatory</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Forest land remaining forest land; land converted to forest land; soils</td>
<td>CO₂</td>
<td>NE</td>
<td>yes</td>
<td></td>
<td>Lack of adequate data on annual carbon stock changes in the soil in the Forest Land Remaining Forest Land soil organic matter</td>
</tr>
<tr>
<td>Forest land remaining forest land; land converted to forest land; dead wood; litter</td>
<td>CO₂</td>
<td>NE</td>
<td>yes</td>
<td></td>
<td>Lack of adequate data on annual carbon stock changes in the litter and deadwood in the Forest Land Remaining Forest Land</td>
</tr>
<tr>
<td>biomass burning - controlled burning (forest land)</td>
<td>GHG</td>
<td>NO</td>
<td>no</td>
<td></td>
<td>Does not occur</td>
</tr>
</tbody>
</table>
The estimations for 1990-2014 were calculated according to equations 2.14 and 2.27 in 2006 IPCC Guidelines for National GHG Inventories-Agriculture, Forestry and Other Land Use (Volume 4). The parameters were chosen described in Section 2.3.1.1 and 2.4. The parameters have been used from Tables 2.4, 2.5 and 2.6.

The reference to the IPCC Guidelines has to be complete.

1. It should allow to reproduce the estimates

2. It should include all sources/sinks estimated, disaggregated for pools.

3. Equations presented refer only to a small part of the inventory. Maybe, a sub-section on methodological issues could be added.
6.2 Land use definitions & classification systems

The definitions of land uses are explained below. The national forest definition is the legal national definition. For the other land uses technical definitions are applied. The technical definitions are derived from Coordinate Information on the Environment (CORINE) technical guide (http://image2000.jrc.ec.europa.eu/reports/technical_guide.pdf).

**Forest Land:** Forest definition according to the legislation (Forest Law No: 0831) (GDR, 1956): Tree and woodland communities, which are grown by both human efforts and naturally are regarded as Forest, together with their lands.

- LU definitions should be clearly documented & applied consistently over time.
- Total country area should be classified into the 6 broad categories, while avoiding double counting.

**Forest land (ARR 2014, para 116, 117):**

- The definition is not clear enough. What is included, what is excluded?
- Are there thresholds (area, height, coverage)? What about area that has the potential to reach the forest thresholds?
- How is it ensured that no duplication occurs with Grassland?
- Any development to ARR finding? Any effort for harmonization? Any progress? (information on any development should be reported).
6.2 Land use definitions & classification systems

The definitions of land uses are explained below. The national forest definition is the legal national definition. For the other land uses technical definitions are applied. The technical definitions are derived from Coordinate Information on the Environment (CORINE) technical guide (http://image2000.jrc.ec.europa.eu/reports/technical_guide.pdf).

Forest Land: Forest definition according to the legislation (Forest Law No: 6831) (GDF, 1956): Tree and woodland communities, which are grown by both human efforts and naturally are regarded as Forest, together with their lands.

Wetlands:

• What about lakes, rivers (unmanaged wetlands (2006 GLs))?

• “NE” is used in CRF tables (e.g. table 4.D).

• Unmanaged land should be quantified and reported in order to maintain consistency over time.
6.2 Land use definitions & classification systems

Land use change matrices should be included, taking into account annual and the transition period length.

It is a very effective way to give a clear overview of land representation.
Sector Overview: land representation

6.2 Land use definitions & classification systems

- SL, OL: “NE”, “NO”
- Total country area = 78,356 kha (FAO official data 2013)

Total annual area should be constant!
Total area covered by the reporting should be equal to national total area!
Sector Overview: land representation

6.2 Approaches & land-use databases used

- A section on “Information on approaches used for representing land areas and on land-use databases used for the inventory preparation” should be included in the NIR.

- In this section the approach followed to assess and detect the land use and land-use changes for the national territory should be detailed and referenced.

- The land use transition period used in the estimation process of CSCs in mineral soils related to land use changes should be included.

- Information table specifying the data sources used (including their main content and the land-use category for which these data have been used) is good practice to be provided.

- In the NIR is stated “…there is an inconsistency between land use types”!!!!. What efforts have been done?

**Total annual area should be constant!**

**Total area covered by the reporting should be equal to national total area!**
✓ Broad planned improvements of the inventory can be presented before sectoral chapters.
✓ Improvements & development state vs ERT’s finding (e.g. progress made, constraints, etc.)
✓ Each section, related to the different categories, should include a paragraph on planned improvement
- detailed description of ongoing project/study/research
- description of main outcomes and their impact on the estimation process
- tentative scheduling for the implementation of the updated data

<table>
<thead>
<tr>
<th>Category</th>
<th>Subcategory</th>
<th>Parameter</th>
<th>Gas</th>
<th>Description</th>
<th>Timing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Forest/land</td>
<td>FL-FL; L-FL</td>
<td>-</td>
<td>GHG</td>
<td>Implementation of the III NFI’s outcomes; the final outcomes, related to the field surveys, are expected to be available in 2015</td>
<td>2017</td>
</tr>
<tr>
<td>Biomass burning</td>
<td>Activity data</td>
<td></td>
<td>GHG</td>
<td>Verification activities comparing EU data sources (i.e. EFFIS).</td>
<td>2017</td>
</tr>
<tr>
<td>Cropland</td>
<td>CL Activity data</td>
<td></td>
<td>GHG</td>
<td>Verification activities, data collection and model implementation for soils pool; data collection and reporting at regional level</td>
<td>2016-2017</td>
</tr>
</tbody>
</table>
NIR Category structure

- Description
- Methodological issues
- Uncertainties
- QA/QC
- Recalculations
- Planned improvements

Keep a consistent structure of the NIR among the sector
According to the figures given by the Forest Management Planning Department of the General Directorate of Forestry (GDF), Turkey has 22,064 kha forest area approximately with regard to its own forestry legislative. Since all the woody areas having more than 3 ha magnitudes are accepted in forest regime disregarding their crown closure, this figure differs from the figure given in FAO’s resources. FAO’s figures cover the woody areas having more than 40% crown closure only. Because of forcing situation initiating from the protective rules of constitution and forestry regulations current in Turkey, the figures given by forestry organization were accepted and used during the estimation of net annual amount of carbon uptake or release in the forests in Turkey. The figures concerning forest

✓ The national forest definition should be clearly stated.
✓ Any possible inconsistency with FAO-FRA definition should be listed (and numerical explained).
✓ According to land representation and forest land area, 96% of the country is Forest land!!

This is not correct! 10% is the crown cover threshold

FAO’s figures cover the woody areas having more than 40% crown closure only.
The footnotes referred to in the NFI table should be included in the NIR.

Units → AVI is in m³ or m³/ha/yr?

Additional information on NFI is needed:
- sampling plots
- coverage
- stratification
- operational process (how the NFI is carried out)
Since 2004, ENVANIS System, a forest resources inventory based on forest management units is used. In this system total forest area changes, total annual increment changes and total growing stock changes can be calculated year by year. Therefore, comparison of forest area, annual increment and growing stock, between two subsequent years, has been possible since 2004. The comparison of removals by forestry sector, according to forest area, annual increment and growing stock changes since 1990 is given in Table 6.3, 6.4 and 6.5.

Total of 1 494 667 ha areas have been converted to forest land between 1990 and 2014 (See table 6.3). According to these data, the forest area was interpolated to be increasing by 20.54 kha per year between 1972 and 1998 and by 97.73 kha per year between 2000 and 2003. The key driver for the

- Description of ENVANIS
- What are the forest management units?
- how ENVANIS takes into account the NFI data (if)?
The data reported in the NIR should be clearly referenced
- where these data come from? Any reference? Are published documents?
- data are provided for 1972. What about 1999?
- how have these data been used in the estimation process?

### Table 6.4 Forest inventory, 1972

<table>
<thead>
<tr>
<th>Type</th>
<th>Areas</th>
</tr>
</thead>
<tbody>
<tr>
<td>Productive</td>
<td>Degraded²</td>
</tr>
<tr>
<td>High fo</td>
<td>Total</td>
</tr>
</tbody>
</table>

### Table 6.5 Growing stock, 1990-2014

<table>
<thead>
<tr>
<th>Type</th>
<th>Productive¹</th>
<th>Degraded²</th>
</tr>
</thead>
<tbody>
<tr>
<td>High fo</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coppice</td>
<td>(thousand m³)</td>
<td></td>
</tr>
</tbody>
</table>

### Table 6.6 Annual volume increment, 1990-2014

<table>
<thead>
<tr>
<th>Year</th>
<th>High forest</th>
<th>Coppices¹</th>
<th>Productive total</th>
<th>Degraded total</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1990</td>
<td>28 263 488</td>
<td>3 594 725</td>
<td>31 858 213</td>
<td>1 292 180</td>
<td>33 911 468</td>
</tr>
</tbody>
</table>

1. Productive
2. Degraded
3. High forest
4. Coppices
Evaluation of Table 6.3, 6.5 and 6.6 can be outlined as below:

- Total amount of areas, growing stocks and annual volume increments of the coppice forests reduced while high forests were increasing. **Highest amount of decrease has occurred in degraded coppices due to converting the coppices into high forests.**
- Total amount of growing stocks and annual volume increment of the coniferous and deciduous tree species have increased. Coniferous tree species have had increase around more than 80%.

- **In which period? (e.g. between 1990-2014)**
- **For which parameter?**
- **decrease of what?**

✓ Description of trends has to be accurate.

✓ Use graphs as well. Are more effective!
Assessment of Forest Land Remaining Forestland (Carbon Stock Changes in Normal and Degraded Forests of Turkey between 1990 and 2014)

Carbon stock changes (CSC) in normal and degraded forests of Turkey (forestland remaining forestland) were estimated since 1990 (see in Tables 6.7 and 6.8). Annual carbon stock changes have been separated according to the annual biomass increment in normal and degraded forests. The percentage of annual carbon stock changes were low in degraded forests due to low values of growing stock and annual biomass increment in degraded forest.

Table 6.7 Carbon removals (living biomass), 1990-2014

<table>
<thead>
<tr>
<th>Year</th>
<th>Coniferous</th>
<th>Deciduous</th>
<th>Coppices</th>
<th>Productive total</th>
<th>Coniferous</th>
<th>Deciduous</th>
<th>Coppices</th>
<th>Degraded total</th>
<th>Total carbon sequestration</th>
<th>CO₂ eq.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1990</td>
<td>7,635</td>
<td>2,758</td>
<td>1,176</td>
<td>12,179</td>
<td>385</td>
<td>147</td>
<td>378</td>
<td>910</td>
<td>13,089</td>
<td>47,994</td>
</tr>
</tbody>
</table>

- How have CSCs been estimated?
- Which data have been used to assess belowground biomass (part of living biomass reported)?
- Which IPCC method has been applied (describe the methodology in the same section)

Nomenclature has to be applied consistently.
How have CSCs been estimated?
Which data have been used to assess belowground biomass (part of living biomass reported)?
Which IPCC method has been applied (describe the methodology in the same section)
This section should be moved under Grassland category chapter

Assessment of Forest Land Converted to Grass Land

Annual changes from forest land converted grass land (deforestation) can be monitored by ENVANIS system. These changes were showed (See table 6.11). We assume these areas are grassland. Annual CSCs (emissions and removals) of forest land converted grass land have been estimated since 1990 in Table 6.12.

✓ Land and land use classification process should be clearly reported
✓ it is not clearly stated if the data reported in the table are elaborated (interpolation?) or are measure driven

Table 6.12 Annual carbon stock changes of forest land converted to grassland, 1990-2014 (kt)

<table>
<thead>
<tr>
<th>Year</th>
<th>Living biomass (Grass land)</th>
<th>Dead organic matter</th>
<th>Soil</th>
<th>Total gains</th>
<th>Living biomass (Forest land)</th>
<th>Dead organic matter</th>
<th>Soil</th>
<th>Total losses</th>
<th>Net carbon emission</th>
<th>CO₂ eq.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1990</td>
<td>1.7</td>
<td>0.1</td>
<td>26.9</td>
<td>28.7</td>
<td>7.5</td>
<td>5.2</td>
<td>71.8</td>
<td>84.5</td>
<td>55.8</td>
<td>204.6</td>
</tr>
</tbody>
</table>
Table 6.12 Annual carbon stock changes of forest land converted to grassland, 1990-2014

<table>
<thead>
<tr>
<th>Year</th>
<th>Living biomass (Grass land)</th>
<th>Dead organic matter</th>
<th>Soil</th>
<th>Total gains</th>
<th>Living biomass (Forest land)</th>
<th>Dead organic matter</th>
<th>Soil</th>
<th>Total losses</th>
<th>Net carbon emission</th>
<th>CO₂ eq.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1990</td>
<td>1.7</td>
<td>0.1</td>
<td>26.9</td>
<td>28.7</td>
<td>7.5</td>
<td>5.2</td>
<td>71.8</td>
<td>84.5</td>
<td>55.8</td>
<td>204.6</td>
</tr>
</tbody>
</table>

Methodology

Annual CSC calculations of forests made by gain and loss method. Annual CSC in living biomass and net carbon stock change in dead organic matter and soil in forest areas were evaluated as three categories divided into 4.A.1 Forest remaining Forest Land, 4.A.2 Land Converted to Forest Land and 4.C.2 Forest Land Converted to Grass Land (Table 6.15).

✓ How have CSCs been estimated?
✓ Which data have been used to assess belowground biomass (part of living biomass reported)?
✓ Which IPCC method has been applied (describe the methodology in the same section)
✓ Factors used for Grassland category?
Forest land

This section should be moved below, after all other categories, and renamed category - Biomass Burning 4(V)

Data on Forest Fires and Others

The information about the forest fires was received from the Department of Fighting Forest Fires of General Directorate of Forestry and written on the table 6.13. Include the whole time-series

✓ Which IPCC method has been applied (describe the methodology in the same section)

Existing document concerning the forest resources and forestry activities permitted to second level communication (T2 methods) mainly during the calculation of carbon uptake and the other GHG inventory. Since there was no adequate and baseline data on land use changes concerning the olden time, first level communication (T1 methods) was applied for the estimation of carbon sequestrations and GHG emissions between the years 1990–2014.

More clarification is needed. Is it related to biomass burning?

The required data on the dead organic matter’s annual carbon change for forestland remains forestland because of the absence of specific researches in this scope. Carbon contents in the forest soils were not considered too due to same reason for forestland remains forestland.
Table 6.15 Annual changes in carbon stocks in forest areas, 2014

<table>
<thead>
<tr>
<th>Land-use category</th>
<th>Activity data</th>
<th>Changes in carbon stock (kt C)</th>
<th>Net carbon stock change in dead organic matter and soil (kt)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Area (kha)</td>
<td>Carbon stock change in living biomass</td>
<td>Gains</td>
</tr>
<tr>
<td>Total Forest Land</td>
<td>22063.8</td>
<td>-18590.3</td>
<td>8256.2</td>
</tr>
<tr>
<td>1. Forest Land</td>
<td>20063.0</td>
<td>-17833.4</td>
<td>8015.0</td>
</tr>
<tr>
<td>remaining Forest Land</td>
<td>1635.8</td>
<td>-736.1</td>
<td>152.1</td>
</tr>
</tbody>
</table>

 TABLE 4.A SECTORAL BACKGROUND DATA FOR FOREST LAND (Sheet 1 of 1)

<table>
<thead>
<tr>
<th>Land-use category</th>
<th>Subdivision(1)</th>
<th>Total area (2) (kha)</th>
<th>Area of mineral soil (kha)</th>
<th>Area of organic soil (kha)</th>
<th>Carbon stock change in living biomass (3) (4)</th>
<th>Gains</th>
<th>Losses</th>
<th>Net change</th>
<th>Net carbon stock change</th>
<th>Net carbon stock change in soils (4)</th>
<th>Net CO₂ emissions/removals (4) (7)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Total forest land</td>
<td></td>
<td>22063.75</td>
<td>22063.75</td>
<td>NE</td>
<td>18569.51</td>
<td>-8167.10</td>
<td>10402.41</td>
<td>NE</td>
<td>501.60</td>
<td>3948.29</td>
<td>NE</td>
</tr>
<tr>
<td>1. Forest land remaining forest land</td>
<td>20427.94</td>
<td>20427.94</td>
<td>17833.39</td>
<td>-8014.97</td>
<td>9818.42</td>
<td>NE</td>
<td>NE</td>
<td>NE</td>
<td>NE</td>
<td>NE</td>
<td>-36000.86</td>
</tr>
<tr>
<td>2. Land converted to forest land(6)</td>
<td>1635.81</td>
<td>1635.81</td>
<td>736.12</td>
<td>-152.13</td>
<td>583.99</td>
<td>NE</td>
<td>501.60</td>
<td>3948.29</td>
<td>NE</td>
<td>NE</td>
<td>-18457.57</td>
</tr>
</tbody>
</table>

✓ The numbers included in the NIR should be the same included in the CRF!
✓ C gains (+), losses (-)
Table 6.16 Net carbon emissions and removals in the forests, 1990-2014

<table>
<thead>
<tr>
<th>Year</th>
<th>Carbon gains (tonnes)</th>
<th>Carbon losses* (tonnes)</th>
<th>Net removals (kt)</th>
<th>CO₂ eq. (kt)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1990</td>
<td>14 927 303</td>
<td>7 250 691</td>
<td>7 668.6</td>
<td>28 118.3</td>
</tr>
</tbody>
</table>

Similarly

✓ The numbers included in the NIR should be the same included in the CRF!
✓ C gains (+), losses (-)
Which tier method has been used (equation 2.10 includes different Tiers)? To include only the equation(s) for methods applied.

Always provide the definitions of the equations’ terms.

The data source for every parameter should be included, providing information and metadata on references.
For annual increase in carbon stocks, both the national and default data were used. National forestry data was mainly come from the General Directorate of Forestry.

- Area of forest land: It exists for each management class in the forest management plans (T2).
- Average annual net increment in volume suitable for industrial processing ($I_v$): It exists for each management class in the forest management plans (T2).
- Average basic wood density (BWD) and biomass conversion and expansion factors (BCEF). It was determined for all fundamental tree species and vegetation types which form a stand in the Turkey's forests (Tolunay, 2013) (Table 6.17) (T2).
- Annual increment for young stands (≥20 years old) and land converted to forest land accepted as 1.95 m³/ha for coniferous, 1.24 m³/ha for deciduous according to GDF expert judgment.

✓ How has the biomass growth been assessed?
✓ References for the tables are missing.

| Table 6.17 The Average basic wood density and national BCEF’s factors |
| The Basic wood density of Turkey’s fundamental tree species |

| Table 6.18 Root/Shoot rates and carbon content used for temperate zone forests |
Forest land

**Equation 2.11.** $\Delta C_L = L_{\text{wood\ removals}} + L_{\text{fuelwood}} + L_{\text{disturbance}}$

*Annual Carbon Loss Due to Wood Removals*

**Equation 2.12.** $L_{\text{wood\ removals}} = H \cdot BCEF_R \cdot (1+R) \cdot CF$

$H$: Wood harvesting data includes whole harvested woods as industrial harvesting including planned harvests ($m^3$/year) (T2).

**Equation 2.13.** $L_{\text{fuelwood}} = [(I/G_{trees} \cdot BCEF_R \cdot (1+R)) + I/G_{part} \cdot D] \cdot CF$

*Annual Carbon Loss Due to Fuelwood Gathering*

**Equation 2.14.** $L_{\text{disturbance}} = \{A_{\text{disturbance}} \cdot B_w \cdot (1+R) \cdot CF \cdot I_d\}$

✓ Always provide the definitions of the equations’ terms
✓ The data source for every parameter should be included, providing information and metadata on references
Tier 1 approach is followed by Turkey. However, it is good practice to provide transparent and verifiable information in the NIR, to demonstrate that the pool is not a source.

In the absence of measurements or country specific data, a review of scientific papers on Turkish soils can be carried out, with the aim of collect the needed information.
Estimation of GHGs Directly Released in Fires

Equation 2.27. \[ T_{\text{fire}} = A \cdot M_B \cdot C_f \cdot G_{ef} \cdot 10^{-3} \]

Where:

- \( L_{\text{fire}} \) = quantity of GHG released due to fire, tonnes of GHG
- \( A \) = area burnt, ha
- \( M_B \) = mass of fuel available for combustion, kg d.m. ha\(^{-1}\) (GDF data)
- \( C_f \) = combustion factor (IPCC 2006 Guidance Table 2.6)
- \( G_{ef} \) = emission factor, g kg\(^{-1}\) (IPCC 2006 Guidance Table 2.5)

✓ Provide with values used in the estimation process.
Land converted to Forest land

Annual Increment in Carbon Stocks Due to Living Biomass Increment in Land Converted to Forest Land

Equation 2.16. \[ \Delta C_{\text{CONVERSION}} = \sum \{(B_{\text{AFTER}} - B_{\text{BEFORE}}) \cdot \Delta A_{\text{TO OTHERS}}\} \cdot CF \]

The conversion period accepted assumed 20 years according to guidance.

Annual Change in Carbon Stocks in Dead Organic Matter in Land Converted to Forest Land

Equation 2.19. \[ \Delta C_{\text{DOM}} = \left[ A \cdot \frac{\text{DOM}_{\text{O}} + \text{DOM}_{\text{H}}}{T} \right] \cdot CF \]

T: 20 years according to guidance.

CSs at \( t_{(0-T)} \) are subtracted from CSs at \( t_{(0)} \).

✓ Always provide the definitions of the equations’ terms;

✓ The data source for every parameter should be included, providing information and metadata on references; (e.g. values for GL?)

✓ Is there any development on the information required from ARR 2014, para. 122?
Error propagation (IPCC Approach 1) should be applied through the whole estimation process of CSCs, taking into account all the equations applied.

Expert judgment should be avoided while the default IPCC uncertainty values should be used.
The following sections should be included:

**Category Specific QA/QC and Verification:**
Describe any category-specific QA/QC checks undertaken. Include the results of the QA/QC analysis.

**Recalculation:**
A quantitative description of each recalculation occurred should be included. The main causes of recalculation should be listed (e.g. updated AD, new EFs, errors fixed). If there is anything unique in the recalculation for the time series, or a much larger impact for certain years, please describe here as well.

**Planned improvements:**
As previously described, the following elements should be included:
- detailed description of ongoing project/study/research
- description of main outcomes and their impact on the estimation process
- tentative scheduling for the implementation of the updated data.
Cropland

Source Category Description:

Cropland remaining Cropland and land converted to Cropland has been reported under this category. CSC in aboveground, belowground, organic and mineral soil pools have been calculated and reported. The Cropland category was a large source in the last submission but has diminished with the change in LRs and AD.

The Cropland covers all perennial and annual crops in agriculture lands. Orchards and poplars are included in this category.

Information on approaches used for representing land areas and on land-use databases used for the inventory preparation

As explained in the AD section database we have calculated land use changes based on 3 temporal time points: 1990, 2000 and 2006. We had a more compatible and consistent monitoring system with this methodology. In Turkey the cropland areas decreased between 1990 and 2006 as seen in Figure 6.4.

✓ A description of trends and key drivers is missing

Cross-check the text for missing words (e.g. ag biomass)

→ Move this para in the beginning

✓ The description is unclear.

- monitoring system?
- what is happening after 2006? (fig.6.4)
- any check/comparison with crops annual statistics?
The annual crops have a decreasing trend while the aerial distribution of perennial crops increases.

The AD given in CRF table 5B is the cropland areas that are subject to changes in management. The total area of croplands in Turkey was 28,774.21 ha in 2006. In 1990 it was 31,259.93 ha.

**GREENHOUSE GAS SOURCE AND SINK CATEGORIES**

<table>
<thead>
<tr>
<th>Land-use category</th>
<th>Subdivision (1)</th>
<th>1990 Total area (kha)</th>
<th>Area of mineral soil (kha)</th>
<th>Area of organic soil (kha)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>B. Total Cropland</strong></td>
<td></td>
<td>970.35</td>
<td>951.93</td>
<td>18.42</td>
</tr>
<tr>
<td>1. Cropland remaining cropland</td>
<td></td>
<td>724.75</td>
<td>706.33</td>
<td>18.42</td>
</tr>
</tbody>
</table>

**Fig. 6.4 indicates exactly the opposite**

Consistency with CRF data is missing

<table>
<thead>
<tr>
<th>Land-use category</th>
<th>Subdivision (1)</th>
<th>2006 Total area (kha)</th>
<th>Area of mineral soil (kha)</th>
<th>Area of organic soil (kha)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>B. Total Cropland</strong></td>
<td></td>
<td>870.94</td>
<td>852.19</td>
<td>18.75</td>
</tr>
<tr>
<td>1. Cropland remaining cropland</td>
<td></td>
<td>684.85</td>
<td>666.10</td>
<td>18.75</td>
</tr>
</tbody>
</table>

**ARR 2014, para 116:** Any progress?? To report the method used after 2006.
This table should be moved in the sector overview section, and merged with the information related to forest land.
Note that a complete Cropland inventory for Tier 1 has three elements:

1) carbon stock changes and non-CO2 emissions from biomass burning have been estimated for all Land Converted to Cropland and Cropland Remaining Cropland during the inventory time period

2) inventory analysis addressed the impact of all management practices described in the Tier 1 method

3) the analysis accounted for climatic and soil variation that impacts emissions and removals (as described for Tier 1)

In addition for the emissions reported as “NE”, is there a rationale to be provided (e.g. biomass burning)?
Cropland

Methodological Issues:

New emission/removal factors

The Scientific and Technical Research Council of Turkey (TUBITAK) Project (COST 112Y096) mentioned in the Planned Improvements section of the previous NIR has not been completed but some preliminary results have been provided and used in this NIR (i.e., Table 6.21). This project entitled “Development of a climate change ecosystem services software to support sustainable land planning works” involved in quantification of ecosystem services including C sequestration in urban and peri-urban regions.

The carbon stocks for the pools have been calculated on 59 sample plots in forests, agriculture areas and pastures. The study is conducted in warm-dry high activity clay (HAC) soils that are the dominant climate and soil type in Turkey. The sample size for the soil C stocks for croplands of this study is relatively small therefore a larger scale study has been conducted and reported (Table 6.21) for cropland soils as explained below. Dry organic matter contents have been determined and IPCC (2006) default CF values were used to convert biomass d.m. values to C.

✓ This is a good example of providing information on progress made.

✓ Suggestion: Move this part in the methodological section under CL-CL and/or under planned improvement section in the same chapter.
This section should be moved under Settlements category chapter

CS Estimation for Land Converted to Settlements Category

The land converted to settlement category has been reported in the previous submission for the first time. The calculated conversions were for cropland converted to settlements (CL-SL) and grasslands converted to settlements (GL-SL). It is a widely accepted fact that most of the sprawl in Turkey occurs on croplands and grasslands around the cities. On the other hand, conversion from settlements to other land uses is not a typical occurrence and is not estimated conservatively. To estimate CSC due to conversions of GL-SL and CL-SL, CS in SL has to be determined. The CS of settlements has been

✓ ARR 2014, para 115: Please follow the outline suggested by dec. 24/CP.19
A combination of T1 and T2 has been applied to calculate biomass increase for perennial croplands with Gain-Loss method. The areas of perennial woody cropland were multiplied by a net estimate of biomass accumulation from growth and subtract losses associated with harvest or gathering or disturbance (according to Equation 2.7 in Chapter 2 in IPCC 2006).

**Biomass accumulation and harvesting**

The gain-loss method of was used in calculating CSC in biomass pool. Biomass accumulation rate for perennial crops on Cropland remaining croplands have been taken as 1 Mg C ha⁻¹ yr⁻¹ based on values used by Italy inventory. Therefore biomass accumulation rate has been assumed to be 1 Mg C ha⁻¹ yr⁻¹ with a rotation period of 20 years and we also assume 10 years growth and 10 years stable (pruning and slow down of growth) periods similar to the mentioned inventory (NIR 2013 Italy, page 209).

- Reference in given only to equation 2.7. Provide with all the equations used.
- The data source for every parameter should be included, providing information and metadata on references.
- It is good practice to structure the NIR in each category (e.g. CL-CL, L-CL) on a pool by pool basis.
- Include a clear description of the rationale for this assumption (e.g. why Italian values are best representative for Turkey and better than the defaults from the 2006 IPCC guidelines?)

For the estimation of CSC in poplar plantations we used a database that covers the period 2003-2010. These values were extrapolated to 2011 and to the period before 2003. The poplar plantations were disaggregated for soil and default IPCC climate types.

- The data source should be referenced, providing information and metadata
Land converted to cropland

CSC in biomass and soil pools have been calculated in this category. CSC estimations for

- Grasslands converted to Perennial croplands
- Grasslands converted to Annual croplands

✓ But the CRF includes also values related to DOM pool. Thus, methods, equations, data sources should be provided.

The default C stock value of 0.75 Mg C/ha (country specific EF) in aboveground biomass were used for annual crops while 10 Mg C/ha was taken for perennial crops.

✓ The data source for every parameter should be included, providing information and metadata on references

Grassland converted to Perennial Cropland (EFs used are from Tables 7.23 and 7.25)

Aboveground CSC = AREA for GL - Perennial CL * 10 Mg C/ha – AREA * 0.49 Mg C/ha

However, the value given previously is 0.735 Mg C/ha

Is this a D or CS factor?

Check the correct numeration!
Where can those tables be found?
The following sections should be included:

**Uncertainty and Time Series Consistency**
include a discussion of the determined uncertainties for AD and EFs

**Category Specific QA/QC and Verification:**
Describe any category-specific QA/QC checks undertaken. Include the results of the QA/QC analysis

**Recalculation:**
A quantitative description of each recalculation occurred should be included. The main causes of recalculation should be listed (e.g. updated AD, new EFs, errors fixed) If there is anything unique in the recalculations for the time series, or a much larger impact for certain years, please describe here as well

**Planned improvements:**
As above described, the following elements should be included
- detailed description of ongoing project/study/research
- description of main outcomes and their impact on the estimation process
- tentative scheduling for the implementation of the updated data.
Grassland

**Source Category Description:**

Grasslands are all lands with non woody vegetation subject to grazing.

✓ A clear definition of the land areas under Grassland should be included.
✓ All woody vegetation is included in forest land category?

A description of trends and key drivers is missing

The following section should be included:

**Information on approaches used for representing land areas and on land-use databases used for the inventory preparation**

**Land-use definitions and the classification systems used and their correspondence to the LULUCF categories**

✓ You can add it in this chapter or in the beginning of the NIR according to the approach that will be followed.
Note that a complete Grassland inventory for Tier 1 has three elements:

1) carbon stock changes and non-CO2 emissions from biomass burning have been estimated for all Land Converted to Grassland and Grassland remaining Grassland during the inventory time period

2) inventory analysis addressed the impact of all management practices described in the Tier 1 method

3) the analysis accounted for climatic and soil variation that impacts emissions and removals (as described for Tier1)

In addition for the emissions reported as “NE”, is there a rationale to be provided (e.g. biomass burning)?
Grassland

Grassland remaining Grassland

CSC in grasslands is assumed to be not changing if management is not changed. Actually, there are grassland rehabilitation projects implemented in the country but conservatively we assumed no change in biomass. We plan to report these projects as the grassland monitoring system becomes available.

Emissions from organic soils are reported assuming that all grasslands are managed. Default EHs are used in this procedure but the AD is disaggregated for climate types.

✓ Why the soils are not reported? A rationale should be included in the NIR

✓ The estimation process of emissions from organic soils has to be described (method, equation(s), parameters, data sources, references, etc.).

Forest Land Converted to Grass Land

The information of Forest Land Converted to Grass Land is provided in section 6.2.5.

This section should be moved under Land converted to Grassland category chapter

✓ In section 6.2.5 only information on land identification is provided. Here is should be included all information related to methodological issues (tier, equation(s), parameters, data sources, etc.)
Grassland

CSC in biomass, soils and litter are reported in this category based on the CS values given in Table 7.23 and 7.25.

Perennial Cropland converted to Grassland (EFs used are from Tables 7.23 and 7.25)

- Aboveground CSC = AREA for Perennial CL-GL* 0.49 Mg C/ha - AREA * 10 Mg C/ha
- Belowground CSC = AREA for Perennial CL-GL* 1.37 Mg C/ha - ARBA * 5 Mg C/ha
- Litter = AREA for Perennial CL-GL* 0.06 Mg C/ha - AREA * 0 Mg C/ha
- Soil = AREA for Perennial CL-GL* 29.3 Mg C/ha - AREA * 33.6 Mg C/ha

Annual Cropland converted to Grassland (EFs used are from Tables 7.23 and 7.25)

- Aboveground CSC = ARFA for Annual CL-GI* 0.49 Mg C/ha - ARFA * 0.75 Mg C/ha
- Belowground CSC = ARFA for Annual CL-GI* 1.37 Mg C/ha - ARFA * 0 Mg C/ha
- Litter = ARFA for Annual CL-GI* 0.06 Mg C/ha - ARFA * 0.27 Mg C/ha
- Soil = ARFA for Annual CL-GI* 29.3 Mg C/ha - ARFA * (27.3 Mg C/ha for Warm-Dry, 23.9 Mg C/ha for Cool Dry)

✓ The data source for every parameter should be included, providing information and metadata on references.
Grassland

The following sections should be included:

Uncertainty and Time Series Consistency
include a discussion of the determined uncertainties for AD and EFs

Category Specific QA/QC and Verification:
Describe any category-specific QA/QC checks undertaken. Include the results of the QA/QC analysis

Recalculation:
A quantitative description of each recalculation occurred should be included.
The main causes of recalculation should be listed (e.g. updated AD, new EFs, errors fixed)
If there is anything unique in the recalculations for the time series, or a much larger impact for certain years, please describe here as well
FL-GL is reported for the 1st time. You can highlight here this improvement!!!

Planned improvements:
As above described, the following elements should be included
- detailed description of ongoing project/study/research
- description of main outcomes and their impact on the estimation process
- tentative scheduling for the implementation of the updated data.
A description of trends and key drivers of emissions is missing.

Explain why no emissions/removals are reported for WL-WL. Is peat extraction applied to Turkey (NE or NO)?

Explain what is happening after 2011 ("NE,NO")
✓ The data source for every parameter should be included, providing information and metadata on references.
The following sections should be included:

**Category Specific QA/QC and Verification:**

Describe any category-specific QA/QC checks undertaken. Include the results of the QA/QC analysis.

**Recalculation:**

A quantitative description of each recalculation occurred should be included. The main causes of recalculation should be listed (e.g., updated AD, new EFs, errors fixed). If there is anything unique in the recalculation for the time series, or a much larger impact for certain years, please describe here as well.

**Planned improvements:**

As above described, the following elements should be included:
- Detailed description of ongoing project/study/research
- Description of main outcomes and their impact on the estimation process
- Tentative scheduling for the implementation of the updated data.

**Uncertainty and Time Series Consistency:**

Include a discussion of the determined uncertainties for AD and EFs.
✓ A description of trends and key drivers of emissions is missing.
✓ Give a quick overview of the category (i.e. land use conversions to SL reported, pools, etc.)
Settlements

6.6. Settlements (Category 4.E)

The methods we developed for reporting Settlements category has been given in the Methodology section above.

✓ Methodological issues should be included in this chapter.

✓ Explain why no emissions/removals are reported for SL-SL. Bring the relevant text from below to the beginning of the chapter.  

We assumed that CSC in SL-SL is zero (e.g. following tier 1 methodology)

The method we used to develop EFs for Settlements category is a T3 level modeling study while representativeness is weak because the study is conducted in Istanbul.

✓ Be more positive. This is an improvement of you. Highlight it!!

✓ Proposed text: The method we used to develop EFs for Settlements category is a T3 level modeling study. The study is based on Istanbul only so the results are interim and we hope to improve the representativeness of the study.
The data source for every parameter should be included, providing information and metadata on references.

The estimation of CSC for land converted to Settlements has to be done on the same area.

Information on DOM and SOM in GL-SL is missing, while emissions/removals are reported.
Settlements

The following sections should be included:

Uncertainty and Time Series Consistency
include a discussion of the determined uncertainties for AD and EFs

Category Specific QA/QC and Verification:
Describe any category-specific QA/QC checks undertaken. Include the results of the QA/QC analysis

Recalculation:
A quantitative description of each recalculation occurred should be included.
The main causes of recalculation should be listed (e.g. updated AD, new EFs, errors fixed)
If there is anything unique in the recalculations for the time series, or a much larger impact for certain years, please describe here as well

Planned improvements:
As above described, the following elements should be included
- detailed description of ongoing project/study/research
- description of main outcomes and their impact on the estimation process
- tentative scheduling for the implementation of the updated data.
✓ The NIR does not include a section on Other land.

✓ A section could be included or otherwise a clear description on national circumstances with respect to this category should be included in the land classification section.
To be included

The following sections should be included, also in case in the CRF NO or NE is reported.

A brief description of the assumptions or data used to confirm that the emissions are not occurring (NO) or in the case of (NE) the rationale for not estimating these emissions (e.g. AD are not available) and, if appropriate, to discuss plans to estimate these emissions in the coming years.

Direct $\text{N}_2\text{O}$ emissions from N inputs to managed soils (4(I)):

Emissions and removals from drainage and rewetting and other management of organic and mineral soils (4(II))

$\text{N}_2\text{O}$ emissions from N mineralization/immobilization associated with loss/gain of soil organic matter resulting from change of land use or management of mineral soils

Indirect $\text{N}_2\text{O}$ emissions from managed soils (4(IV))

Biomass Burning (4(V))

The discussion on forest fires should be included, also reporting the rationale for why fires on other types of land are not estimated
✓ Provide here a description of trends and key drivers of emissions/removals

✓ Include a section on Methodological issues, describing the approach followed (if applicable) in the estimation process (e.g. stock change, atmospheric flow, etc) or how the method highlighted in the 2013 KP Supplement has been followed.
The harvest rate was high in the 90’s. From there, it decreased to its lowest level at the beginning of the 2000’s (12.5 Million m³/yr in 2001),

Is this number supposed to be reflected in table 6.27?

The CSC have been calculated by using an excel spreadsheet (Table 6.26) using the calculated (country specific) D values and a default CF value of 0.5 given in IPCC (2006).

✓ Provide with equations used in the estimation method
✓ The data source for every parameter should be included, providing information and metadata on references
Uncertainty and time series consistency:
Data for some years or periods had to be interpolated or extrapolated to have a complete inventory that covers the whole reporting period. To extrapolate the data we used linear equations derived from cumulative values (Figure 6.8).

Category-specific QA/QC and verification:
The QA/QC mechanism has been established in the LULUCF working unit established under MFAL.

Planned improvements:
There is a need to improve the forest resources inventory studies, the quality assurance of relevant data and increase the researches to obtain the country specific data. Planned activities are:

✓ Very good!!
✓ It could be elaborated further more and move in the beginning. Alternatively, could form the main material for discussion in each sector.

✓ Is not clear where this chapter refers to?
✓ The discussion here applies to all categories (mostly refers to instit. Arrangements). Is better to move in the beginning. Provide QA/QC activities per category, otherwise make cross-reference to the general one (aren’t they already QA/QC activities performed?)
Thank you for your attention!

marina.vitullo@isprambiente.it
i.tzamtzis@accel.gr