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Report of the technical assessment of the forest management reference level submission of Sweden submitted in 2011

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Contents

I. Introduction and summary

A. Overview

1. This report covers the technical assessment (TA) of the submission of Sweden on its forest management reference level (FMRL), submitted on 15 April 2011 in accordance with decision 2/CMP.6. The TA took place (as a centralized activity) from 23 to 27 May 2011 in Bonn, Germany, and was coordinated by the UNFCCC secretariat. The TA was conducted by the following team of nominated land use, land-use change and forestry (LULUCF) experts from the UNFCCC roster of experts: Mr. Nagmeldin G. Elhassan (Sudan), Mr. Giacomo Grassi (European Union), Ms. Rehab Ahmed Hassan (Sudan), Mr. Vladimir Korotkov (Russian Federation), Mr. Rae-Hyun Kim (Republic of Korea), and Mr. Kevin Black (Ireland). Mr. Nagmeldin G. Elhassan and Mr. Giacomo Grassi were the lead reviewers. The TA was coordinated by Ms. María José Sanz-Sánchez (UNFCCC secretariat).

2. In accordance with the "Guidelines for review of submissions of information on forest management reference levels"(decision 2/CMP.6, appendix II, part II), a draft version of this report was communicated to the Government of Sweden, which provided comments that were considered and incorporated, as appropriate, into this final version of the report.

B. Proposed reference level

3. Sweden has proposed an FMRL of –41.336 million tonnes of carbon dioxide equivalent (Mt CO_2 eq) per year, when applying the first-order decay function for harvested wood products (HWP), and –36.057 Mt CO_2 eq per year, when assuming instantaneous oxidation of HWP. Changes have been made to the FMRL compared with the value submitted earlier,[1] which was –21.840 Mt CO_2 eq per year. Sweden provided an explanation for the reasons behind this change, which included the following: new data had become available for most carbon pools; a new method for calculating sequestration in stumps had been implemented; the calculation of the net removals of small trees had been updated; and the soil organic carbon had been recalculated.

II. General description of the reference level

A. Overview

4. The FMRL is based on the expected average annual net removals in the period 2013–2020, which is based on the reported net removal for the period 2005–2009, and the 'business as usual' scenario for 2015 and 2020.

[1] Reference level inscribed in decision 2/CMP.6, annex I, submitted by Parties included in Annex I to the Convention in December 2009.

B. How each element of footnote 1 to paragraph 4 of decision 2/CMP.6 was taken into account in the construction of the reference level

1. Historical data from greenhouse gas inventory submissions

5. The national inventory report (NIR) for 2011 provided historical data for the calculation of the FMRL. The data used represents the greenhouse gas (GHG) inventory for the period 1990–2009. For HWP, the FAOSTAT data as well as the national data for 1961–2007 have been used. Data for the harvesting rate during the period 2000–2020 were also provided for transparency purposes.

2. Age-class structure

6. The age-class structure that was considered by Sweden represents the historical situation as well as the projected age-class structure for both the area and the volume, described for the period 1988–2020. The description comprises seven age classes for the volume and eight age classes for the area.

3. The need to exclude removals from accounting in accordance with decision 16/CMP.1, paragraph 1

7. See paragraph 21 below.

4. Other elements

Forest management activities already undertaken

8. Sweden explained that the structure of its standing stock at the start of the model simulation is based on the Swedish forest national inventory, which reflects the effect of the forest management regime. It is also indicated that the model used simulates the future development of forests based on assumptions of how forests are managed and harvested over a period of 100 years.

C. Pools and gases

1. Pools and gases included in the reference level

9. Sweden includes the following pools in its FMRL calculation: living above-ground and below-ground biomass, dead organic matter and soil organic carbon, consistent with the UNFCCC reporting guidelines and the Intergovernmental Panel for Climate Change (IPCC) *Good Practice Guidance for Land Use, Land-Use Change and Forestry*. Sweden also includes nitrous oxide (N_2O) emissions from nitrogen (N) fertilization and CO_2, methane and N_2O emissions from biomass burning in the construction of its FMRL. These emissions are also included under the current Kyoto Protocol LULUCF reporting.

2. Consistency with inclusion of pools in the estimates

10. The pools and emissions included in the FMRL are consistent with the information provided in the 2011 NIR.

D. Approaches, methods and models used

1. Description

11. The proposed reference level for Sweden includes only policies that were in place by mid-2009. The projection of net removals for the period 2015–2020 has been estimated using the HUGIN modelling tool. The model simulates the future development of the forests based on assumptions about how they are managed and harvested over a 100-year period. The assumptions for growth and harvest are the same as in the reference scenario for long-term forest state calculations made by the Swedish Forest Agency.

2. Transparency and consistency

12. The approach and methods used are well described in the submission, and in response to the expert review team (ERT), Sweden provided information during the TA on the assumptions and documentation relating to the model used.

E. Description of the construction of the reference levels

1. Area under forest management

13. The area of Sweden under forest management, as presented in its submission, is 28.2 million hectares (ha). Of this total, 23.4 million ha are included in the model simulation, including mainly productive forest (which encompasses the protected forest area). Unproductive forest area has not been included in the model. However, a fixed value of 2 Mt CO_2 eq for the estimated net annual removals of biomass carbon stock from these areas has been added in the calculations. Sweden stated that areas of afforestation and reforestation (AR) for the period 1990 to 2006 (approximately 220,000 ha in total) are included in the simulation of forest management, and that areas expected to be deforested for the period 2006 to 2020 (approximately 12,000 ha per year) are also included in the simulation of forest management.

14. The ERT considers the definition of area used in the simulation inconsistent with the definition of forest management since it also contains areas of afforestation, reforestation and deforestation (ARD). The ERT also noted that the forest management area reported in 2011 NIR is 29.1 million ha. In response to a request of clarification by the ERT, Sweden provided additional information (see annex below) showing an increased forest management area in 2009 due to statistical reasons (i.e. the 2009 estimate is based on a partial NFI cycle). Since the present FMRL value is estimated using a smaller area (28.2 million ha), the impact of any future recalculation of the reported time series should be reflected in a technical correction of the FMRL value. The ERT also posed questions to Sweden regarding the inclusion of ARD in the simulation, and the response given was that at the moment, it is not possible to fully separate the effect of ARD in the simulation of forest management, because the total area used in the model is fixed and it includes some of the ARD areas.

15. In response to a request from the ERT, Sweden explained that the implication of the above approach on area is that the estimate of net removals in the FMRL is overestimated by approximately 3 Mt CO_2 due to the inclusion of afforested and reforested lands, and is underestimated by approximately 2.1 Mt CO_2 due to the inclusion of deforested lands. Consequently, this approach leads to an overestimation of the FMRL net removals. The ERT noted that in the 2011 NIR, Sweden reports a sink from afforested and reforested lands of 1.27 Mt CO_2 and 0.98 Mt CO_2 in 2008 and 2009, respectively, and a source from deforested lands of 4.0 Mt CO_2 and 3.5 Mt CO_2 in 2008 and 2009, respectively. The ERT noted its concerns regarding the conservative nature of the FMRL as a result of the

differences in the Kyoto Protocol reporting and the FMRL submission and asked Sweden for additional information. In response to this request, Sweden provided additional information (see annex below) showing how the 3 Mt CO_2 (for AR) and the 2.1 Mt CO_2 (for D) were estimated.

2. Relationship of the forest land remaining forest land category with the forest management activity reported previously under the Convention and the Kyoto Protocol

16. Sweden has described the trend in the Kyoto Protocol activity areas and the area reported under the Convention. Sweden has also provided information on reported net removals for LULUCF under the Kyoto Protocol that comprises areas under forest management as well as ARD, and reported net removals for LULUCF under the Convention that comprises forest land and the forest land remaining forest land category. As explained above, Sweden has not excluded ARD areas from the forest management area in the projection of its FMRL.

3. Forest characteristics

17. Sweden classified its forestry as unproductive and productive forests; the latter class encompasses all types of forestry, such as trees for timber production, in national parks, in nature reserves and for use in habitat protection. Unproductive forest (less than 1 m^3 annual growth rate) is smaller in area than productive forest and is treated separately in the construction of the FMRL.

4. Historical and assumed harvesting rates

18. Since 1990, the level of harvesting in Sweden has increased steadily. However, during the last few years, there have been some fluctuations because of large storms experienced in Sweden in the period 2005–2007. Sweden provided in its submission the historical data of gross felling for the period 1990–2009 and projected data up to 2020. The assumed level of harvest for the period 2015–2020 is in the same order as the average rate for the period 2005–2009, which is below the level that represents the historical trend since 1990. The historical data for harvesting for the period 1990–2009 represents gross felling including wood supplied annually to the forestry industry and the energy sector in Sweden and other countries.

5. Harvested wood products

19. Sweden has provided estimates for harvested wood products. It calculated emissions and removals from HWP, from wood removed from the forests, as well as from wood consumed domestically and exported. Sweden adopted a first-order decay function for HWP, consistent with the IPCC default method, and the default half-lives of 2 years for paper, 25 years for wood panel and 35 years for sawn wood. Proposed reference levels for Sweden were estimated using both emissions from HWP assuming first-order decay and instantaneous oxidation of HWP.

6. Disturbances in the context of force majeure

20. The total effect of disturbances including two storms that affected Sweden in 2005 and 2007 led to a 50 per cent increase in the harvesting rate and resulted in an increase in emissions. However, due to salvage logging, the long-term additional emissions from storm-felled wood was reduced. The additional emissions will be distributed over time until the wood has decomposed completely. The large-scale salvage logging during the storm years also led to reduced harvest levels in the years subsequent to the storm. The historical data on forest fires shows that these emissions are negligible. Consequently, Sweden has

not adjusted its FMRL for force majeure because the known magnitude of disturbances, and the related effect on total greenhouse gas emissions in Sweden, is considered to be very small.

7. Factoring out

21. Use of a projected reference level is considered to factor out dynamic age-class effects. With the present state of scientific knowledge, the effects of elevated CO_2 concentrations and indirect N deposition are considered to be approximately the same in the reference level and in the commitment period, and therefore they can be assumed to factor out.

F. Policies included

1. Description of policies

22. Various forestry and other policies affecting the FMRL are included in the projection and are well described in Sweden's fifth national communication.

2. How policies are taken into account in the construction of the reference level

23. In the construction of its FMRL, Sweden has taken into account policies adopted before mid-2009 only.

3. Other issues

24. Sweden has provided information on uncertainty assessment for its projected FMRL. The main source of the overall uncertainty originates from the historical data as well as from the model simulation. Sweden also conducted a sensitivity analysis to assess the following: the trend in wood harvest, the annual net removal in living biomass, and the annual net removal in all pools.

III. Conclusions and recommendations

25. Sweden has constructed its FMRL in a transparent manner, which was consistent with the elements set out in footnote 1 to paragraph 4 of decision 2/CMP.6 and in accordance with appendix II, part I, of the same decision. The information provided during the TA was useful as it clarified the assumptions of the approach and methods used and their documentation.

26. The ERT encourages Sweden to revisit the forest management area used in FMRL to make it consistent with the forest management area included under Kyoto Protocol reporting.

27. The ERT recommends that the impact of any possible future recalculation of the time series of forest management area should be reflected in a technical correction of the FMRL value (see paragraph 13 above).

Annex

Documents and information used during the technical assessment

A. Reference documents

Submission of information on forest management reference levels by Sweden, 15 April 2011. Available at <http://unfccc.int/files/meetings/ad_hoc_working_groups/kp/application/pdf/awgkp_sweden_2011.pdf>.

National greenhouse gas inventory of Sweden submitted in 2010. Available at <http://unfccc.int/5270.php>.

National greenhouse gas inventory of Sweden submitted in 2011. Available at <http://unfccc.int/5888.php>.

B. Additional information provided by the Party[1]

Explanation of the difference between FM area of 28.2 Mha (used for setting FMRL) and 29.1Mha (reported under KP for the year 2009)

Sweden use a five-year inventory cycle and estimates for the most recent years in the reporting are based on a gradually smaller sample which might influence the estimate by increasing the variation. The difference between 28.2 (used in the simulation) and 29.1 (reported for FM in NIR 2011) is mainly due to the fact that the first number is based on full sample cycle of the NFI (30 000 sample plots) and that the second one is based on only one year (a fifth of a sample cycle, 6 000 sample plots) which to a high degree affects the uncertainty. While both estimates can be considered as representative for the FM area for Sweden the uncertainty increase significantly when the estimate is based on only one year of data. Since the reported record of data in the NIR 2011 for FM is only two years we illustrate this in the table below using the time series from 1990. The area is decreasing slightly due to deforestation as long as the estimate is based on 30 000 plots (until 2005) and starts to fluctuate more randomly thereafter. Also note that the FM area in the table is slightly smaller than the area used in the simulation. This is due to the fact that AR land is included in the simulated area as explained below under question 2.

Table 1. Area for Forest management 1990-2009.

Year	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Area (M ha)	28,24	28,22	28,21	28,20	28,18	28,17	28,16	28,15	28,14	28,13
Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Area (M ha)	28,12	28,10	28,09	28,08	28,08	28,09	28,03	28,06	28,38	29,10

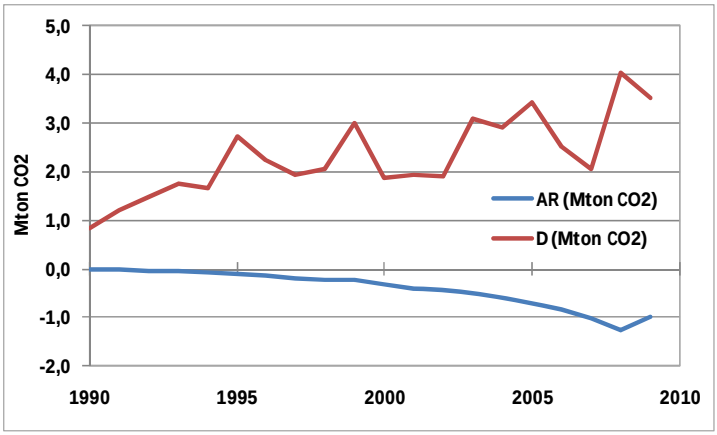
Explanation of the estimated emissions and removals for AR and D

The estimates of AR and D in the latest NIR has to be assessed taking into account that the estimates for the two latest years are based on only 12 000 and 6 000 sample plots respectively. In accordance with the methods described for the area above the estimates are very uncertain since only a few plots every year are identified as AR or D-plots. The

[1] Reproduced as submitted by the Party.

estimates will be updated until a full set of 30 000 plots can be used for the estimates which will significantly increase the accuracy. Currently we are developing a method using remote sensing to enhance the precision for estimates for years where we do not have a full record of sample plots. The plan is to use it for the final reporting under the first CP. The figure below shows the net removals for AR and D from 1990-2009 and illustrates a stable trend until 2005 as well as the uncertainty during the latest years for AR. Fluctuations between years for D is mainly due to the variation in harvest on D plots.

Figure 1. net removals for AR and D 1990-2009.



The fact that the forest area in the simulation model is fixed has three different implications for the projected reference level. The implications and our preliminary quantifications of the effects on the FMRL are described below:

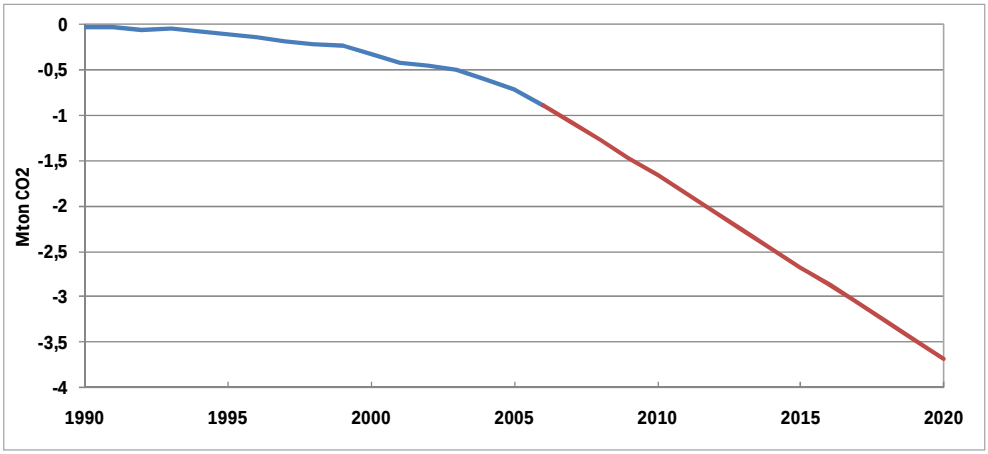
1. Areas afforested/reforested from 1990 until the time of the start of the simulation are included although they should have been excluded. This causes an overestimation of annual net removals in Forest Management (FM) of approximately 3 million ton CO_2 in average for the period 2013-2020.

The estimate is based on the following assumptions:

- The forest area assessed as AR between 1990 and 2006 is 220 000 ha in total.
- Consequently, the mean stand age for these forests in 2006 is approximately 8 year and the mean stand age for the same forests in 2020 is approximately 22 years. We considered that the average growth in a 22 year old forest is much higher than in an 8 year old forest and used a factor of 3.5 times the growth of the 8 year old forest to estimate the growth for the 22 year old forest. This factor is based on the HUGIN simulation results used in the projection for the simulated period.
- Net removals for AR in Living biomass (above and below ground) in 2006 were -0.79 million ton CO_2. No harvest occurs on these areas so this estimate is almost solely the annual growth. Net removal in Living biomass in 2020 was estimated to -2.77 million ton CO_2.
- The same approach was used for dead wood and litter (an increase by a factor 3.5 between 2006 and 2020). Net removal in Dead wood and Litter in 2006 was -0.27 million ton CO_2 and -0.96 million ton CO_2 in 2020.
- Linear interpolation was used to estimate the years between 2006 and 2020.
- Using the 20 year approach for land use transfers Soil organic carbon from 2010 was partly estimated as AR-land and partly based on average net removal in soils on forest land. In average the soils were estimated to be a source of 0.09 million ton CO_2 annually for the period 2013-2020.
- Based on the assumptions described above, net removal for AR for 2013-2020 on the 220 000 ha included in the simulation was estimated to -3.0 million ton CO_2 annually.

- The figure below illustrates historical data and the preliminary projection described above for AR.

Figure 2. AR for 1990-2020. The blue line indicates reported figures until 2006 and the red line indicates the estimated AR 2006-2020.



2. Emissions on areas being deforested during the commitment period are included although they should have been excluded. This causes an underestimation of net removals in FM. This means that harvests used by the model also includes harvest that in reality will occur on D lands and that emissions due to harvest is overestimated in the FMRL estimate. Additional calculations indicate that the annual emissions from harvests due to deforestation are approximately 2.1 million ton CO_2 on average for the period 2013-2020. The estimate is based on the following assumptions:

- The average standing volume is 130 m^3 per hectare
- 1 m^3 of standing volume represents 750 kg whole tree biomass. The carbon content was set to 50 %.
- The average annual deforestation area is 12 000 ha.
- The annual emission due to D during the simulated period is estimated to 2.1 million ton CO_2.

3. The area under Forest Management wrongly includes areas deforested from the time of the simulation until 2020, which leads to an overestimation of the Forest Management area that accumulates over time. This causes an overestimation of annual net removals of 0.15 million ton CO_2 for the period 2013-2020 (the difference to earlier estimates is the time of the start of the accumulation of areas). The estimate is based on the following assumptions:

- The average annual removal for Forest management is -0.0012 million ton CO_2 per hectare
- The average annual deforestation area is 12 000 ha.
- The accumulation of area starts 2006.
- The average annual net removals was estimated to of 0.15 million ton CO_2 for the period 2013-2020.