



Enhanced incentives for mitigation efforts in the Land Use.

- Land Use Change and Forestry sector in the next global climate change agreement

Hans Petersson, Mattias Lundblad, Jón Guðmundsson, Kim Pingoud, Sten Gyldenkaerne, Lars Vesterdal, Michelle Slaney, Gro Hysten and Tarja Tuomainen.

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Central concepts – List of Abbreviations

AFOLU	Agriculture, Forestry and Other Land Use – a suggestion to merge the LU-LUCF-sector by the Agriculture sector in future climate reporting. IPCCs (2006) AFOLU-reporting guidelines not yet approved
Annex-I Party	A Party that has signed and ratified the KP and has a specified reduction commitment to limit GHG emissions during the period 2008-2012
AR	Afforestation/ Reforestation are land use conversions to Forest land (e.g. FCCC/CP/1997/7/Add.1 Article 3.3 Page 3; FCCC/CP/2001/5 2 Page 45)
Assigned amount	Each Party's commitment referring to its GHG-emission level at the base year (normally in 1990). This emission level is fixed and named the Assigned amount
Baseline	Emission commitments are compared to an emission level at a reference year or a period of years. The baseline refers to the reference year/ years
cap	A Party-specific constant (FCCC/CP/2001/13/Add.1 Page 63). In the KP-accounting, additions to or subtractions from the assigned amount of a Annex-I Party, resulting from Forest management under Article 3.4 of the KP, after application of ARD debit compensation of Article 3.3 of the KP and resulting from Forest management undertaken under Article 6 of the KP, shall not exceed this constant (FCCC/CP/2001/5 6(c) Page 46)
CM	The KP Article 3.4 eligible activity Cropland management is Net-Net accounted under the KP. CM refers to carbon stock changes on Cropland (all Cropland assumed managed) (FCCC/CP/2001/5 6(a) Page 46)
COP/ MOP or CMP	Conference of the Parties serving as the meeting of the Parties to the Kyoto Protocol,
D	Deforestation are human induced land use conversions from Forest land (e.g. FCCC/CP/1997/7/Add.1 Article 3.3 Page 3; FCCC/CP/2001/5 2 Page 45)
Emission	Greenhouse gases released or emitted to the atmosphere
FM	The KP Article 3.4 eligible activity Forest management is capped and Gross-Net accounted under the KP. FM refers to changes in carbon pools and emissions on managed Forest land
GHG	Greenhouse gases are accounted in CO ₂ (Carbon dioxide) equivalents. CO ₂ , N ₂ O (Nitrous oxide) and CH ₄ (Methane) are the most important GHGs of the LULUCF-sector
GM	The KP Article 3.4 eligible activity Grazing land management is Net-Net accounted under the KP. GM refers to carbon stock changes on managed Grasslands (FCCC/CP/2001/5 6(a) Page 46)
Gross-Net	Gross-Net accounting is when the annual net change of carbon removals/ emissions is credited/ debited. Consequently Gross-Net is (nearly) independent of the emissions at the baseline (c.f. Net-Net accounting)
HWP	Harvested Wood Products refers to crediting/ debiting annual changes in carbon pools of products originating from forest biomass. By definition HWP includes all wood material that leaves harvest sites
IPCC	The Intergovernmental Panel on Climate Change. In this context they have developed practical guidelines for reporting of GHG emissions under the UNFCCC and the KP
KP	The Kyoto Protocol (FCCC/CP/1997/7/Add.1)
LULUCF	Land Use, Land-Use Change and Forestry

Net-Net	Net-Net accounting is when the current net emissions/ removals are compared to a baseline value, usually the net emission for a Party in year 1990
Non-CO ₂	Greenhouse gases other than CO ₂ (i.e. CH ₄ , N ₂ O)
Removals	Removal of greenhouse gases from the atmosphere
RV	The KP Article 3.4 eligible activity Revegetation is Net-Net accounted under the KP. RV refers to carbon stock changes on land under RV (FCCC/CP/2001/5 6(a) Page 46)
Sector	The IPCC have introduced six different reporting sections: Energy, Industrial processes, Solvent and other product use, Agriculture, Waste and LULUCF. Only emissions arise from the first five sectors (that are Net-Net accounted) while both emissions and removals may arise from the LULUCF-sector
UNFCCC	United Nations Framework Convention on Climate Change

List of key decisions and background documents

Decision and/ or description of document	Document
<i>Decision 13/CMP.1</i> Modalities for the accounting of assigned amounts under Article 7, paragraph 4, of the Kyoto Protocol	FCCC/KP/CMP/2005/8/Add.3
<i>Decision 15/CMP.1</i> Guidelines for the preparation of the information required under Article 7 of the Kyoto Protocol	
<i>Decision 16/CMP.1</i> Land use, Land-Use Change and Forestry Good practice guidance for Land Use, Land-Use Change and Forestry activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol	
<i>Decision 17/CMP.1</i> Good practice guidance for Land Use, Land-Use Change and Forestry activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol	
<i>Decision 18/CMP.1</i> Criteria for cases of failure to submit information relating to estimates of greenhouse gas emissions by sources and removals by sinks from activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol	
<i>Decision 21/CMP.1</i> Issues relating to adjustments under Article 5, paragraph 2, of the Kyoto Protocol	
<i>Decision 6/CMP.3</i> Good practice guidance for Land Use, Land-Use Change and Forestry activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol	FCCC/KP/CMP/2007/9/Add.1
<i>Decision 15/CP.10</i> Good practice guidance for Land Use, Land-Use Change and Forestry activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol	FCCC/CP/2004/10/Add.2
<i>Decision 14/CP.11</i> Tables of the common reporting format for Land Use, Land-Use Change and Forestry	FCCC/CP/2005/5/Add.2
Analysis of means to reach emission reduction targets and identification of ways to enhance their effectiveness and contribution to sustainable development, Land Use, Land-Use Change and Forestry.	FCCC/KP/AWG/2008/L.11
Analysis of possible means to reach emission reduction targets and of relevant methodological issues - Technical paper.	FCCC/TP/2008/2
Report of the Ad Hoc Working Group on Further Commitments for Annex I Parties under the Kyoto Protocol on its resumed fifth session - Land Use, Land-Use Change and Forestry	FCCC/KP/AWG/2008/3
Elaboration on how to address, where applicable, the definitions, modalities, rules and guidelines for the treatment of land use, land-use change and forestry - Note by the Chair	FCCC/KP/AWG/2009/IN F.1

1. Preface

With the overall objective to facilitate international discussions on enhancing incentives for mitigation efforts in the next global climate change agreement, the COP-15 group under the Nordic Council of Ministers in the spring of 2008 outlined a project with the aim of analysing different options for the inclusion of the LULUCF-sector in a future agreement on emission reductions for Annex I Parties. The project aims to find ways to adjust the current accounting rules into rules that would create better incentives for actively managing lands in order to decrease the emission of greenhouse gases to the atmosphere and/ or to remove greenhouse gases from the atmosphere. Different proposals for the treatment of the LULUCF-sector are compared and analysed according to the criteria below.

The study focuses on four areas:

- Effects of different alternative accounting rules, e.g. Gross-Net, Net-Net, with and without caps/ discount factors and other ways of accounting, on the incentives to increase removals or decrease emissions in the LULUCF-sector
- A comparison of a land-based accounting system with a further development of the current activity based accounting
- The feasibility of introducing new activities, such as Wetland restoration and degradation, in a future commitment
- The feasibility of including emissions and removals from Harvested Wood Products in a future commitment

The project has been carried out by researchers from all Nordic countries and was funded by the Nordic Council of Ministers with the intention to

provide input for the discussion on a post-2012 agreement under the Kyoto Protocol accounting rules for the LULUCF-sector.

The authors are fully responsible for the content of this document, and views and interpretations of the results do not reflect the opinion of the Nordic governments nor the Nordic Council of Ministers nor the Nordic COP-15 group.

2. Short summary

The most important results of the discussion on different accounting options are summarised in table 2.1. We draw the conclusion that to enhance the incentives to store or sequester more carbon there is in general no difference between a Gross-Net and a Net-Net approach for Forest management. There will nevertheless be large effects on the accountable amount of carbon credits or debits depending on the situation for Forest management in each country. This effect can be balanced using a discount factor. Using a cap, as done in current accounting rules under the Kyoto Protocol, limits the incentives substantially.

Table 2.1. Pros and cons of different accounting concepts (subjectively judged)

Accounting rule	Accounting restriction	Incentives for increasing sinks and decreasing emissions	Handling of natural disturbances with no additional measures
Gross/ Net	No cap or discount factor	High	No ¹
	cap	Low ²	Partly ²
	Discount factor	Medium ²	Partly ²
Net/ Net	No cap or discount factor	High	No ³
	cap	Low ²	Partly ³
	Discount factor	Medium ²	Partly ³
Activity based	No cap or discount factor	High ⁴	Partly ⁵
	cap	Low ^{2,4}	Partly ^{2,5}
	Discount factor	Medium ^{2,4}	Partly ^{2,5}
Land-based	No cap or discount factor	High	No
	cap	Low ²	Partly ²
	Discount factor	Medium ²	Partly ²
Mandatory 3.4		Yes	No ⁶
Voluntary 3.4		Partly ⁷	Partly ⁵
Additional activities		Yes	No ⁶
HWP		Yes ⁸	Partly ⁹

¹A long accounting period would average out natural disturbances.;

²Depends on the level of the cap/ discount factor;

³May average out natural variation if such variation correlated to base year;

⁴Incentives only for activities and not for areas left out;

⁵Possible to exclude areas where Natural disturbances occur;

⁶Additional measures needed to handle natural disturbances;

⁷Incentives only for elected activities and incentives reduced when activities are left out;

⁸The completeness of the accounting will also be improved;

⁹A large proportion of the biomass can be used as timber or for energy generation after storms, forest fires and insect attacks. The natural disturbances would decrease carbon pools in living biomass but could increase the stocks in the HWP-pool.

Going towards a land-based approach increases the incentives compared to the current system with eligible activities and gives a more complete accounting. However, the same incentives could be attained making all KP Article 3.4 activities mandatory. Since the situation for forestry is very different among the Nordic countries, as among countries all over the world, it is impossible to find a solution that will be attractive to all countries when considering the quantitative effects on the current commitment. Introducing new activities such as Wetland restoration and Wetland degradation as new accountable activities would create incentive to decrease present emissions from drained wetlands. Suggested (IPCC 2006) approaches of reporting HWP would probably also increase the incentives of storing carbon.

3. Introduction

Hans Petersson, Sweden

3.1. History of LULUCF reporting and accounting

The United Nations Framework Convention on Climate Change (UNFCCC) was adopted in 1992 and entered into force in 1994. The general objective of the convention is to “stabilize greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system”. Under the Convention, governments gather and share information on greenhouse gas (GHG) emissions, national policies and best practices, launch national strategies for addressing GHG emissions and adapting to expected impacts, including the provision of financial and technological support to developing countries and cooperate in preparing for adaptation to the impacts of climate change.

In accordance with Articles 4 and 12 of the Convention and the relevant decisions of the Conference of the Parties (COP), Annex I Parties to the Convention shall submit national GHG inventories of anthropogenic emissions by sources and removals by sinks of GHGs not controlled by the Montreal Protocol.

The UNFCCC Reporting Guidelines on Annual Inventories require Parties included in Annex I to the Convention (Annex I Parties) to provide annual national GHG inventories covering emissions and removals of direct GHGs (CO₂, CH₄, N₂O, HFCs, PFCs and SF₆) from six sectors (Energy, Industrial processes, Solvents, Agriculture, LULUCF, Waste), and for all years from the base year to the most recent year.

Regarding guidance and uncertainty management for the LULUCF-sector, COP 9 decided that Annex I Parties should use the IPCC Good

Practice Guidance for LULUCF (GPG, 2003) for preparing and reporting annual GHG inventories under the Convention due in 2005 and beyond (decision 13/CP.9).

The GPG for LULUCF describes six broad land-use categories for reporting national inventories under the Convention: Forest land, Cropland, Grassland, Wetlands, Settlements and Other land. For each land use class estimates of changes in carbon stocks and emissions of GHGs associated with the LULUCF sector and activities should be reported. The land-use categories are divided into lands remaining in the same land use (for example, forest lands that remain as forest lands) and lands converted into another land-use category (for example, forest lands converted into croplands) during the inventory period.

In 1997, the Conference of the Parties to the UNFCCC agreed to the Kyoto Protocol (KP) which established an overall target to reduce Annex I Party-GHG emissions by at least 5 per cent below the emission level of 1990 in the first commitment period 2008 to 2012 (UNFCCC, 1998) as well as specific commitments for emission reductions by each Annex I Party for this period. Regarding the Land Use, Land-Use Change and Forestry sector (LULUCF) it was decided that in meeting their emission reduction commitments under KP Article 3, Parties should implement and/ or further elaborate policies and measures to protect and enhance sinks and reservoirs of GHGs, to promote sustainable forest management, afforestation and reforestation, and sustainable forms of agriculture.

Under Article 3.3 of the KP, net changes in GHG emissions by sources and removals by sinks through afforestation (A), reforestation (R) and deforestation (D) since 1990, should be accounted for in all Annex I Parties fulfillment of their commitments on emission reductions. Under Article 3.4 of the KP, Parties were allowed to elect whether to include the effect of additional human induced activities related to LULUCF, i.e. Forest management (FM), Cropland management (CM), Grazing land management (GM) and Revegetation (RV) in fulfilling their emission reduction commitment for the period (2008-2012). Upon election, the decision by a Party is fixed for the first commitment period. The changes in carbon stock and GHG emissions relating to LULUCF activities under KP Article 3, paragraphs 3 and 4, must be reported for each year of the commitment period, beginning with the start of the commitment period, or with the start of the activity, whichever is later.

Modalities and definitions for activities under KP Article 3.3 and 3.4, and rules by which activities will be handled for the first commitment period were discussed at several meetings (SBSTA and COP). Finally a decision on LULUCF in Marrakesh 2001 (Decision 11/CP.7), later adopted at the first Conference of the Parties serving as the meeting of the Parties to the Kyoto Protocol (CMP) as decision 16/CMP.1, outlined three main elements:

- A set of principles to govern the treatment of LULUCF activities;
- A common definition for “Forest,” plus definitions for activities under Article 3.3 and agreed activities under Article 3.4; and
- Modalities, rules and guidelines relating to the accounting of activities under Articles 3.3 and 3.4.

After the meeting in Marrakesh discussions began on the methodological issues, i.e. the use of the IPCC good practice guidance for LULUCF in the preparation of national GHG inventories. After several years of negotiations on methods and reporting formats, the first CMP decided that Annex I Parties to the Kyoto Protocol shall apply the IPCC good practice guidance for LULUCF, in a manner consistent with the Kyoto Protocol, in their provision of information on GHG emissions and removals from LULUCF activities under Articles 3.3 and 3.4 for the first commitment period.

3.2 The uniqueness of the LULUCF sector

In a climate perspective, the LULUCF sector is unique in contrast to other sectors because appropriate management may imply removals of GHG. There is potential to afforest/ reforest land (but there exists also the risk of deforesting land) and to increase the carbon stocks on existing forested (and other) land. Due to low growth rates and high respiration levels, the net accumulation of carbon in mature forests is declining and from a pure climate perspective, it may therefore be better to harvest, regenerate and store or retain carbon from the harvested mature biomass. This harvested biomass can be made into products provided they are long-lived or eventually replace fossil fuels. From a climate perspective,

it will be better to use the harvested biomass in “long-lived” buildings than in paper with a relatively fast turnover rate, as this carbon is removed from the atmosphere for the duration of the products life span. Eventually, “long-lived” products decompose and a favourable end use might be to use the waste as fuel for power and/ or heat generation, replacing fossil fuels. There is an increased interest in using by-products from the forest industry and forest fuels for energy generation.

Other land use categories also possess a large potential to increase C-pools and decrease emissions through proper management. In many areas Agricultural and Grassland soils have decreased their original carbon pool due to intensive cultivation and livestock grazing. Drainage of organic wetland soil starts aerobic respiration of large carbon pools, thus causing CO₂ and N₂O emission but stopping CH₄ emission.

In the LULUCF sector the resulting emissions generally result from big opposite fluxes. Forest growth is the net result of a much larger uptake of CO₂ through photosynthesis and its emission through respiration. Small changes in the environmental factors affecting these processes can shift the balance of these processes from net uptake to net emission.

Another sector specific issue is that the net emission/ removal might vary quite a lot between years. While the growth rate is quite stable, the harvest may vary by demand of forestry products. Stored carbon may also be released by natural disturbances (forest fires, storms, pest outbreaks). However, only a proportion of the biomass is directly released to the atmosphere – a quite large proportion can be harvested or remains in the forest but is converting from living biomass into the dead wood pool.

It should be recognised that storing carbon in terrestrial carbon pools and in HWPs may only be a temporary solution in detaining climate change. The time frame of climate change mitigation is an essential issue here.

An important deviation of the LULUCF sector from other sectors is how it is treated in the KP. Only a few of the emission sources and removal sinks are accounted for. The only land use changes accountable under current KP rules are when land is changed to or from Forest land through Afforestation/ Reforestation or Deforestation respectively. Other land use changes involving the conversion of land between the other five land use categories are not accountable under the KP.

The LULUCF sector has large potential to contribute to a decrease of GHG emissions and in removing carbon from the atmosphere. This potential has been restricted in some ways by the tendency to use LULUCF as an escape route to avoid taking action in other sectors. One solution to this problem might be to introduce separate targets (commitments) for the sector (or even for other sectors as well) and in that way lessen the critique of using it as an escape route and also relieve the somewhat unrealistic demands for accuracy in emission removal estimates.

Usually stakeholders consider multiple objectives and problems. Consequently it is logical not only to consider the climate, but also economies, sustainability, food production, energy demands, etc., in the decision process. In addition, the UNFCCC states that actions under the UNFCCC should not counteract the intention of other conventions such as the Convention on Biological Diversity (CBD) and the Convention to Combating Desertification (UNCCD). In summary:

- Photosynthesis makes it possible to remove carbon dioxide (CO₂) from the atmosphere and to store it in biomass
- This biomass could be stored in terrestrial pools and in harvested products or be used to substitute fossil fuels
- Increased gross production of biomass, sustainable harvest of mature biomass, and an increase and efficient use of harvested products are means to increase the amount of stored carbon in terrestrial pools and HWP
- Due to natural disturbances and varying demand of forest products, the net emission/ removal might vary quite a lot between years
- When striving to reduce net emissions of GHG to the atmosphere, aspects such as net change in carbon pools and substitution of fossil fuels should be considered
- Decision makers should consider multiple objectives – not only the climate – when creating policies

4. Accounting concepts of the LULUCF-sector today and in a future accounting system

Hans Petersson, Sweden

4.1 General accounting concepts

This section briefly describes the different concepts of accounting that are used in accounting under the KP today and concepts relevant for a future LULUCF accounting system.

4.1.1. Net-Net- and Gross-Net accounting

Net-Net accounting is when net emissions are compared to a baseline value – in the current system these are the net emissions for a Party in 1990. If emissions are lower than the baseline emissions, the difference is credited; if emissions are higher, the difference is debited.

Gross-Net accounting is when the annual net change in carbon pools is credited or debited. If the annual net change constitutes a removal of GHG, then the Party is credited. Consequently Gross-Net accounting has no direct connection to past emissions/ removals.

Under the KP during the first commitment period, emissions from all sectors except for the LULUCF-sector are accounted Net-Net. In the LULUCF-sector, emissions/ removals from Afforestation, Reforestation, Deforestation and Forest management are accounted Gross-Net while other activities are accounted Net-Net (See chapter 4.2).

4.1.2. Cap and discount factor

Today, only a part of sequestered carbon in forests is accounted since there is a limitation under the KP set by the cap (See chapter 4.2). The aim of the cap is to ensure that only direct human induced carbon sinks are credited and to reduce the risk of large uncertainties affecting the accounting.

A discount factor (one option in a future accounting system) works in the same manner as a cap. The objective with a discount factor is the same as with the cap, but a discount factor is set as a percentage of the removal/ emission and is not absolute (as in the case of a cap). It is therefore more difficult to predict the actual mitigation potential of the LU-LUCF-sector if a discount factor is used instead of a cap. In contrast to the cap an accurately set discount factor may give incentives to keep large removals at a certain level and to limit large emissions.

4.1.3. Activity based and land-based accounting

Activity based accounting, as in the current accounting system, refers to accounting of carbon pool changes and emission of other GHG than CO₂ only on land where certain activities occur (AR, D, FM, CM, GM and RV).

The idea of a land-based approach is to cover the human induced changes in carbon pools and emission of other GHG due to human activity of a Party's entire land area. Instead of defining activities, Parties would report and account for emissions and removals from all land areas. This approach is very close to the approach used for the UNFCCC-reporting of LULUCF where reporting of carbon pools are attributed to six land-use classes and changes between them.

Both activity-based and land-based accounting could use either a Net-Net or a Gross-Net approach. The main difference between these two approaches is that in a land-based accounting system, all land areas are represented, whereas for an activity-based system (as it is defined today) some activities are mandatory and some are voluntary.

4.1.4. Harvested Wood Products (HWP)

Accounting for Harvested Wood Products (HWP) means that emissions resulting from harvesting forests are not directly accounted for or are ‘delayed’ in various ways depending on the use (and life time) of the round wood. Four different approaches for accounting HWP are described by the IPCC (2006). The IPCC does not favour or prescribe any of these approaches but focuses on describing each approach and the variables needed for reporting using a particular approach.

One option (approach: “Not reporting HWP”) is to assume HWP to be in a steady state, assuming that all harvested biomass is oxidised in the year of harvest and therefore results in a zero stock change. This is the current accounting rule used under the KP and has the advantage of being simple. A major disadvantage of using this approach is that there is no incentive for storing carbon in HWP. Another disadvantage is that removals and emissions from forest products are accounted incorrectly over time. Not reporting HWP is probably a temporary solution until technical issues (how to trace HWP) and accounting issues (mainly referring to whether producer or consumer should receive credit from HWP) are solved.

The three other approaches described by the IPCC are: i) the Stock-change approach (SCA), ii) the Atmospheric-flow approach (AFA), and iii) the Production approach (PA). The approaches are mutually exclusive and to avoid double counting and inconsistencies, only one approach should be elected by the Conference of the Parties (CMP) to be applied by all Parties. The approaches differ in how they allocate products and their removals and emissions between producing and consuming countries, and the processes on which they focus.

4.2. The current accounting system of the LULUCF-sector under the KP

The actual accounting¹ rules for the LULUCF-sector under the KP are found in an annex to decision 16/CMP.1 (UNFCCC, 2006). In this annex, “Forest land” and the activities Afforestation (A), Reforestation (R), De-

¹ This study does not consider accounting rules under CDM and JI mechanisms

forestation (D), Forest management (FM), Cropland management (CM), Grazing land management (GM) and Revegetation (RV) are defined. Accounting of activities under KP Article 3.3 (A, R, D) is mandatory whereas accounting of activities under Article 3.4 (FM, CM, GM, RV) is voluntary.

The GHG-changes in carbon pools on ARD-land is currently Gross-Net accounted, crediting annual net removals by sinks and debiting net emissions by sources. Also the eligible Article 3.4 activity of FM is Gross-Net accounted. Other eligible Article 3.4 activities, CM, GM and RV are Net-Net accounted. Land where AR (A and R are usually reported together) and D activities occur should be traced back to 1990 and from this date be accumulated to 2012. The net removal/ emission originating from changes in carbon stocks on such ARD-land in 2008-2012 shall be added to a Party's assigned amount.

Parties that have elected FM could use this activity to offset a potential net emission from ARD. A prerequisite is that changes in carbon stocks of land under FM constitutes a removal larger than an eventual net emission from ARD and is in the range of 0-165 M ton CO₂ (or 0-45 M ton C, see 16/CMP.1, paragraph 10) for the period 2008-2012. Land under FM is accumulated from 2008 and carbon stock changes on such land are reported 2008-2012. To avoid double counting at a certain year, each unit of land can only be reported under one activity (or not reported at all). Usually AR has FM as a secondary classification (if FM is elected). One important part of the accounting rules of the LULUCF-sector is found in paragraph 10 in the annex to decision 16/CMP.1 (The interpretation of accounting rules are under negotiation and especially the last part of the following sentence):

“For the first commitment period, a Party included in Annex I that incurs a net source of emissions under the provisions of Article 3, paragraph 3, may account for anthropogenic greenhouse gas emissions by sources and removals by sinks in areas under forest management under Article 3, paragraph 4, up to a level that is equal to the net source of emissions under the provisions of Article 3, paragraph 3, but not greater than 9.0 megatonnes of carbon times five, if the total anthropogenic greenhouse gas emissions by sources and removals by sinks in the managed forest since 1990 is equal to, or larger than, the net source of emissions incurred under Article 3, paragraph 3”.

For Forest management, the common interpretation is that both debits from potential FM-emissions and credits from potential FM-removals are restricted to a maximum limit, the so called cap (Paragraph 11; 16/CMP.1). Thus, if FM is elected, the figure a country could account must be in the range $-cap$ to $+cap$. The ARD offset and cap are linked and if the FM-removal is only large enough to offset a net emission from ARD-activities there is no removal left to claim additional credits from the cap.

KP rules state that once land is accounted for under elected activities, the GHG emission and removal on this land must be accounted for throughout subsequent and contiguous commitment periods. This means that land cannot be removed from the elected activity once it has been accounted for but new land can be added throughout the commitment periods.

To avoid overlaps each Party has to decide a scheme of precedence conditions and/ or a hierarchy to determine under which activity a certain area of land is to be reported. Within some limits, a Party is quite free to decide the scheme of precedence conditions among elected KP Article 3.4 activities. These conditions or hierarchies have to be in harmony with the definitions of land use categories defined under UNFCCC reporting. It is important to note that under present accounting rules, eligible activities don't have to be confined to a certain UNFCCC land use category or be independent of land use categories. As an example, Grazing land management is not only restricted to Grassland, but to land used for grazing of livestock (FCCC/KP/CMP/2005/8/Add.3). The definitions of what land is under FM, GM or CM is left open to be decided by each Party electing the relevant activity (GPG for LULUCF ch. 4.1.2. page 4.15).

4.3. Studying incentives to store carbon in terrestrial pools and in HWP – Some pros and cons with the current accounting system under the KP

4.3.1. *Pros*

The main advantages of keeping the current accounting system are that:
It works,

- it has been negotiated, and accepted by signatory countries,
- it keeps the continuity in reporting and does not require efforts to build up new systems for reporting for those already using the KP-system and
- there is no formal requirement that the underlying data should represent the specific reporting year (this limits several undesired properties related to accuracy and random variation in annual data).

It should be recognised that the current accounting system works and is accepted by signatory Parties and other stakeholders. A completely new accounting system that is not based on the current system may take years to negotiate since it will require new reporting methods, reporting guidelines, reporting tables, etc., and would of course be inconsistent with the current system used. Also the current and potential reporting principles outlined by the IPCC (1997, 2000, 2003, 2006), have been welcomed in most instances.

It should be noted that the reporting/ accounting is done on an annual basis but the underlying data may refer to a trend rather than to annual fluctuations in carbon stocks. IPCC (2003) states that it is good practice to use methods that provide the highest levels of certainty (IPCC 2003) and the certainty may be implemented to correspond to a trend in change of carbon pools. The recommendation to use a five-year inventory cycle of land use data, to interpolate and extrapolate data, and to use models confirms that IPCC (2003) aims to report trends. Reporting the trend has the advantage, to some extent, of averaging out random effects from natural disturbances and random errors from surveys.

Observe that almost no Party could provide data that exactly matches the changes in terrestrial carbon pools to a specific year. However, since the reporting is presented annually, there is a risk that stakeholders will assume that the underlying data represents carbon stock changes pertaining to single years. This assumption may be based on the wish of many stakeholders that the reporting system should be sensitive enough to reflect the effect of policies and measures on the annual net emission/ removal.

4.3.2. *Cons*

In the current accounting system, incentives for storing carbon in terrestrial carbon pools and in Harvested Wood Products (HWP) are often lacking because:

- I. Carbon pools are excluded
- II. Only part of the included carbon pools are credited/ debited
- III. Carbon units emitted/ removed from different activities are accounted differently
- IV. The voluntary election of reporting some activities and pools may introduce bias

I) An accounting system that strives to increase the incentives for storing carbon in terrestrial carbon pools and in HWP should set a value on each quantity removed or emitted. A system where accounting is based on all land classes including all pools has such properties. In this accounting system, terrestrial carbon and HWP could be considered pools and all other emissions as non-pools. To avoid double counting, emissions from, for example, biomass burning should not debit a Party since it has already been accounted by decreasing the biomass pool.

II) The two-sided cap limits incentives both to remove large quantities of carbon from the atmosphere and to avoid large emissions from biomass. The main objective with the cap is to factor out causes that are non-human induced.

III) The current activity-based system credits storage on AR-land differently than on FM-land. Full credit is given from removals on AR land while credit is sometimes zero on FM land. Every emission from D is debited while a reduction of carbon stocks on FM land might not be debited at all.

IV) The accounting of carbon changes is biased not only since large pools are excluded from the accounting (and since these stocks are probably not in a steady state), but also since it is optional to elect and account for Article 3.4 activities. Parties may tend to exclude more activities resulting in net emissions rather than activities resulting in net removals. However, since there are uncertainties in the measurement of certain emissions due to methodological problems, one advantage with the current system is that uncertain emissions can be left out of accounting.

5. Options for future reporting and accounting of the LULUCF-sector under the KP

Mattias lundblad, Sweden

During the spring of 2008, discussions on how the LULUCF-sector should be accounted for were started. Based on the current accounting rules and submissions from Parties, several options were presented by the UNFCCC-secretariat in the report on Analysis of means to reach emission reduction targets and identification of ways to enhance their effectiveness and contribution to sustainable development (FCCC/KP/AWG/2008/L.11). Discussions in Bonn and in Accra resulted in four different options or concepts (FCCC/KP/AWG/2008/3). The intention at COP 14 in Poznan was to decide which option, or combination of options, was to be used to account for emissions/ removals from LULUCF. However, the Parties could not come forward in the negotiations and the situation was not changed at all. Therefore, the main options which are also reflected in the latest documents from the UNFCCC (i.e. FCCC/KP/AWG/2009/INF.1) still are:

1. Accounting according to current system (KP)
2. Net-Net accounting using a base year or a base period for Article 3.4
3. Net-Net accounting using forward looking baseline
4. Land-based accounting

The first three options include several sub-options such as voluntary or compulsory activities; with or without a cap/ discount factor; different options for the debit of harvesting AR-land; how to treat HWP; how to

consider natural disturbances; and considering additional activities such as Wetland restoration and degradation, as well as Forest degradation and revegetation. All of these sub-options are not applicable to all four options.

In the fourth option (land-based accounting), definitions and accounting methods are described in a land-based approach. Concepts such as ARD, FM, CM, GM and RV are not considered and all land-use categories and all emissions and removals from managed lands would be included. This option also includes several sub-options on Net-Net/ Gross-Net accounting and how to treat HWP.

5.1. Activity-based accounting

As described above, three concepts of activity-based accounting, basically regarding how to treat the eligible Article 3.4 activity of Forest management, are under consideration by the Parties.

It should be noted that at this time there is no exclusion of the possibility that changes could be suggested for the Article 3.3 activities. However, since no proposals in that regard have been put forward, we assume that the Article 3.3 activities are accounted for as done today.

We are fully aware of the fact that the situation can be changed and/ or that options could be withdrawn from the negotiating table. The aim of this study is not to prescribe which option is preferred, but to describe the consequences on the GHG-accounting and to summarise pros and cons for the incentives to increase removals or decrease emissions in the LU-LUCF-sector.

The current Gross-Net accounting approach and Net-Net accounting using a base year or base period is well known. The main idea with the third option, forward looking baseline, is to compare the estimated emissions and removals in the commitment period to a projected base-line. The base-line is set as a projection of a Party's carbon stock changes under FM taking into account business-as-usual management, post-harvest regeneration, as well as HWP accounting. After the commitment period either the base-line or the reported figures are updated by adding or removing the effects of natural disturbances to reflect only the human induced changes. If the reported removals are larger than the baseline the

Party will account for a credit and if it is lower the Party will be debited. It is not fully clear in the proposal on which basis the baseline should be set. Calculations on the effect of this option have therefore not been made, since further details on such an approach are required for a quantitative analysis. We also believe that this option simply may be too complicated to be accepted by Parties. It can be concluded, however, that if the baseline is perfectly set and consequently matches the anthropogenic net removal/emission during the commitment period, there will be no accountable credits or debits at all. This approach gives incentives to increase the removals or decrease the emissions but since the baseline is set as the business-as-usual-projection, the influence of FM (and LULUCF) for most Parties will be much lower compared to a Net-Net approach (i.e. when using 1990 or a base period as the reference level).

In the discussion of the three activity-based accounting approaches several sub-options that largely affect the net outcome of the LULUCF-sector are also included. In a future agreement it is possible that the cap for Article 3.4 FM will be removed or displaced with a discount factor and that some or all of the activities will be compulsory. There is also the option to include HWP, to adjust for natural disturbances, and to change the debit/ credit rule for Article 3.3.

One of the most important rules for the accounting of the LULUCF-sector today can be found in paragraph 10 in the annex to decision 16/CMP.1. The paragraph states that a Party may balance emissions from Article 3.3 using credits from Article 3.4 FM. Currently there is no proposal to change this rule, and therefore, in our analysis we assume that the level of 9 M ton C (annually) can still be used by Parties to compensate for net emissions from ARD (Article 3.3). For individual Parties, a removal of this paragraph could largely affect the contribution of the LULUCF-sector to the national total emissions.

We have performed a numerical analysis based on data from the Nordic countries for the period 1990-2006. Primarily, we have used the latest reported data to the UNFCCC. In the analysis the reference base year refers to 1990, the reference base period is 1990-1994 and data from 2002-2006 were used as a proxy for the probable outcome of KP Article 3.3 and 3.4 during the commitment period. A drawback of doing so was that this period was quite far from the real commitment period.

Another shortcoming that implies that the results should be interpreted with care is that the data to a large extent are derived from UNFCCC convention reporting because activity-based data are not available at the moment. The proxy used for Forest management is Forest land remaining forest land, for Cropland management it is Cropland remaining cropland and for Grazing land management it is Grassland remaining grassland. The differences when using actual Article 3.4 data could be significant and results of the analyses should be treated with much caution.

In the calculations on an activity-based approach we combined different options of keeping activities voluntary or mandatory with different use of the cap/ discount approach applying option i) and ii) previously mentioned. The cap or the discount factors were only applied to Forest management (FM).

Where activities are voluntary, the countries' election of KP activities has been used (table 5.1). The current level of 9 M ton C annually used to offset emissions from Article 3.3 was used both for the Gross-Net option and the Net-Net option. We first added any emissions from ARD to the removal from FM and then used the cap or the discount factor on the remaining part of FM.

When we compare the outcome of the different combinations of options it is clear that the importance of changing different factors (or changes in the accounting set up) differ for the Nordic countries. The effect of adding more activities to the current accounting system are discussed in Chapter 6.

5.2. Land-based accounting

The fourth option that is under consideration is to introduce an accounting system that covers all land-areas and pools by using the UNFCCC-format as a base for the LULUCF-accounting.

One reason for a land-based accounting system is that it could be seen as a natural step since it is suggested that the LULUCF-sector will be merged with the Agriculture-sector into the AFOLU-sector according to the IPCC 2006 guidelines. Today, the whole LULUCF-sector is kept apart from the other sectors in the accounting but it may be more difficult to handle certain parts of a sector separately if new guidelines are

adopted. The 2006 guidelines will be considered at the thirtieth session of the SBSTA (June 2009) and it is therefore not yet clear which role they will play in the future reporting and accounting system.

In this case-study, the accounting approaches are based on the current UNFCCC- reporting format. Only land that is considered managed in the reporting is covered.

We have performed calculations on different combinations of options, according to UNFCCC-management. Below we describe some of the combinations:

1. Net-Net accounting of the entire LULUCF-sector using different discount factors for the whole LULUCF UNFCCC-dataset
2. Gross-Net accounting of managed forest land using different discount factors and Net-Net accounting for the rest of the LULUCF UNFCCC-dataset without discount factors
3. Net-Net accounting of Managed Forest land using different discount factors and Net-Net accounting on the rest of the LULUCF UNFCCC-dataset without discount factors

The numerical analysis uses the most recent data reported to the UNFCCC or, if there are certain circumstances to do so, recalculated values sent in from the entity in the country that is responsible for the national inventory. For the Net-Net calculations we use a base period (1990-1994) and the years 2002-2006 serve as a proxy for the commitment period.

Besides the calculation of the net outcome of the LULUCF-sector we have also calculated the relative contribution to each Party's base-year emissions. When we relate the LULUCF sector to the total emissions we can draw more conclusions on how different accounting options affect the incentives to store more carbon.

5.3. Results and discussion

Country	FM	CM	GM	RV	Current cap [M ton CO ₂]	Base year emissions [M ton CO ₂]	Commit- ment [%]
Denmark	Elected	Elected	Elected	-	0.18	70.0	-21%
Finland	Elected	-	-	-	0.59	71.1	0%
Iceland	-	-	-	Elected	0.00	3.4	+10%
Norway	Elected	-	-	-	1.47	49.8	+1%
Sweden	Elected	-	-	-	2.13	72.3	+4%

Before going into the discussion of the results it may be noted that the LULUCF-sector is very different among Parties and even among the Nordic countries. Some of the Nordic countries report large net uptake, whereas others report removals/ emissions that are more or less negligible relative to the total reported emissions from other sectors. In Annex 1 to this report we also present figures illustrating the relative importance of the LULUCF sector to the national total emissions for all Annex I Parties.

Another important observation is that the variations in the removals on Forest land over time are very different between the countries with strong sinks. Besides the quite large fluctuations between years for individual countries, there are also differences in the direction of the trend in the sink. Some countries have a strong increasing trend in the sink whereas others have a decreasing trend mostly because of differences in the harvest level trend.

The difference in the reported totals is also due to the fact that reporting is still not complete. In the analyses we include all pools reported by the countries today. Including more pools (i.e. soil organic carbon), however, may not alter the relative changes over time of the complete LULUCF-sector, since the annual changes of these pools are relatively stable.

Some observations have been made regarding the outcome of the LULUCF-sector (i.e. the effect on the amount of accountable credits or debits) based on the calculations of different options:

- Given the accounting rules, national commitments should be reached in a cost efficient way. It is clear that the studied Parties will usually benefit from their selected activities compared to if they did not select any activities. Most apparent is the effect of the possibility to offset any net emissions from Article 3.3 using the excess of credits from

Article 3.4 FM for countries with large sinks. However, the large climate benefits of these sinks are limited in the accounting by the cap.

- Net-Net accounting credits an increasing sink or a decreasing source, while Gross-Net accounting credits/debits the situation during the commitment period. A change in approach without constraints using a cap or discount factor might heavily influence the volume of credits/debits. This does not necessarily change the incentives for improvements.
- For countries with relatively small and stable sink/ source from FM over time, the effect of shifting from Gross-Net to Net-Net does not influence the outcome very much. If, however, the sink/ source shows a trend or is large, a cap or a discount factor could be used to harmonise commitments between the current and new accounting system but also to (if desired) balance the relative importance of the LULUCF-sector compared to other sectors.
- A large difference in the outcome of a Net-Net approach when using a base period instead of a base year is due to large annual differences in the emissions or removals in the beginning of the analysed period. Changes in removals or emissions for single activities for some Nordic Parties vary up to 60% between years. When Net-Net accounting is used, a base period seems to be more robust than a base year when accounting for removals and emissions from the LULUCF-sector.
- Changing from voluntary to mandatory accounting of FM results in very small changes since most of the Nordic countries have already elected Article 3.4 FM. However, if no Article 3.4 activities were elected at all, the difference is relatively large.
- In a land-based accounting system with a Net-Net approach (without any cap or discount factors) the outcome of the sector could correspond up to almost 40% of the base-year emissions for some of the Nordic countries. This is independent of the size of the sink on Forest land and depends only on the current trend in the removals. On the other hand there are countries where the difference in removals or emissions between the base period and the “commitment period” is negligible.

- The consequence of using a Gross-Net approach instead of Net-Net in a land-based system gives very different effects depending on the specific situation in the Nordic countries. For some countries it makes no difference at all whereas for other countries the difference between a Gross-Net and a Net-Net approach results in an important difference, especially for countries with a relatively small difference in the sink between the beginning and the end of the period. The share of the LULUCF-sector to the total emissions differs as much as up to 40% between a Net-Net and a Gross-Net approach for FM.
- There are no major differences between the outcome of an activity-based approach where all activities are mandatory compared to a land-based approach when using the same accounting method (Gross-Net or Net-Net with or without discount factors).

Since the situation in the LULUCF-sector is very different among Parties, an important part of the discussion (and a reason for different views) may be about how much influence the LULUCF-sector should be given when determining which accounting method should be used. This discussion should be separate from that concerning the need to adjust Forest management to limit the natural and indirect influences on forest growth (climate change, nitrogen deposition and age-class distribution) according to Decision 16/CMP1.

It is apparent that a discount factor could be used to balance the removals/ emissions from FM with the purpose of adjusting the importance of the LULUCF- sector relative to emissions from other sectors and to handle the uncertainties in the estimates of carbon pool changes. The discount factor should however be set in a way so that some incentives to enhance sequestration or to reduce emissions are kept.

One way to assess and to set an appropriate discount factor could be to decide how large the contribution of the LULUCF-sector to the total emissions is allowed to be. Based on that, differentiated discount factors or individual discount factors for each Party could be set. Using them during the commitment period will give more or less credits based on the outcome of the LULUCF-sector. A differentiated discount factor could be used both in an activity based system and in a land-based system.

To illustrate this with an example using a differentiated discount factor for FM, we first assume that the share of LULUCF removals to the

total emissions in the base period (i.e. 1990-1994) have been allowed to be not more than 10% (in absolute terms), that all Article 3.4 activities are included, and that the contribution from Article 3.3 is negligible. Forest management is accounted Gross-Net and the rest of the sector is accounted Net-Net.

In our example we assume that the emissions from other sectors for a specific country are 100 Mton CO₂ and the net removals from LULUCF are 20 Mton CO₂ of which FM constitute a removal of 23 Mton CO₂. To balance the LULUCF-sector in this example we then end up in a discount factor for FM on 0.56. This is the discount factor that this specific country has to use during the commitment period.

This is one example of how to set differentiated discount factors. Calculating differentiated discount factors in this way has the effect that countries with a large LULUCF-share of the total emissions will account less for each extra ton of carbon sequestered than a country with a smaller share. If the share of LULUCF to the total emissions is below 10%, the discount factor could be set to 1. Another way is to use an approach that gives more credits for efforts in the LULUCF-sector to countries that have a larger LULUCF share of the totals.

Using differentiated discount factors will ensure that there are incentives to increase the removals of, and decrease the emissions from, the LULUCF-sector for all Parties without decreasing the incentives in other sectors. The main concern is that both the model to set differentiated discount factors and the ‘weight’ of the sector (the share of the base year emissions) has to be negotiated carefully using relevant historical and current data.

In the annex to this report we present several figures illustrating how LULUCF or parts of LULUCF may influence the national totals for the Annex 1 countries. We have also calculated the share of the cap relative to different parts of the LULUCF-sector and to the national totals. These “indicators” can help in understanding how to resolve the issue with a cap or a fairly set discount factor.

We can see, for example, that the share of the LULUCF-sector to the total emissions are ca 17% on average for all Annex I Parties over the whole reported period (median value 8%), We also note that the average share over the whole reported period of the cap to Forest land emissions/removals is ca 24% (median ca 10%) and 2.5% to the national totals.

Three options to handle natural disturbances are currently under consideration. The first is to not address additional measures for natural disturbances at all. The second is to address natural disturbances by temporarily removing affected areas from accounting, and the third option is to consider further options to address and implement natural disturbances in accounting.

The second option is straight forward, but it can only work if affected areas are known and if natural disturbances can be separated from direct or indirect human induced disturbances. Since natural (as well as indirect human induced) effects may vary from Party to Party it will be difficult to measure and verify the magnitude of these effects. How should we for instance treat a storm-felling where a certain quantity of the effect could be attributed to poor management? The challenges lie mainly in how to do this in a balanced way, also taking into account the resulting impact on the net removals. Temporary exclusion of areas affected by natural disturbances may decrease the incentives of managing land to avoid these disturbances. The third option includes several sub-options to handle natural disturbances.

If the natural and indirect human induced effects are the same in the base year and in the commitment period, the Net-Net accounting approach itself can be used to factor out indirect and non-anthropogenic effects. However, under a changing environment with increasing impacts from climate change, this approach may have limitations.

However, a Net-Net approach is not suitable to factor out large inter-annual fluctuations caused by natural disturbances. Using longer base-periods and commitment periods can improve the possibility of balancing out these effects.

In the accounting approach with a forward looking baseline, natural disturbances are already addressed since known natural disturbances are explicitly withdrawn from the reported figures or from the baseline after the commitment period.

Since many countries use mean values of the changes in carbon pools (i.e. living biomass) over periods of up to 10 years to represent individual years in the reporting, a large part of the natural disturbances from single years are automatically balanced out.

6. Accounting Wetland Restoration

Jón Guðmundsson, Iceland

6.1. Introduction

In the Accra Climate Talks (FCCC/KP/AWG/2008/3), Wetland restoration and degradation was proposed for consideration to be included as a new activity under Article 3.4. This chapter explores the potential of Wetland restoration as a new activity for the next commitment period, additional to the present elective activities under Article 3.4 of the KP. The reason to amend this activity is the relatively high emissions from drained wetlands in some countries and the restoration potential which could decrease the emissions substantially.

6.2. Wetlands and Land use categories

There are currently four voluntary activities under Article 3.4 of the KP (CM, GM, RV and FM). Land under elected Article 3.4 activities cannot leave the reporting during the commitment period. Rules for RV are different since accountable action is not, according to KP definitions, confined to certain land use. RV as practiced in Iceland is either re-vegetating barren or sparsely vegetated land or restoring vegetation on land where vegetation is severely degraded. RV could therefore just as well be defined as the conversion of Other land (the LULUCF category including de-vegetated upland) to Grassland (possibly also to Cropland or Wetland).

Presently, high emissions from drained wetlands in Iceland are reported to the UNFCCC under Grassland as most of the drained wetlands

fall naturally under that category. There is large potential in Iceland to decrease this emission through Wetland restoration. In practice this would involve land use changes converting land currently under other land use (Forest land, Cropland, Grassland) to Wetland.

In theory, Wetland restoration could be included under other eligible activities, as drained wetlands are currently included in other land use categories. If GM is elected, grassland converted to wetland would remain under GM throughout the commitment period according to current KP accounting rules. Likewise by electing FM and CM, forest land and cropland converted to wetland during the commitment period is included in the KP accounting. Electing FM, GM and CM to include Wetland restoration is not straight forward and therefore discourages utilizing the activity to decrease GHG emissions.

Introducing Wetland restoration as a new voluntary activity would therefore give increased incentive to utilize the potential in decreasing emissions from drained organic soils and provide an incentive for Parties to restore and manage wetlands and a disincentive to degrade wetlands.

The elements of Wetland restoration as an activity in a new commitment period could be similar as the other elective activities under Article 3.4 of the Kyoto Protocol. The principles guiding the activity would be those listed in Decision 16/CMP.1, with any possible changes and amendments.

The eligible Article 3.4 activities, CM, GM and RV are Net-Net accounted. Therefore, credits for decreased emission from the elected activities are accounted as the difference between the emissions during the commitment period and the base year. There are no caps or limitations on amounts accountable from these activities.

Under the present accounting rules, eligible activities can be confined to a certain land use category or be independent of land use categories. Due to the physical nature of wetlands one option is that Wetland restoration and degradation follows the same accounting rules as Cropland and Grazing land management, which is confined to an appropriate land use category.

The effects of adding this new activity to Article 3.4 as conversion of land previously under different land use to wetland or vice versa would, according to these definitions, only reflect the drainage of previously undrained wetland and rewetting of a previously drained area. The emis-

sion resulting from land already drained would not be included unless it is already incorporated under other elected activities of Article 3.4.

6.3. Definitions

6.3.1. Wetlands

Wetlands are covered in the IPCC 2006 guidelines where they are defined according to LULUCF accounting:

“Wetlands include any land that is covered or saturated by water for all or part of the year, and does not fall into the, Forest land, Cropland or Grassland categories.” AFOLU ch. 7.1. (IPCC 2006).

“This category includes areas of peat extraction and land that is covered or saturated by water for all or part of the year (e.g., peatlands) and that does not fall into the Forest Land, Cropland, Grassland or Settlements categories. It includes reservoirs as a managed sub-division and natural rivers and lakes as unmanaged sub-divisions.” AFOLU ch. 3.2. (IPCC 2006).

Several options are possible for including Wetland restoration and degradation as a new Article 3.4 activity under current KP accounting rules.

6.3.2. Wetland restoration and degradation

In order to analyse the consequences of introducing Wetland restoration as a new activity, the activity has to be defined in more detail:

Wetland restoration (WR): Human induced activity resulting in transforming managed wetland, including areas presently under another land use category such as forest land, cropland, grassland or settlement, into restored wetland. The unit of land transformed needs to be at least x ha (to be defined) and to be a hydrologically sustainable unit.

Hydrologically sustainable unit of wetland is a unit of wetland that can maintain it self as wetland, once restored, without artificial maintenance of water level by damming, pumping water, flooding, irrigating or other methods.

Wetland degradation (drainage) (WD): Human induced activity changing wetland into managed wetland or other land use including forest land, cropland, grassland or settlement.

6.4. Case study: Icelandic wetlands

Iceland drained many of its lowland wetlands in the 20th century, mostly in order to enhance agricultural production.

Within Iceland, Wetland restoration is an activity with a high potential for reducing emissions reported within the LULUCF sector. This is in part due to the fact that the greater portion of drained wetlands in Iceland have not been altered in other ways than the excavation of ditches, i.e. the soil surface has not been ploughed or sown with non-wetland species. Restoring these sites is in most cases both relatively easy and inexpensive.

This is not necessarily true for the other Nordic countries where a majority of drained wetlands are under intense land management (e.g. forestry, cultivation, peat excavation, etc.) some of which do not lead to high emissions of GHG (e.g. forestry). Additionally, some studies, for example from Finland, have indicated that under certain conditions Wetland restoration does not lead to an overall reduction of emissions.

The network of drained ditches in Iceland has been mapped. The presently reported emission of drained organic soil is based on this mapping. The total length of ditches according to this mapping is 27.140 km applying estimated drainage efficiency (Óskarsson 1998) and the drained area is estimated to be 3.806 km². Emissions reported in 2006 due to this drainage are 1.788,7 Gg CO₂ eq and the bulk of it as organic soil under grassland. This emission can be compared to 4.234,22 Gg CO₂ eq as total emission reported from Iceland, excluding LULUCF.

Studies on restoration of wetlands have shown that blocking drainage ditches and raising water levels can restore the biodiversity and functions of the original wetlands to large extent. The results of a study in Western Iceland specifically looking at the GHG budgets of intact, drained and restored wetlands indicate that with successful Wetland restoration CO₂ and N₂O emissions can be stopped or significantly reduced. The results further showed that the GHG dynamics of the restored site was comparable to that of the intact wetland site. The restored site showed a signifi-

cant increase in CH₄ emission over the drained site, but the overall effect was positive in terms of atmospheric GHG concentrations, due to the reduction in the emission of CO₂ and N₂O.

Clearly, this means that there is high technical mitigation potential in Wetland restoration in Iceland, which could be utilized by providing incentives.

In practice, the real potential for mitigation is probably lower than these figures indicate, as part of the drained and damaged wetlands in Iceland cannot be easily restored. Some of the land is used for habitation and most of it is used for agriculture, croplands and grazing. A possible national programme to restore wetlands in Iceland would most likely focus on neglected and marginally used lands, especially in the beginning. The first phase of a programme would focus on establishing and improving land inventory and methodology for evaluating the effect of Wetland restoration on GHG emissions.

7. Accounting Harvested Wood Products

Kim Pingould, Finland

Harvested wood products (HWP) include all wood materials (including bark) that leave harvest sites. Slash and other material left at harvest sites should be regarded as dead organic matter and not as HWP. Two issues must be solved if the accounting of HWP will be elected to the accounting framework of the AFOLU/ LULUCF sector in the next commitment period: first, a choice must be made on the reporting approach that will be used in the basic reporting under the UNFCCC; second, the accounting approach – giving credits/ debits in the next commitment period(s) – must be agreed upon. The accounting approach would obviously be based on HWP reporting, but the accounting could differ from the full-carbon based reporting of the national HWP pool, mainly because the accounting rules must be balanced with the accounting rules of Articles 3.3 and 3.4 under the Kyoto Protocol in the next commitment period.

7.1 Alternative HWP approaches

The prevailing practice under the UNFCCC is to assume that the carbon stock change in HWP is constant, which means that the HWP pool can be neglected from the carbon balance reporting. Only the carbon balance of forests is reported and this is called the IPCC default approach (Fig. 7.1).

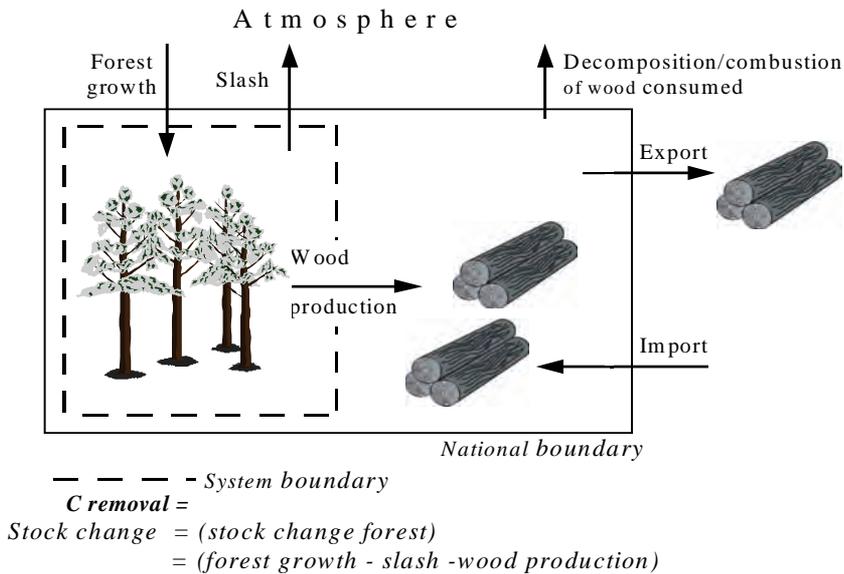


Figure 7.1. The IPCC default approach for forests and HWP. Carbon removal due to HWP = 0. (Lim et al. 1999)

Introducing HWP in the reporting system means that the balance of a new carbon pool, HWP, is included in the UNFCCC/ KP framework within the AFOLU sector. Full carbon reporting of HWP would improve the knowledge about national GHG balances and its inclusion can be justified by this. There have been three basic approaches on the table which describe the full carbon balance of HWP: the Stock-change approach (SCA), Atmospheric-flow approach (AFA) and Production approach (PA) (Lim et al. 1999). The simple decay approach (SD) is a variant of PA giving the same national HWP balance.

In SCA (Fig. 7.2) the HWP stock consists of all products that are within the reporting country regardless of their origin – domestic or imported. Stock changes in forests are accounted for in the wood producing country, whereas stock changes from wood products are accounted for in the consuming country; that is, stock changes are accounted for in the country where and when they occur.

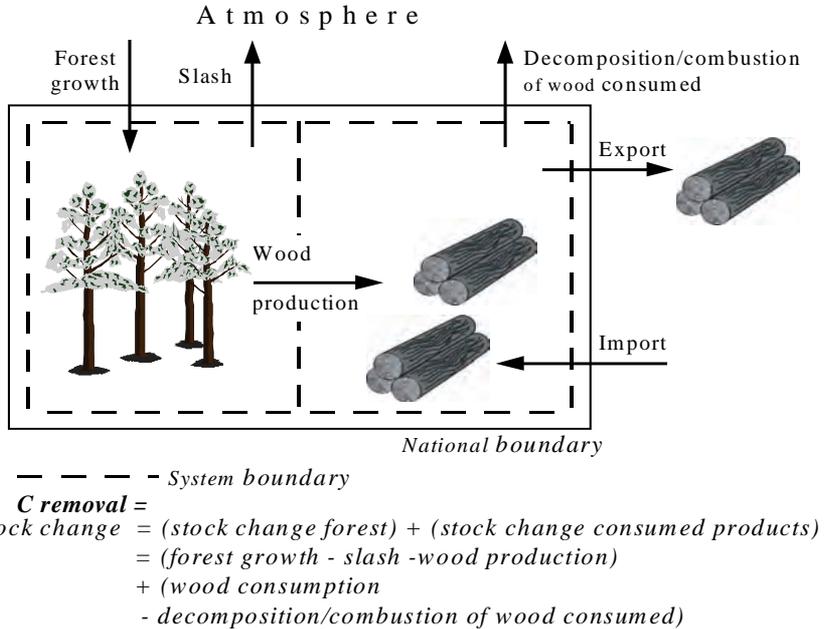
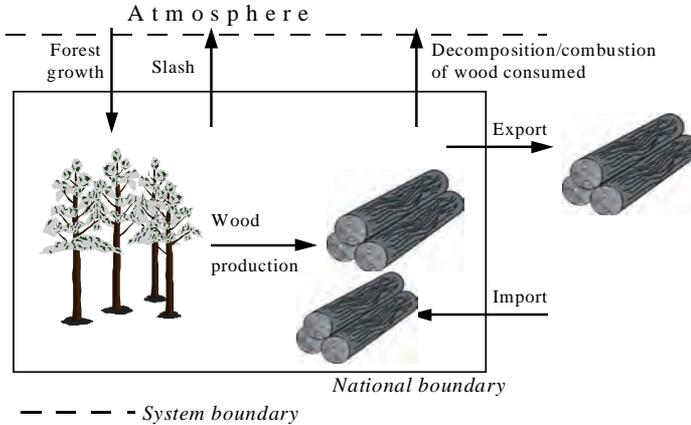


Figure 7.2. The stock change approach for forests and HWP (SCA). C removal due to HWP = stock change consumed products = wood consumption – decomposition/ combustion of wood consumed. (Lim et al. 1999)

AFA estimates the carbon fluxes between the atmosphere and carbon pools of forests and HWP (Fig. 7.3) within national boundaries where and when they occur. Flows to the atmosphere from decay or combustion of roundwood and wood products are accounted for in the consuming country, whereas the uptake from forest growth is accounted for in the producing country. Any carbon flows to the atmosphere from the oxidation or combustion of imported products are accounted for in the inventory of the importing country.



$$C_{\text{removal}} = \text{Atmospheric flow} = \text{forest growth} - \text{slash} - \text{decomposition/combustion of wood consumed} \\ = (\text{stock change forest}) + (\text{stock change consumed products}) + \text{export} - \text{import}.$$

Fig. 7.3: The atmospheric flow approach for forests and HWP (AFA). C removal due to HWP = stock change consumed products + export – import = wood production – decomposition/ combustion of wood consumed. (Lim et al. 1999)

The production approach (Fig. 7.4) also estimates changes in carbon stock in the forest and in the wood products pool. Stock changes derived from forests are accounted for in the producing country. The carbon contained in exported wood products remains accounted for in the carbon stock of the producing country. The production approach estimates changes in stock in forests and wood products; it counts them in the country where the wood was grown. The approach takes into account when but not where stock-changes in wood products actually occur if they are traded. Any carbon stocks that cross a system boundary are not transferred from one country's inventory to another. The exported carbon stocks remain in the inventory of the exporting country. (Lim et al. 1999)

The simple decay (SD) approach is a variant of PA focusing on atmospheric fluxes (= forest growth - slash - decomposition/ combustion of wood grown in country) rather than stock changes, but the removal/ emission to be reported is the same for both of the approaches (see e.g. Pin-goud et al. 2006).

7.2. HWP reporting and its consistency

The 2006 IPCC Guidelines describe a Tier 1 level method to estimate all the variables required for calculating the C balance of HWP by any of the approaches describing the full carbon balance of HWP. The IPCC does not prescribe any of the approaches. However, to be able to estimate the global C balance in HWP correctly, a single approach must be chosen by all Parties. The situation where countries could freely choose their own approach would lead to double-counting or no-counting of emissions from HWP. Adding the emissions to the AFOLU totals could lead to substantial errors in global emission estimates. Thus the primary condition for consistency is that all countries use the same basic approach in reporting HWP under the UNFCCC.

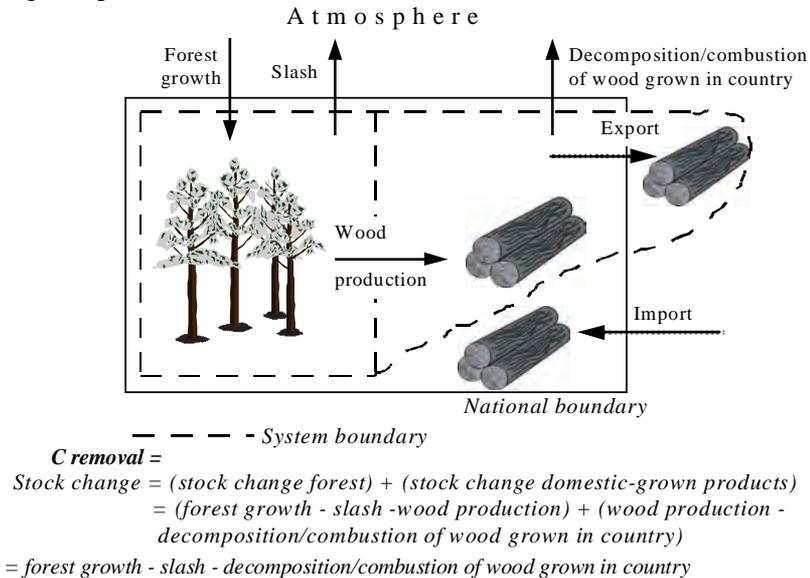


Fig. 7.4. The production (PA) and simple decay (SD) approaches for forests and HWP. C removal due to HWP = stock change domestic-grown products = wood production – decomposition/ combustion of wood grown in country. (Lim et al. 1999)

The secondary consistency condition is how the HWP approach itself fits within the reporting framework under the UNFCCC/ KP and particularly that of the AFOLU sector. In SCA (Fig. 7.2) the system boundary is the same as the national boundary, which is compatible with the basic idea that each country reports what happens within the country and is in prin-

ciple under its own control. As AFA focuses on atmospheric fluxes instead of biomass stock changes, it is in contradiction with the whole reporting system of biomass within AFOLU sector, based on a stock-change philosophy. The choice of AFA would lead to a strange situation, where wood-based biomass and other biomass (e.g. from agriculture) would be treated in a totally different manner. Consequently, the emissions from traded bioenergy products would be allocated to the importing country in the case of wood-based biomass (e.g. from short-rotation forestry) and to the exporting country in the case of non-wood-based biomass. In the PA approach the boundaries of reporting differ from national boundaries. A country would have to report changes in HWP pools in the export markets. Thus it has to report HWP stocks not within its own control. Based on the above, of the approaches based on full carbon reporting, only SCA would fulfill the second consistency criterion.

Furthermore, a choice should be made as to whether HWP in landfills (=solid waste disposal sites =SWDS) should be included within reporting of the AFOLU sector or not. In case HWP in SWDS were included, it could be desirable from the consistency viewpoint of the reporting framework to include reporting of carbon balance of all biomass stocks in SWDS – not just HWP stocks – and to do it under Waste sector reporting. This, however, would not be compatible with the suggested guidelines (IPCC 2006).

As long as HWP are included only in the reporting under the UNFCCC it can be considered that no incentives for HWP are created, because changes in HWP stocks or C balance do not have any impacts on national obligations concerning emission reductions. However, due to substitution benefits there are still some incentives for wood use in the accounting system of the ongoing commitment period, as will be noted in the next section.

7.3. Inclusion of HWP to the accounting system

A feasible accounting approach would not necessarily be identical to any of the approaches suggested by the IPCC (2006). The accounting rules are political, resulting from climate negotiations. They could be designed to create desirable incentives to improve climate and environmental pol-

icy, in addition to being robust and simple enough, rather than just covering all imaginable carbon stocks on the globe. Factors that must be considered when choosing the HWP accounting approach are 1) possible bad or perverse incentives induced by the accounting and its balancing with the accounting rules of forestry, 2) availability and quality of data, and verification and uncertainties of the calculation methods considered in section D.

The incentives of the basic approaches were discussed in Pingoud et al. (2003). In the recent paper by Hashimoto (2008) the incentives of the basic approaches (presented in section A) are analyzed in detail, taking also into account the incentives created by the substitution impacts of wood; i.e. the avoidance of fossil carbon emissions when HWP are used as materials or bioenergy. However, it is not sufficient to analyze just the basic approaches, because we do not know yet to which kind of forest accounting system they are connected and what the accounting rules for HWP would be, if it is potentially not based on full carbon accounting.

Stock-change approach (SCA), being consistent with the basic reporting framework, could possibly create non-desirable incentives:

1. through HWP trade,
 2. with respect to harvest from managed forests (especially Article 3.4 in Kyoto Protocol) or
 3. to waste management practices (if HWP in SWDS were included in accounting).
-
1. Most likely all countries will not be committed to emission reduction targets - including forestry activities - beyond 2012 (“Annex countries and non-Annex countries”). Thus in theory a committed country could create credits by increasing HWP stocks due to imported wood coming from countries without commitments on forests and originating from illegal logging, unsustainable forestry or deforestation. To avoid this kind of carbon leakage in the HWP accounting, SCA could be modified so that all imported products were excluded from for the carbon stock to be accounted for, or alternatively, to include only those imported HWP coming from countries having obligations on

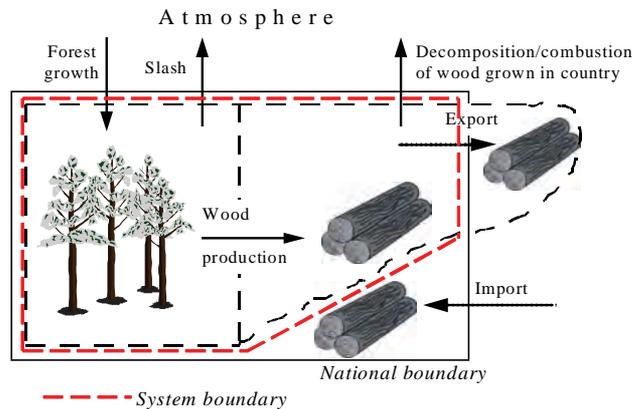
forests (Article 3.4)². The former hybrid approach could be called Stock Change Approach for HWP of domestic origin (SCAD) (Figure 7.5). This approach was originally presented by Cowie et al. (2006) and is consistent with the submission of Tuvalu to the UNFCCC (2008).

2. The post-2012 accounting rules for forestry are not agreed upon yet. HWP accounting could possibly create unfavorable incentives in case it is not balanced with the accounting rules of forestry. Accounting of activities in forestry could include caps (as during the ongoing commitment period) or discounting, which would be another presumable option for the future in a framework based on Gross-Net accounting. In case of capping there is no incentive to sequester carbon in forest biomass above the cap, but on the other hand, there would be a full incentive to sequester carbon in HWP. Would this create unintended incentives due to HWP accounting? If discounting were applied to forestry accounting, only a smaller percentage (e.g. 15%) of the net sequestration into forests would be credited. Then the question arises, “Should sequestration into the HWP pool still be credited on a full carbon basis or should the same discounting factor be applied to HWP as to the forest pool to avoid unfavorable incentives for HWP?” Here it should be noted that only a fraction of harvested wood biomass can ever be sequestered into long-lived products. Thus to avoid unintended incentives (e.g. for forest degradation) there would possibly be no need for crediting of HWP and forest biomass by the same discount factor. Furthermore, during the ongoing commitment period there is asymmetry in crediting of carbon removal of forest under the (mandatory) Article 3.3 with full carbon accounting and (voluntary) Article 3.4 with country-tailored caps for forestry activities. If similar accounting rules are applied in the next commitment period, should this be reflected in the HWP crediting so that HWP and forest ac-

² However, even in the present accounting system (“IPCC default approach”), where the changes of HWP stock is not accounted for, all the biomass trade (wood, agricultural biomass) is carbon neutral. Thus an Annex country can use imported biomass as an emission free source of energy to replace fossil fuels and reduce its national GHG emissions, even if production of this imported biomass would cause high GHG emissions not accounted for in some non-Annex countries. By SCAD this carbon leakage cannot be prevented. In fact this is a more general leakage problem which is also related to international trade of electricity and energy-intensive commodities between Annex and non-Annex countries and cannot be solved through HWP accounting.

counting would be in mutual balance? This could imply that HWP should also be credited with different accounting rules depending on wood origin (in plantations launched after 1990 or in older managed forests), which would be perceived as odd and very impractical. Furthermore, applying a Net-Net approach everywhere in the AFOLU sector could solve this problem, but it would be very difficult to negotiate on any fair country-specific baselines needed in a Net-Net based accounting system.

3. If HWP in SWDS were included in the basic reporting under the UNFCCC, would it be reasonable to have it also within accounting, giving credit for disposal of HWP into SWDS after their useful life? It is against other environmental targets to dispose of organic waste into landfills, as expressed, for example, in the EU waste directive. Should the HWP accounting be compatible with these objectives?



$$\begin{aligned}
 C_{\text{removal}} &= \\
 \text{Stock change} &= (\text{stock change forest}) + (\text{stock change domestic-grown products in domestic use}) \\
 &= (\text{forest growth} - \text{slash} - \text{wood production}) + (\text{wood production} - \\
 &\quad \text{decomposition/combustion of wood grown and in use in country})
 \end{aligned}$$

Figure 7.5. Stock change approach for forests and for HWP produced and consumed domestically (SCAD) C removal due to HWP = stock change domestic-grown products in domestic use = wood production – decomposition/ combustion of wood grown and in use in country. (Cowie et al. 2006, Submission from Tuvalu 2008)

An issue to be negotiated is whether HWP should be a voluntary activity or mandatory in the accounting system. It should be noted that although HWP stock appears to be increasing globally for the time being, HWP stocks are substantially declining in many countries; they could be at least a temporary carbon source in most countries in the future, for instance, in

an economic recession with decreased consumption of long-lived wood products. Could it be possible to elect HWP accounting only if HWP would be a removal, and to cancel this activity when there are risks of emissions?

Furthermore, even the present HWP accounting system, not recognizing changes in HWP stocks, provides incentives to use HWP both as material products and for energy. HWP substituting for emission-intensive materials of fossil fuels is emission-free when imported or coming from domestic harvest (in the case of growth of forest growing stock being above the cap). Simultaneous use of HWP reduces emissions in the Energy and Industrial Processes and Products Use sectors accounted for in the Kyoto Protocol.

7.4. Applicable estimation methods and their uncertainties

The approaches previously discussed define only a framework for estimation. Regardless of the approach we need an estimation method to describe how to obtain removal estimates from available data in practice. The two sets of equations above show that in all the approaches, the removal can be estimated using either an emission angle or a stock change angle as noted by Flugsrud et al. (2001). The two angles are complementary, as all wood consumed goes either to stocks or is emitted to the atmosphere. We have to distinguish between the approaches, which focus on either stocks or emissions in order to assign removals to countries, and the actual estimation methods, which can be based on either stocks or emissions depending on the availability of data (Pingoud et al. 2003).

Let us first consider the carbon pool of HWP in use. There are basically two practicable methods of estimating carbon balance of HWP:

1. *Application of mathematical models using HWP production and trade flows as input data:* Time series on production and trade flows of HWP in different countries of the world are compiled, for example, by the FAO. From these statistics the historical inflow to the HWP pool as a function of time can be estimated. In case there are some reliable estimates on lifetimes and decay patterns of various HWP in different end uses, the carbon balance of the national HWP pool can in principle be es-

timated. In this estimation method a mathematical model is used to integrate the HWP stock as a function of time – based on the historical inflows and outflows of the HWP pool – and to estimate the annual change of the HWP carbon stock. An example of this method is the simple “Tier 1” level calculation tool described in the 2006 IPCC Guidelines (Pinguod et al. 2006). In this model the decay of HWP is assumed to be of first order and only two long-lived HWP stocks – solid wood products (=sawn wood + wood-based panels) and paper products (=paper + paperboard) – are assumed, both with different lifetimes. A similar modeling philosophy could be used to develop more complicated models with more realistic decay patterns and more than two product stocks. Basically this method could be applied to any country from which there is historical activity data to estimate the inflow to the HWP pool. The basic weakness of this method is, however, the uncertainty concerning the lifetime of HWP. By exaggerating the lifetime parameters in the estimation model a country could get extra credits in the HWP accounting.

2. *Direct inventories of HWP stocks:* In this method certain major HWP stocks could be estimated such as the housing stock, based, for example, on knowledge about wood use per square m in various building types. The principal advantage of this method is that it is more robust. No uncertain dynamic calculation models are required whose results are not validated against any real data on HWP stocks. The disadvantage is that the method is very country-specific, applicable only in countries with high level statistics and applicable only to some major HWP stocks. The method has been applied at least in Finland and Norway. Potentially this method could be used in combination with Method 1 to create some more realistic and conservative estimates for the lifetime of HWP. First doing sequential direct inventories and then fitting a mathematical model to them by adjusting the lifetime parameters could be a way to find better lifetime estimates that could possibly be used in other countries too.

The best way of estimating HWP in SWDS would be to rely on waste statistics and use the models that are applied in the Waste sector reporting.

It should be noted that also the approach that will be chosen for the reporting or accounting framework has an impact on the accuracy of the estimation methods. The fact that the system boundaries of the SCA are

the same as the national boundaries makes it more accurate because the available statistics are also country-based. The approaches, where HWP stocks in the export markets (PA, SD) or the origin of HWP in domestic use (PA, SD, SCAD) - from domestic or imported wood - must be estimated, are basically inaccurate. For instance, in the estimation methods very approximate formulas based on the relative share between imported and domestic roundwood have been used to estimate the “domestic” share in the national HWP stock. In addition, when using SCA, direct stock inventories could be applied very easily to validate the uncertain parameters of the HWP model.

7.5. Numerical estimates for some countries

In the following some previous numerical results are presented, where a predecessor of the 2006 IPCC Guidelines calculation tool of HWP, EXPHWP, is used (Pingoud et al. 2003). In the calculations it has been assumed that the average lifetime of solid wood products is 30 years or equivalently that their half-life is 21 years.

The outcomes of the three approaches for some selected countries in Annex B of the Kyoto Protocol are illustrated in Table 7.1. The emissions due to HWP are expressed here as Gg CO₂ and compared to

1. total GHG emissions (in Gg CO₂ equivalent) excluding the Land Use, Land-Use Change and Forestry sector (LULUCF) in the base year 1990 and,
2. emissions from LULUCF, as reported in the national GHG inventories.

If the emission is negative it means a removal or C sink. The numbers were calculated with the EXPHWP model.

Considering first SCA, we see that HWP in use constituted a removal for all the selected countries in 2000, with the highest negative emission in proportion to base year emissions estimated for Austria and Finland. However, the removal estimates by the model appear to vary more or less yearly depending on the HWP consumption. For instance, in Finland, HWP even formed a carbon source in year 1991. Some bias is caused by the fact that trade and consumption of final products are excluded from

the numbers of Table 7.1. The FAO statistics being the basis of the model includes only roundwood and semi-finished HWP. Thus, for instance, furniture manufactured in a country but exported has been counted in the stock change of the producer country. Denmark is an example of such a country. However, according to Table 7.1 stock change in HWP appears to be a quite significant factor in the countries' GHG balance, especially compared to the reduction commitments in Annex B of the Kyoto Protocol (KP). As these are at most 8% of the base year emissions, stock changes in HWP could in theory contribute to a remarkable portion in emission reductions. Note also that in some countries with small forest area, the estimated changes in HWP stocks are much larger than stock changes in LULUCF.

PA appears to be a less favourable approach than the stock change approach for most of the selected countries. One reason for this is the concentration of roundwood production in fewer countries than consumption of HWP, the wood producing and exporting countries taking all the advantage of the growing HWP stocks.

The numbers are most dramatic for AFA. From the results we note that some countries (Finland, Sweden and Canada) have very large removals due to HWP. In the case of Finland, the removal due to HWP would be more than 30% of the total base-year emissions! The numbers become understandable when bearing in mind that the removal = stock change consumed products + net export consists of two terms in which the net export term totally dominates the amount of carbon removal of the previously mentioned exporter countries, giving a huge credit to their national carbon balance.

Table 7.1. Total emissions excluding LULUCF and emissions from LULUCF only for the base year 1990, reported in the national communications under the UNFCCC.

Greenhouse gas emissions	Total without CO ₂ from LULUCF		CO ₂ from LULUCF		Emissions from HWP		Emissions from HWP		Emissions from HWP		
	Base year 1990	Base year 1990	2000	% of total base-yr	Stock change approach	Atmospheric flow approach		Production approach			
						2000	% of total base-yr	2000	% of total base-yr		
Australia	425175	78124	-2061	-0.5%	-3%	-443	-0.1%	-1%	-2117	-0.5%	-3%
Austria	77388	-9215	-3088	-4.0%	34%	-3355	-4.3%	36%	-1835	-2.4%	20%
Belgium	142741	-1600	-1443	-1.0%	90%	1342	0.9%	-84%	-694	-0.5%	43%
Canada	607183	-61498	-9207	-1.5%	15%	-91509	-15.1%	149%	-33848	-5.6%	55%
Denmark	69360	-916	-1892	-2.7%	207%	2286	3.3%	-250%	-106	-0.2%	12%
Finland	77093	-23798	-2381	-3.1%	10%	-23582	-30.6%	99%	-4484	-5.8%	19%
France	559342	-56232	-6707	-1.2%	12%	-2995	-0.5%	5%	-8077	-1.4%	14%
Germany	1222765	-33719	-10844	-0.9%	32%	-6725	-0.6%	20%	-12566	-1.0%	37%
Greece	104895	1441	-591	-0.6%	-41%	1536	1.5%	107%	-52	0.0%	-4%
Ireland	53700	-89	-879	-1.6%	991%	-225	-0.4%	254%	-932	-1.7%	1050%
Italy	520571	-23532	-6529	-1.3%	28%	13733	2.6%	-58%	-1310	-0.3%	6%
Japan	1246724	-83903	-1187	-0.1%	1%	29843	2.4%	-36%	5153	0.4%	-6%
Netherlands	210347	-1422	-966	-0.5%	68%	4792	2.3%	-337%	-458	-0.2%	32%
New Zealand	73161	-21845	-1178	-1.6%	5%	-9383	-12.8%	43%	-4025	-5.5%	18%
Norway	51965	-9765	-720	-1.4%	7%	-1409	-2.7%	14%	-182	-0.4%	2%
Portugal	64948	-3751	-1146	-1.8%	31%	-2690	-4.1%	72%	-660	-1.0%	18%
Spain	286428	-29252	-5512	-1.9%	19%	7848	2.7%	-27%	-1293	-0.5%	4%
Sweden	70566	-20292	-1051	-1.5%	5%	-18397	-26.1%	91%	-2808	-4.0%	14%
UK	919189	-52107	-3434	-0.4%	7%	15068	1.6%	-29%	-3073	-0.3%	6%
USA	6130724	-1097747	-72571	-1.2%	7%	-40302	-0.7%	4%	-46085	-0.8%	4%

The importance of the trade flux term in AFA is illustrated in Table 7.2. $C \text{ removal} = \text{Stock change consumed products} + \text{net export}$ or equivalently $C \text{ emission} = -\text{Stock change consumed products} - \text{net export} = -\text{Stock change consumed products} + \text{net import}$. Net import represents the zero-sum part in AFA. It is the additional emission with respect to the SCA that is added to net importer when using AFA, and the net exporter gets a corresponding additional removal with respect to that in SCA. The net exports of HWP (negative imports in Table 7.2) provide the leading exporter countries with a huge C removal. Finland, Sweden and Canada could in principle take care of all their reduction commitments by exporting HWP, if the AFA were chosen as the accounting framework. On the other hand, significant emissions would be allocated to Denmark, Spain, the Netherlands, Japan, and the UK.

It is important to note that the international trade flows are an order of magnitude larger than the net growth of the HWP stocks, leading to the results presented in Table 7.1. AFA is a kind of zero-sum game between importers and exporters. If HWP would be included in the GHG accounting framework of both the importer and exporter, there would possibly be no advantage for the exporter as there is an incentive to avoid importing HWP, or alternatively the burden from importing HWP would be discounted in their international market price.

Table 7.2. Net imports of HWP in 2000 converted to CO₂ flows and compared to base-yr emissions. Final products such as pre-fabricated houses, furniture, books, etc., are excluded from these numbers. (+ means that the country is net importer, - that it is net exporter).

CO ₂ (Gg/ yr)	Net import 2000	% of base-yr emissions
Australia	1617	0.4%
Austria	-267	-0.3%
Belgium	2785	2.0%
Canada	-82303	-13.6%
Denmark	4179	6.0%
Finland	-21201	-27.5%
France	3712	0.7%
Germany	4118	0.3%
Greece	2127	2.0%
Ireland	654	1.2%
Italy	20262	3.9%
Japan	31029	2.5%
Netherlands	5758	2.7%
New Zealand	-8205	-11.2%
Norway	-689	-1.3%
Portugal	-1544	-2.4%
Spain	13361	4.7%
Sweden	-17346	-24.6%
UK	18501	2.0%
United States	32269	0.5%

8. Discussion

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8.1. The current activity-based accounting system

As background information to the decision of whether or not it could be beneficial to keep the current activity-based accounting system, we have listed some pros and cons of the current system:

- It keeps the continuity in reporting and does not require efforts to build up new systems for reporting for those already using the KP-system.
- The need to negotiate new rules is avoided which could be a strong argument when time is running out around the negotiating table.
- Some incentives are still available through the mandatory accounting of ARD-activities but in principal there are no incentives to take action at the national level in the Nordic countries in the current system since ARD-activities are negligible compared to other activities (i.e. FM).
- In the current system there are some drawbacks such as the use of a cap for FM, which limits the incentives to increase removals in existing forests, and the complex system for reporting and accounting. Changing the cap to a discount factor could, to some extent, increase the incentives. The current accounting system of LULUCF also lacks in comparability with other sectors since only a small part of the actual removals/ emissions from FM are accounted. It should, however, be kept in mind that the fundamentals for other sectors' emissions are different when compared to LULUCF.

8.2. In general about changing to a new accounting system

A new accounting system will influence the total accountable credits or debits of a country. Therefore, if the rules are changed, countries should be allowed to negotiate their commitments in the new agreement in accordance with the new situation. This is probably a prerequisite for fruitful negotiations on finding sound incentives for storing carbon in terrestrial carbon pools and HWP, as well as for dealing with natural disturbances. Without this option countries might focus on their own commitment instead of on the best way to increase incentives to mitigate GHGs.

With the intention of increasing incentives to reduce emissions and increase removals, an accounting system should cover all emissions (including HWP), substitution effects, etc. Considering the global commitment, to make the system efficient, an emitted/ removed unit of GHGs should have the same value independent of origin (it is the fluxes from and to the atmosphere that counts, not the origin of the GHG) and of course all elements should be mandatory. In this regard, no cap or discount factor should be used. All carbon pools and other emissions on all land types should be considered given the same accounting rules.

However, in a multiple criteria decision involving not only climate but also, for example, sustainability, there could be political reasons to value the LULUCF-sector differently from other sectors. This might be valid for terrestrial carbon pools and HWP because they can result in either removals or emissions. From this perspective, a suggestion could be to account carbon pool changes differently from other emissions of GHG. If decision makers want emissions/ removals from carbon pools to be valued differently, it is a delicate matter to decide this value. The synergy between UNFCCC and other conventions such as the Convention on Biological Diversity (CBD) and the Convention to Combating Desertification (UNCCD) might also motivate different treatment of LULUCF as compared to other sectors. Use of a cap or a discount factor is an example of limiting the value of the LULUCF-sector. The magnitude of the fixed cap is crucial for the incentives and the relative discount factor might therefore be an alternative.

From a climate perspective and without considering sustainability, it is very difficult to value emissions/ removals from ARD land differently

from other types of tree covered land as it is today and the restriction to only consider “human induced emissions/ removals” should not be acceptable either. One solution is to consider “human induced” emissions/ removals directly in the accounting system, in order to avoid “market imperfections” within the accounting system. This solution could also be applied to smooth the undesired variation resulting from natural disturbances. Then the natural variation from forest fires and insects attacks should be considered in the accounting as well as the factoring out of indirect climate effects. This would induce incentives to manage the land in order to avoid for example forest fires.

However, a need still exists to reduce the influence of random effects when evaluating the fulfillment of commitments. A simple and quite robust way might be to use some kind of multi-year baseline. Using five-year baselines and commitment periods may be acceptable and thus reporting would reflect the trend rather than annual changes, which is desirable for most Parties.

8.3. Pros and cons for different options in a future accounting system

The following presents some general pros and cons of different options. We have included conclusions that can be drawn from our analysis and more general views.

Gross-Net vs. Net-Net

Currently discussions are based on a change in accounting from Gross-Net to Net-Net for FM (or Forest land in a Land-based approach).

For several countries, there is an effect of changing from Gross-Net accounting of FM to Net-Net accounting, but in general there are no great differences in the enhancement of incentives. There is an increase of up to 1.6% in net removals on the emission budget for all Annex I countries when changing to Net-Net accounting according to FCCC/2008/TP/2, and 19 of 41 countries will gain credits in changing from Gross-Net to unrestricted Net-Net (see Annex 1)

If the cap is removed, both approaches produce an incentive to enhance sequestration to store more carbon.

An advantage of using Gross-Net accounting is that there are no connections to the past, where the uncertainties in the estimates are large. Therefore, more Parties have the possibility to accurately report emissions/ removals using a Gross-Net approach.

Using a Gross-Net approach may lead to accounting for a sink that is gradually diminishing or is to a large extent dependent on indirect or natural disturbances.

General concerns with using a Net-Net accounting approach relate to how forestry has been managed historically. This is a question about equality which to some extent can be balanced using differentiated discount factors, enabling each Party to take action to increase removals and decrease emissions from the LULUCF-sector in relation to their capability to do so. This issues could also be considered in future commitments. In fact changing to Net-Net accounting can transform an actual sink into a calculated source, as well as the other way around.

Other concerns with using a Net-Net approach are (i) that natural disturbances may cause large fluctuations in emissions or removals and (ii) problems associated with calculating base year removals/ emissions. This can, to some extent, be corrected using a base period instead of a base year.

An advantage of using Net-Net accounting is that it is consistent and comparable to other activities under Article 3.4, and to other sectors. However, the comparability issue is very challenging. Caution should be advised when making direct comparisons with Net-Net accounting of “fossil carbon emissions” and, for example, between forestry and agriculture and LULUCF sinks/ emissions. Fundamentals for these two phenomena are different. For instance, a LULUCF sink could be saturating due to natural reasons (e.g. changing age-class distribution in forests), and still remain a sink, but be reported as an emission due to its decreased sink with respect to a historical base-year sink. A forward looking baseline for sinks or tailored national emission-reduction targets could in theory provide a solution, but their agreement would be very challenging in practice.

In general there are no big differences in changing the reporting system to Net-Net accounting, since definitions and methods will be the same.

If Net-Net accounting is applied but refers to the stock (instead of change in stock) in 1990 then this would credit a long term positive trend (stock change should be divided by number of years of the period). This is the same as using a continuous Gross-Net accounting but since the five-year commitment period is ending the whole accounting period, current Gross-Net accounting is a trade-off between crediting an increasing change in stock and recent actions.

Mandatory vs. Voluntary accounting

Given the pros and cons of using Net-Net or Gross-Net accounting for increasing incentives, it seems to be more important whether or not activities are mandatory or voluntary.

According to the current system, only Article 3.3 is mandatory. A reason to keep the other activities (Article 3.4) voluntary was due to the uncertainties related to natural disturbances, methodological problems associated with the quantification of the emissions, and the fact that the possibilities for forest- and agriculture management are very different in different parts of the world.

Mandatory accounting of emissions/ removals from all activities or a land-based approach may lead to a more logical and simplified framework for reporting. This would increase the comparability and transparency of reporting and accounting.

Voluntary accounting of emissions/ removals from certain activities would allow large amounts of human induced carbon fluxes to be kept outside of the system and unaccounted for. However, an advantage is also that the uncertainties of these fluxes are kept out of the system. Mandatory accounting also increases the risk of accounting for pools with large uncertainties whereas voluntary accounting gives the freedom to report pools only where the estimates are more certain.

With mandatory accounting there is no tactical reason to keep activities apart from the accounting and to only account for activities where there is a positive net effect on the total emissions for the Party.

Mandatory accounting leads to increased costs to build up new reporting systems whilst voluntary accounting gives the freedom to prioritise

recourses on a national level. Voluntary accounting also gives freedom to prioritise resources to sources or sinks where the mitigation potential is essential.

Activity based vs. Land-based

The main advantage with a land-based system is that it includes all land-areas. However, there is no obvious difference in the outcome of different accounting approaches. The outcome strongly depends on the specific conditions for the Parties in the reporting years studied.

Another advantage of using a land-based approach as compared to an activity-based approach is that it is consistent with UNFCCC-reporting and could therefore easily be implemented by countries that today only report under the UNFCCC. This will simplify the reporting since the system already exists under UNFCCC.

A land-based approach may enhance the incentives for measures to increase the sink since more of the emissions and removals will be part of the entire accounting system. This could, however, also be achieved with an activity-based system where all activities are mandatory.

The main advantage of keeping the activity-based approach is continuity and the fact that most countries have developed national reporting facilities based on these conditions.

Cap vs. Discount factor

In the current system there are few economic incentives for storing large quantities of carbon by FM. If the FM activity results in a large sink, the possibility of using the credits is limited by the cap. This is even more obvious if the removals from FM are much larger than the cap. The possibility of balancing out any eventual emissions from ARD still gives some incentives to increase the removals by FM.

An adjustment is needed for the removals/emissions from FM due to several uncertainties linked to the activity (e.g. natural variation, uncertain estimates, etc.). An adjustment may also be needed to balance the importance of the sector compared to other sectors, so that the incentives to reduce emissions in other sectors will not be reduced. By using a discount factor, some of the uncertainties and risks are balanced. Sector specific targets are another option to counteract the effects on the incentives.

According to the analysis in FCCC/TP/2008/2, the effect on the amount of carbon available to the system is negligible compared to the current cap when using a discount factor of 0.15.

The possibility of using a discount factor is not dependent on whether the current system (Gross-Net for FM) is kept or if there is a change to another approach, such as accounting FM Net-Net or by using a land-based approach.

Dealing with natural disturbances

If areas, where impacts from natural disturbances are large, are removed from the accounting, the incentives to account for FM (or Forest land) increase. On the other hand, the incentives to deal with the natural disturbances decrease.

The complexity in reporting and accounting will increase. After some years the land areas may be taken in to the system again when the negative effects have diminished. At that moment there may be positive effects that increase the growth (i.e. after a forest fire) that should be adjusted in order to keep the balance in accounting.

If natural disturbances are not explicitly considered there are several more or less simple ways to deal with disturbances which are built into the different accounting concepts. Here some examples:

- One is to apply a base period on a Net-Net approach. This will not have any major effects on the incentives but the relationship to the assigned amount has to be considered.
- A second one is to keep all activities voluntary. However, this means that fluxes are kept outside the system.
- A third one is to use Gross-Net accounting with a discount factor or a cap as done today.

There are also concepts under consideration that are developed to keep the human-induced effects apart from indirect and natural effects. One is the forward looking baseline concept. Since the natural disturbances are balanced out in these concepts, the incentives to deal with them will be reduced.

Adding new activities and pools

Adding new activities such as Wetland restoration will increase the incentives to reduce the emissions from such land. However, considering only restored areas and leaving out the rest of the land may be seen as “cherry-picking” activities.

The advantage of including harvested wood products (HWP) would be to complete the accounting system and to provide additional incentives to use wood. The disadvantage would be an increase of monitoring costs and complexity of the accounting system. The pros and cons must be valued against the magnitude of the accounted emissions/removals associated with HWP stocks. A prerequisite of the inclusion of HWP to the accounting system would be that the basic HWP reporting approach should be first agreed on.

In the present accounting system there are already incentives to use wood due to the substitution benefits. Another issue to be discussed is C leakage due to HWP trade. As long as the emission reduction commitments between the countries differ from each other substantially (e.g. Annex vs. non-Annex countries) there is a risk of leakage. This applies to all trade, not just HWP, and cannot be solved by any of the HWP accounting approaches. Even in the present accounting system, where C stock changes of HWP are neglected, there is an incentive to import wood from potentially unsustainable sources to be used as bioenergy or biomaterials because of the national substitution benefits.

8.4. Summarizing pros and cons

The table below summarizes how different accounting concepts may influence incentives for increasing sinks and decreasing emission and to what extent the concepts may handle natural disturbances. Observe that the evaluation is subjective and not based on empirical data.

Table 8.1. Pros and cons of different accounting concepts (subjectively judged)

Accounting rule	Accounting restriction	Incentives for increasing sinks and decreasing emissions	Handling of natural disturbances with no additional measures
Gross/ Net	No cap or discount factor cap	High	No ¹
	Discount factor	Low ²	Partly ²
Net/ Net	No cap or discount factor cap	Medium ²	Partly ²
	Discount factor	High	No ³
Activity based	No cap or discount factor cap	Low ²	Partly ³
	Discount factor	Medium ²	Partly ³
Land-based	No cap or discount factor cap	High ⁴	Partly ⁵
	Discount factor	Low ^{2,4}	Partly ^{2,5}
Mandatory 3.4	No cap or discount factor cap	Medium ^{2,4}	Partly ^{2,5}
	Discount factor	High	No
Voluntary 3.4	No cap or discount factor cap	Low ²	Partly ²
	Discount factor	Medium ²	Partly ²
Additional activities		Yes	No ⁶
HWP		Yes ⁸	Partly ⁹

¹A long accounting period would average out natural disturbances.;

²Depends on the level of the cap/ discount factor;

³May average out natural variation if such variation correlated to base year;

⁴Incentives only for activities and not for areas left out;

⁵Possible to exclude areas where Natural disturbances occur;

⁶Additional measures needed to handle natural disturbances;

⁷Incentives only for elected activities and incentives reduced when activities are left out;

⁸The completeness of the accounting will also be improved;

⁹A large proportion of the biomass can be used as timber or for energy generation after storms, forest fires and insect attacks. The natural disturbances would decrease carbon pools in living biomass but could increase the stocks in the HWP-pool.

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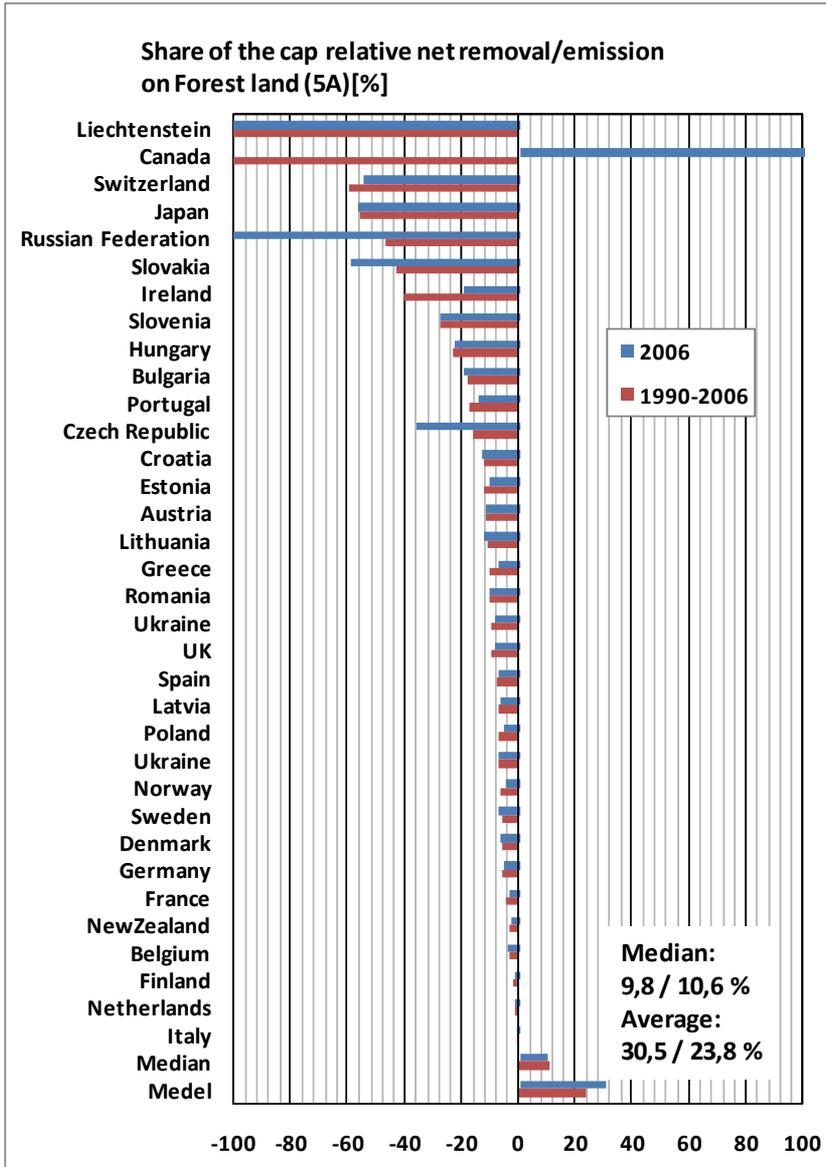
Submission from Tuvalu. United Nations Framework Convention on Climate Change. Views and information on the means to achieve

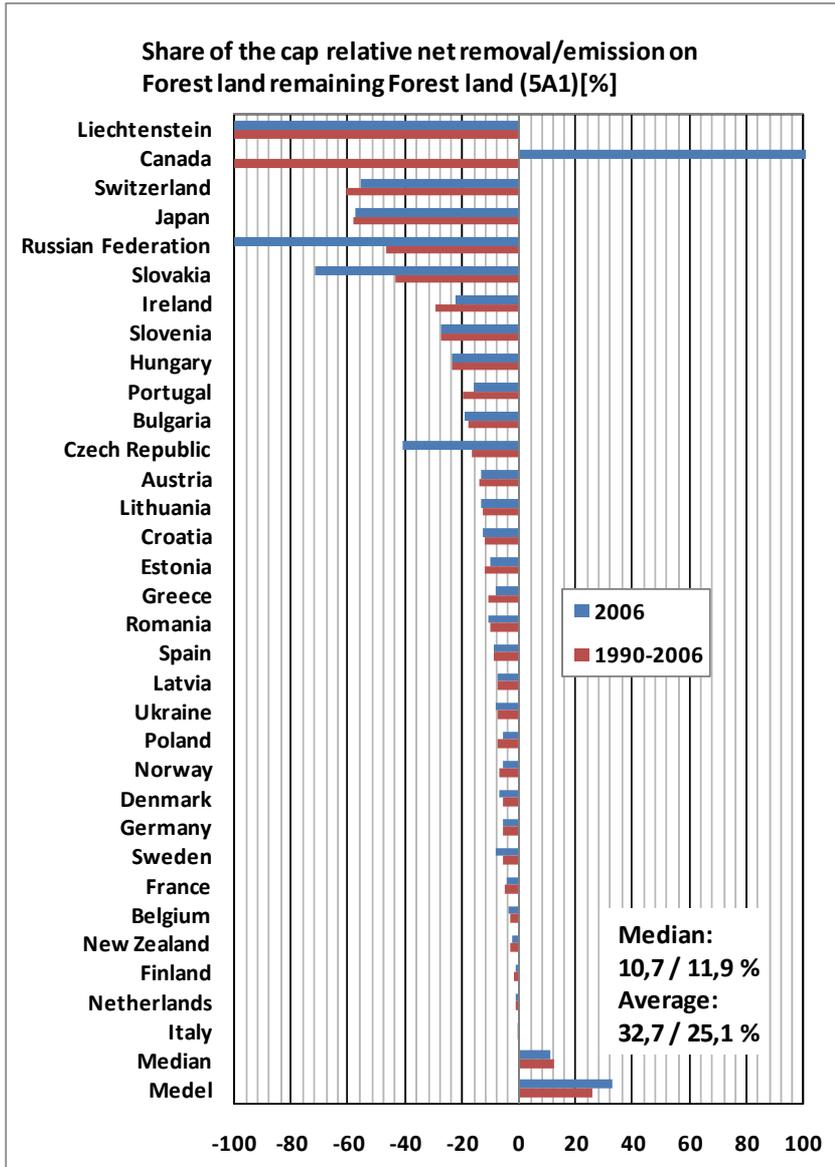
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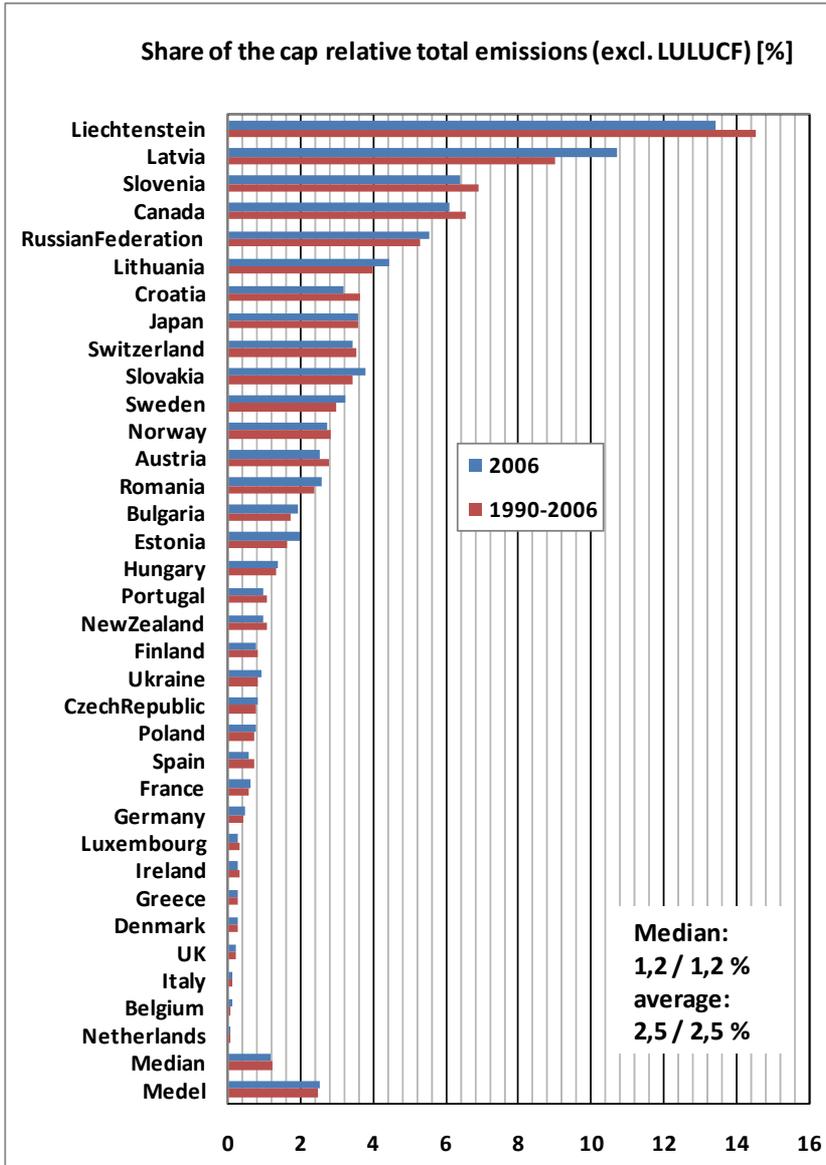
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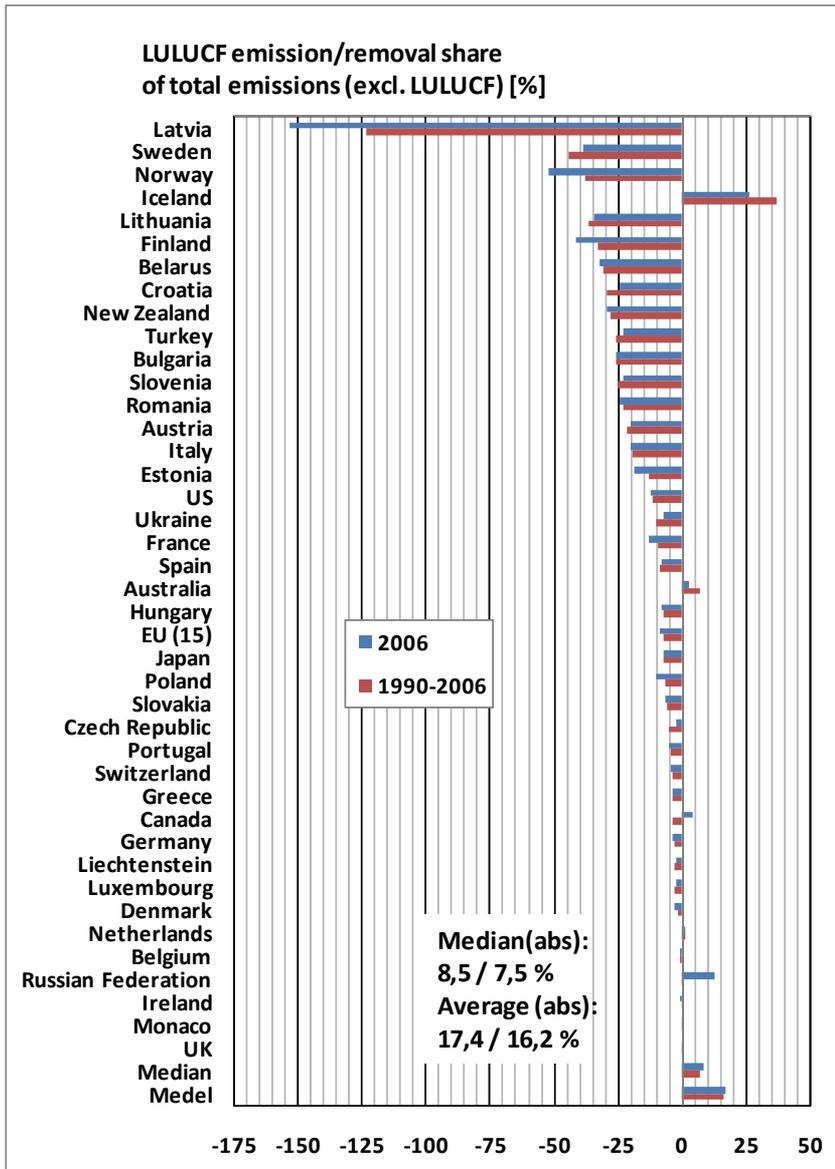
Annex 1

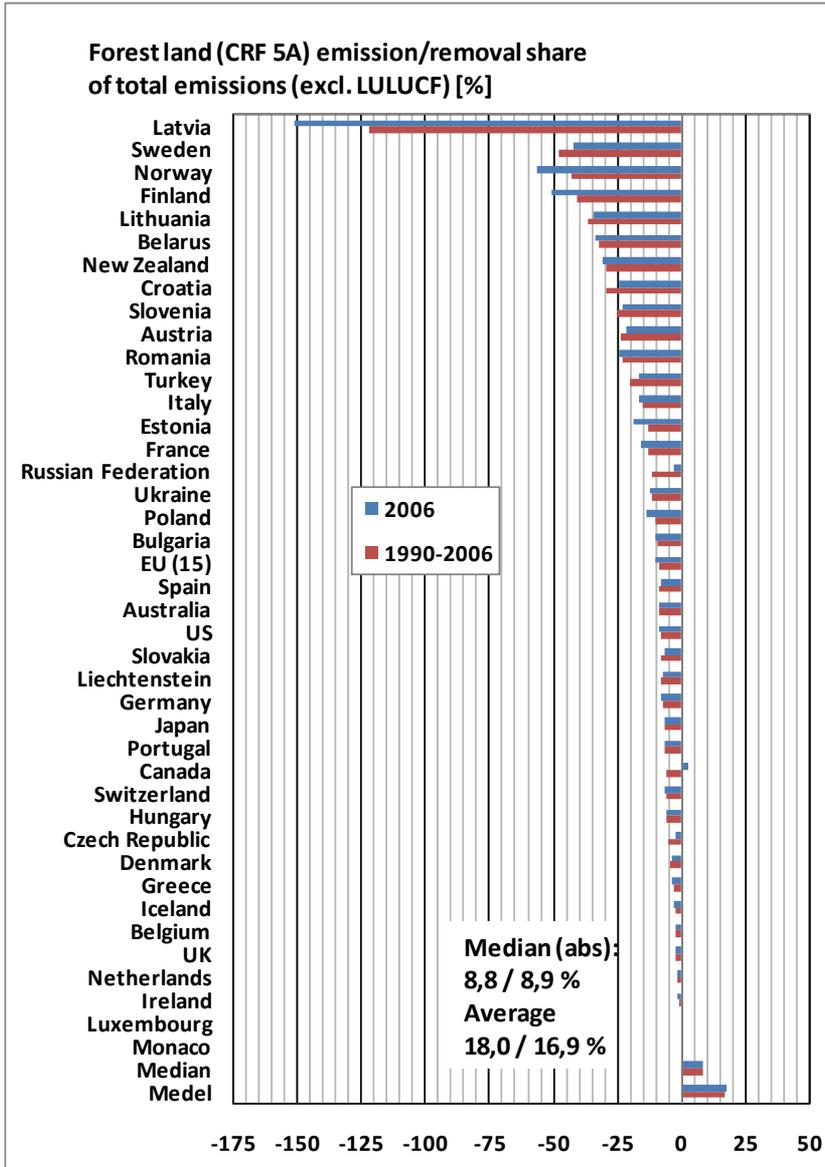
Indicators to be used in the discussion on how to balance FM compared to other sectors. The figures below are based on calculations of different relationships between removals of CO₂ and GHG emissions at different levels of aggregation. All data except for Sweden have been collected at the UNFCCC website for GHG-data. We also present tables regarding the completeness of reporting according to the UNFCCC-reporting obligations (partly compiled in the Mascaref project).

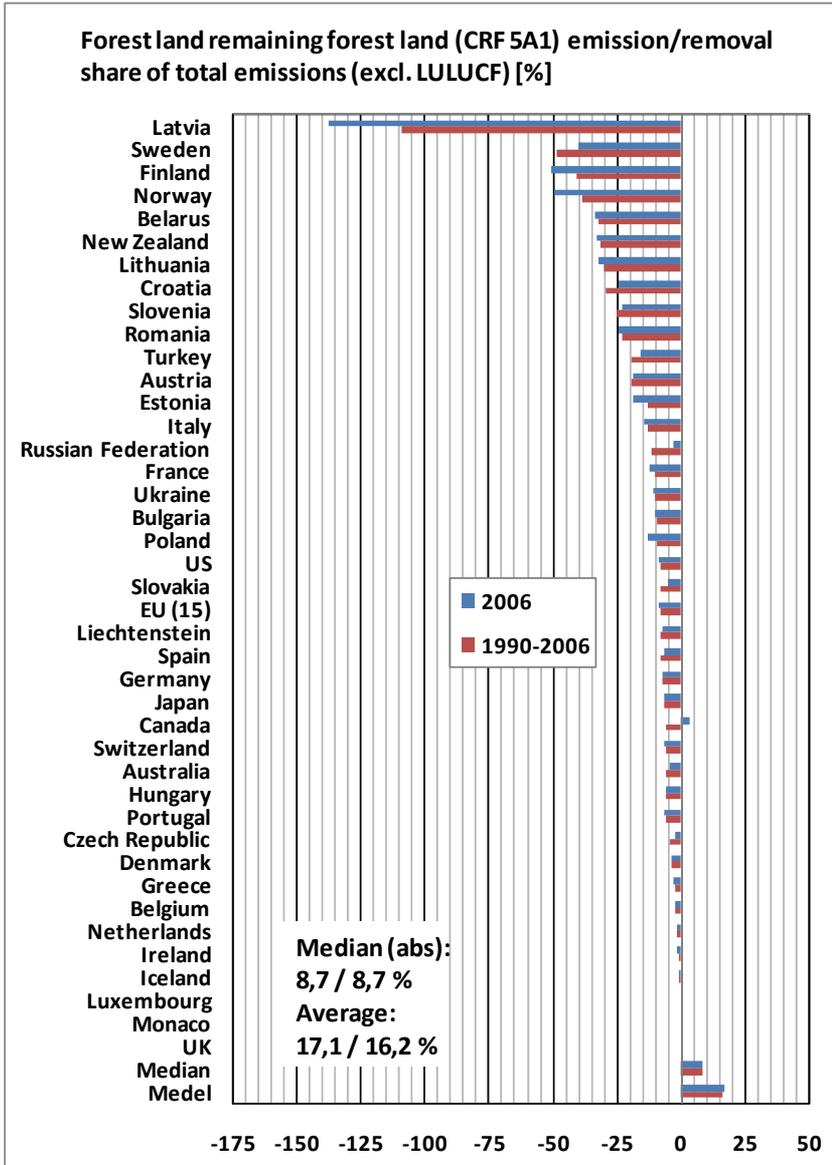












	Forest land		Cropland		Grassland		Wetland		Settlement		Other land	
	5 A1	5 A2	5 B1	5 B2	5 C1	5 C2	5 D1	5 D2	5 E1	5 E2	5 F1	5 F2
	FL-FL	L-FL	CL-CL	L-CL	GL-GL	L-GL	WL-WL	L-WL	S-S	L-S	OL-OL	L-OL
Australia												
Austria												
Belarus												
Belgium												
Bulgaria												
Canada												
Croatia												
Czech Republic												
Denmark												
Estonia												
Finland												
France												
Germany												
Greece												
Hungary												
Iceland												
Ireland												
Italy												
Japan												
Latvia												
Liechtenstein												
Lithuania												
Luxembourg												
Monaco												
Netherlands												
New Zealand												
Norway												
Poland												
Portugal												
Romania												
Russia												
Slovakia												
Slovenia												
Spain												
Sweden												
Switzerland												
Turkey												
Ukraine												
UK												
US												

Completeness of reporting land use categories. Partly from the Mascaref project.

Member State	Reporting category															
	Forest land								Cropland				Grassland			
	5.A.1				5.A.2				5.B.1		5.B.2		5.C.1		5.C.2	
	B	DOM	Min Soil	Org Soil	B	DOM	Min Soil	Org Soil	B	DOM	Min Soil	Org Soil	B	DOM	Min Soil	Org Soil
Austria																
Belgium																
Bulgaria																
Czech Rep.																
Denmark																
Estonia																
Finland																
France																
Germany																
Greece																
Hungary																
Ireland																
Italy																
Latvia																
Lithuania																
Netherlands																
Poland																
Portugal																
Romania																
Slovakia																
Slovenia																
Spain																
Sweden																
UK (GB)																

Completeness of reporting carbon pools. From the Mascaref project.