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UNITED NATIONS FRAMEWORK CONVENTION ON CLIMATE CHANGE

SUBSIDIARY BODY FOR SCIENTIFIC AND TECHNOLOGICAL ADVICE
Thirteenth session
Lyon, 11-15 September 2000
Item 9 (a) of the provisional agenda

METHODOLOGICAL ISSUES

LAND-USE, LAND-USE CHANGE AND FORESTRY

Submissions from Parties

Note by the secretariat

1. At its eleventh session, the Subsidiary Body for Scientific and Technological Advice (SBSTA) requested Parties to provide submissions by 1 August 2000 with views, or proposals for definitions, on activities under Article 3.3 of the Kyoto Protocol, and on how and which human-induced activities will be included under Article 3.4 of the Kyoto Protocol, and on modalities, rules, and guidelines related to these activities, which may include any linkages to other relevant paragraphs of Article 3 of the Kyoto Protocol, and any relevant information on these activities. In addition, Annex I Parties were requested to included national data and information as specified in the first sentence of Article 3.4 of the Kyoto Protocol, on the methodologies that each Party intends to use to measure and report on net changes in greenhouse gas emissions by sources and removals by sinks resulting from activities under Article 3.3 and 3.4 of the Kyoto Protocol, and an assessment of such changes resulting from the proposed activities (FCCC/SBSTA/1999/14, para. 46 (g) and (i)).

2. At its twelfth session, the Subsidiary Body for Scientific and Technological Advice agreed to a format for the submission of the country-specific data and information by Annex I Parties called for by the SBSTA at its eleventh session. In their submissions, Annex I Parties should complete those portions of tables I and III that directly relate to their preferred proposals mentioned in paragraph 1 above. Furthermore, Annex I Parties may provide data and information in relation to other options using tables I and III. The SBSTA requested Parties, in preparing the above-mentioned submissions, to provide textual proposals on Article 3.3, 3.4 and 3.7, and explanatory material to provide the context and rationale of these textual proposals (FCCC/SBSTA/2000/5, para. 32 (d) and (e)).

3. The secretariat has received a total of 15 submissions.[*] For technical reasons, these submissions are being issued in two documents, FCCC/SBSTA/2000/MISC.6 containing the submissions of Australia, Bolivia, Canada, Chile, Costa Rica and France on behalf of the European Community and its member States, and FCCC/SBSTA/2000/MISC.6/Add.1 containing the submissions of Iceland, Indonesia, Japan, New Zealand, Norway, Poland, the Russian Federation, Switzerland and the United States of America. The submissions are presented in alphabetical order and, in accordance with the procedures for miscellaneous documents, are reproduced in the language in which they were received and without formal editing.

[*] In order to make these submissions available on electronic systems, including the World Wide Web, these contributions have been electronically scanned and/or retyped. The secretariat has made every effort to ensure the correct reproduction of the texts submitted.

CONTENTS

PAPER NO. 1: AUSTRALIA

IMPLEMENTATION OF ARTICLES 3.3 AND 3.4 OF THE KYOTO PROTOCOL

Textual Proposal

I. PROPOSED DEFINITIONS AND ACCOUNTING APPROACHES RELATED TO AFFORESTATION, REFORESTATION AND DEFORESTATION UNDER ARTICLE 3.3

Definition of a forest
There is no requirement for a definition of a forest for the purpose of implementing Article 3.3.

Afforestation, reforestation and deforestation
Afforestation is defined as the direct human induced establishment of new forests (trees and woody vegetation) on lands which historically have not contained forests. New forests established by afforestation must cover a minimum area of 1 hectare with a minimum stand width of 10 metres. Potential canopy cover at maturity under current management practices is not less than 20%.

Reforestation is defined as the direct human induced establishment of forests (trees and woody vegetation) on lands which historically have previously contained forests but which have been converted to some other use. Prior to reforestation, the land must have been under some non-forest use for a period of not less than 5 years. New forests established by reforestation must cover a minimum area of 1 hectare with a minimum stand width of 10 metres. Potential canopy cover at maturity under current management practices is not less than 20%.

To be directly human induced, afforestation and reforestation must result from a deliberate human action or intervention.

Establishment includes all deliberate human induced activities to establish trees including: direct planting, artificial seeding, site preparation (fire or mechanical) and protective fencing.

Deforestation will be accounted when the proportion of canopy cover per hectare on a given area of forested land (land with trees and woody vegetation) is reduced by 30% or more through forest conversion as a result of direct human induced removal of trees.

Deforestation is defined as direct human induced forest conversion which is frequently accompanied by burning. This does not include harvesting or other practices which occur as part of ongoing commercial forestry.

Forest conversion means the transition of forested land to non-forested land as a result of direct human induced removal of trees.
For the purposes of accounting for deforestation under Article 3.3, Parties shall determine canopy cover for each forested area within their borders to be accounted for on the basis of a minimum area of 1 hectare with a minimum stand width of 10 metres.

To be directly human induced, deforestation must result from a deliberate human action or intervention.

Carbon Accounting for Article 3.3 activities
Parties are required to account for changes in greenhouse gas emissions that occur during the commitment period on areas of land where afforestation, reforestation and deforestation have taken

place, commencing either in 1990 or in a year subsequent to 1990 but before the end of the commitment period.

Changes in greenhouse gas emissions and carbon stocks as a result of human induced and natural effects (including inter alia commercial forestry, fire, pest invasion, CO_2 and nitrogen fertilisation) during the commitment period shall be accounted for on those areas of land where human induced afforestation, reforestation and deforestation since 1990 have taken place.

To measure changes in carbon stocks, relevant carbon pools shall include above ground biomass, litter and woody debris, below ground biomass, soil carbon and harvested materials. The methodologies for accounting for harvested wood shall be those given in the 1996 IPCC Revised Inventory Guidelines as required by Article 5.2.

Accounting methodologies shall be developed and agreed by the COP to ensure that changes in emissions for non-carbon dioxide gases (methane and nitrous oxide) are accounted for.[1]

Changes in greenhouse gas emissions and carbon stocks on areas of land where human induced afforestation, reforestation and deforestation since 1990 have taken place must be accounted for over contiguous commitment periods.

Accounting sub-rules for Article 3.3 activities

Sub-rule 1

Credits (for sequestration) calculated at the stand level from reforestation following deforestation will be awarded only to the extent that carbon stocks have increased above levels present before the deforestation event took place.

Sub-rule 2

Debits (emissions) calculated at the stand level from harvesting and other natural and human induced effects following afforestation and reforestation will not be greater than credits earned from sequestration.

Carbon accounting baselines for Article 3.3 activities

The adjustment to a Party's assigned amount shall be equal to verifiable changes in carbon stocks and greenhouse gas emissions during the period 2008 to 2012 resulting from direct human induced activities of afforestation, reforestation and deforestation since 1 January 1990. Where the result of this calculation is a net sink, this value shall be added to the Party's assigned amount. Where the result of this calculation is a net emission, this value shall be subtracted from the Party's assigned amount.[2]

This means Parties shall calculate changes in carbon stocks by comparing the carbon stocks in 2012 with the carbon stocks in 2008.

II HOW AND WHICH ADDITIONAL HUMAN INDUCED ACTIVITIES MIGHT BE INCLUDED UNDER ARTICLE 3.4 INCLUDING MODALITIES, RULES AND GUIDELINES RELATED TO THESE ACTIVITIES AND THEIR ACCOUNTING

Selection of additional activities

Changes in greenhouse gas emissions from agreed specific additional activities in the agricultural soils, land use change and forestry categories may be added to or subtracted from a Party's assigned amount if that Party can demonstrate in its reporting under Article 3.4 that the specific activity is

[1] The SBSTA should invite the IPCC to develop such accounting methodologies as part of the IPCC work on methodologies on LULUCF as requested in the SBSTA 10 conclusions.

[2] As per COP decision 9/CP.4

human induced, can be measured in a transparent fashion, is verifiable, is in line with that Party's sustainable management objectives and, for the first commitment period, that the specific activity has occurred since 1990.

Revegetation shall be included as an additional activity in the forest category for the first and subsequent commitment periods.

Revegetation is defined as the human induced establishment of woody vegetation that covers a minimum area of 0.5 hectare with a minimum width in any direction of 10 metres and does not meet the definitions of afforestation or reforestation under Article 3. Eligible revegetation activities include:

- *the establishment of woody vegetation to address sustainable land management;*
- *windbreaks and shelterbelts;*
- *environmental plantings or fencing off areas of native vegetation;*
- *agroforestry planting of trees or the development of new tree crop products such as tea tree oil to encourage a more diversified and sustainable production system that leads to social, economic and environmental benefits for land users; and*
- *changes in stock management practices to encourage regeneration of vegetation.*

If agreed by the COP, further specific additional activities in the agricultural soils, land use change and forestry categories may be included under Article 3.4 for the first commitment period

Accounting for Article 3.4 activities

Parties may account for changes in greenhouse gas emissions to be added to or subtracted from their assigned amounts on areas of land where agreed specific human induced additional activities in the agricultural soils, land use change and forestry categories have taken place, either in 1990 or in a year subsequent to 1990 but before the end of the commitment period.

Changes in carbon stocks and/or emissions as a result of human induced and natural effects (including inter alia commercial forestry, fire, pest invasion, CO_2 and nitrogen fertilisation) shall be accounted for on areas of land where agreed specific human induced additional activities in the agricultural soils, land use change and forestry categories have taken place, either in 1990 or in a year subsequent to 1990 but before the end of the commitment period.

For some additional activities in the agricultural soils land use change and forestry categories under Article 3.4, accounting methodologies will need to be elaborated. This elaboration of methodologies shall ensure that changes in greenhouse gas emissions for non-carbon dioxide gases (methane and nitrous oxide) are accounted for.[3]

Methodologies shall also be elaborated to ensure that changes in greenhouse gas emissions from additional activities in the agricultural soils, land use change and forestry categories are not also credited or debited in accounting for Parties assigned amounts under Article 3.1.

Changes in greenhouse gas emissions and carbon stocks on areas of land where eligible additional activities have taken place on or since 1990 must be accounted for over contiguous commitment periods.

[3] The SBSTA should invite the IPCC to develop such accounting methodologies as part of the IPCC work on methodologies on LULUCF as requested in the SBSTA 10 conclusions.

III METHODOLOGIES FOR ACCOUNTING AND REPORTING IN RELATION TO ARTICLE 3.3 AND 3.4

Methodologies

Methodologies for measuring and reporting on changes in emissions and/or carbon stocks for eligible LULUCF activities under Articles 3.3 and 3.4 shall be in line with requirements of Articles 5, 7 and 8 of the Kyoto Protocol.

Elaboration of methodologies for the implementation of Articles 3.3 and 3.4 shall take into account the methodological work of the IPCC[4], and should extend good practice guidance to land use, land use change and forestry activities including methodologies to ensure that measurement uncertainty is taken into account.

IV OVERALL ACCOUNTING APPROACHES IN RELATION TO THE REQUIREMENTS OF ARTICLES 3.3, 3.4 AND 3.7, REVERSIBILITY, NATURAL EFFECTS AND ACCOUNTING INTERLINKAGES

Overall accounting approaches for Article 3.3 and 3.4

Parties are required to account for changes in greenhouse gas emissions that occur during the first commitment period on areas of land where eligible land use, land use change and forestry activities have taken place, commencing either in 1990 or in a year subsequent to 1990 but before the end of the commitment period.

For Article 3.3, eligible activities are direct human induced afforestation, reforestation and deforestation that have taken place in 1990 or in a year subsequent to 1990 but before the end of the commitment period. (Definitions for afforestation, reforestation and deforestation shall be as provided in this submission (see section below)). To be directly human induced, afforestation, reforestation and deforestation must result from a deliberate human action or intervention.

For Article 3.4, for the first commitment period, eligible activities are specific, human induced activities in the agricultural soils, land use change and forestry categories, that have taken place in 1990 or in a year subsequent to 1990 but before the end of the commitment period. (Definitions for additional activities shall be as provided in this submission (see section below)). To be human induced, an additional activity must result from a process that includes a deliberate human action or intervention.

For eligible Article 3.3 and 3.4 activities in the first commitment period, since 1990 means on or since 1 January 1990 and the end of the commitment period means up to and including 31 December 2012.

An area of land shall be subject to accounting for changes in emissions and/or carbon stocks if it is subject to an eligible activity under Article 3.3 or 3.4. Any changes in carbon stocks and/or greenhouse gas emissions resulting from subsequent eligible LULUCF activities introduced on that specific area of land during the commitment period shall also be accounted for.

Changes in greenhouse gas emissions and/or carbon stocks on areas of land where direct human induced afforestation, reforestation and deforestation and agreed human induced specific additional activities in the agricultural soils, land use change and forestry categories occurred since 1990 must be accounted for over contiguous commitment periods.

For Article 3.3 carbon dioxide emissions are to be measured as changes in carbon stocks by comparing the carbon stocks in 2012 with the carbon stocks in 2008. In the event that an activity commences during the commitment period, the changes in carbon stocks are to be measured by

[4] As requested by the Subsidiary Body for Scientific and Technological Advice at its 10th session.

reference to the carbon stocks at the start year. Changes in emissions for non-carbon dioxide gases (methane and nitrous oxide) shall also be accounted for.[5]

To measure carbon dioxide, relevant carbon pools shall include above ground biomass, litter and woody debris, below ground biomass, soil carbon and harvested materials. The methodologies for accounting for harvested wood shall be those given in the 1996 IPCC Revised Inventory Guidelines as required by Article 5.2.

For forestry activities under Article 3.3, the following accounting sub-rules shall be applied:[6]

Credits (for sequestration) calculated at the stand level from reforestation following deforestation will be awarded only to the extent that carbon stocks have increased above levels present before the deforestation event took place.

Debits (emissions) calculated at the stand level from harvesting and other natural and human induced effects following afforestation and reforestation will not be greater than credits earned from sequestration.

For some additional activities in the agricultural soils, land use change and forestry categories under Article 3.4, accounting methodologies will need to be elaborated. This elaboration of methodologies shall ensure that changes in emissions for non-carbon dioxide gases (methane and nitrous oxide) are accounted for.[7]

Methodologies shall also be elaborated to ensure that changes in emissions from additional activities in the agricultural soils, land use change and forestry categories are not also credited or debited in accounting for Parties' assigned amounts under Article 3.1[8]

Changes in carbon stocks and greenhouse gas emissions as a result of human induced and natural processes (including inter alia commercial forestry, fire, pest invasion, El Nino cycles, CO_2 and nitrogen fertilisation) during the commitment period shall be accounted for on each area of land where an eligible activity has taken place.

Reversibility

Changes in greenhouse gas emissions and carbon stocks on areas of land where human induced afforestation, reforestation and deforestation since 1990 or additional activities agreed under Article 3.4 have taken place must be accounted for over contiguous commitment periods. This means Parties shall account for any reversibility of sequestration or emissions reductions from eligible LULUCF activities under Articles 3.3 and 3.4 during commitment periods and over contiguous commitment periods.

Natural effects

Parties are required to account for all changes in greenhouse gas emissions and/or carbon stocks, including those that result from natural effects, that occur during the commitment period on areas of land where eligible land use, land use change and forestry activities have taken place.

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[5] The SBSTA should invite the IPCC to develop such accounting methodologies as part of the IPCC work on methodologies on LULUCF as requested in the SBSTA 10 conclusions.

[6] Explanatory text on the accounting sub rules for Article 3.3 activities can be found in Section II.

[7] The SBSTA should invite the IPCC to develop such accounting methodologies as part of the IPCC work on methodologies on LULUCF as requested in the SBSTA 10 conclusions.

[8] ibid

Accounting interlinkages - Article 3.7

Parties with a net source of emissions from land use change and forestry in 1990 shall include in the calculation of their 1990 baseline emissions from land use change. Emissions from land use change are defined only as net emissions from the forest and grassland conversion and abandonment of managed lands sub-categories as laid out in the 1996 Revised IPCC Inventory Guidelines[9].

[9] IPCC Guidelines for National Greenhouse Gas Inventories, Greenhouse Gas Inventory Reference Manual Vol 3, Section 5.2.

IMPLEMENTATION OF
ARTICLES 3.3 AND 3.4 OF THE KYOTO PROTOCOL

Summary

- The principles and relevant provisions of the UNFCCC and the Kyoto Protocol recognise the need to enhance and preserve sinks (land use, land use change and forestry activities (LULUCF)).
- Inclusion of sinks gives individual Parties greater flexibility to take action in a way that reflects their national circumstances, and improves the environmental effectiveness of the Kyoto Protocol.
- Sinks can contribute to reducing atmospheric greenhouse gas concentrations while also providing other environmental benefits by addressing soil degradation (eg. salinity), maintaining biodiversity and enhancing sustainable land management.
- Emissions from LULUCF constitute a significant proportion of Australia's emissions profile.
- COP decision 16/CP.5 established decisions on Article 3.3 and 3.4 as an integral part of the Buenos Aires Plan of Action package of decisions required at the Sixth Conference of the Parties (COP6).
- The IPCC Special Report on LULUCF has furnished Parties with the scientific and technical advice needed for effective and informed decision making on LULUCF at COP6.
- Articles 3.3, 3.4 and 3.7 provide a framework for the implementation of a restricted set of land use, land use change and forestry activities by Annex B Parties to the Kyoto Protocol.
  - Under Article 3.3, LULUCF activities are confined to direct human induced afforestation, reforestation and deforestation since 1990.
  - Article 3.4 establishes a process for Parties to include additional human induced activities in the agricultural soils, land use change and forestry categories. Decisions on Article 3.4 activities since 1990 may apply for the first Kyoto Protocol commitment period and must be applied in subsequent commitment periods.
  - Article 3.7 states that countries with a net source from land use change and forestry in 1990, such as Australia, can include emissions from land use change in the baseline used for calculating their assigned amounts.
- Parties should agree definitions and accounting approaches that will facilitate environmentally robust and cost effective implementation of LULUCF activities already specified in Article 3.3 (afforestation, reforestation and deforestation).
- For the first commitment period, Parties should move towards a more comprehensive treatment of greenhouse sinks by agreeing to definitions and accounting approaches for a further defined set of specific human induced additional LULUCF activities under Article 3.4.
- The key to implementing the LULUCF provisions of Article 3 lies in the development of robust approaches to accounting for changes in greenhouse gas emissions and carbon stocks associated with eligible LULUCF activities.
- When taken together, these accounting approaches and definitions should function as a means to integrate Articles 3.3, 3.4 and 3.7 in a coherent carbon accounting system which will allow key requirements of the Kyoto Protocol to be implemented.
- Such key requirements for LULUCF activities in the first commitment period include:
  - That the activity is directly human induced or human induced;
  - That the activity took place since 1990;
  - That measurement of changes in carbon stock or greenhouse gas emissions as a result of the activity is verifiable and transparent; and
  - That measurement uncertainties are taken into account.

I. OVERALL ACCOUNTING APPROACHES IN RELATION TO THE REQUIREMENTS OF ARTICLES 3.3, 3.4 AND 3.7, REVERSIBILITY, NATURAL EFFECTS AND ACCOUNTING INTERLINKAGES

Explanatory material

- An overarching carbon accounting system will need to provide consistent and robust estimates for LULUCF activities.
  - To the extent possible, given the different requirements of Articles 3.3, 3.4 and 3.7 there should be measurement and accounting consistency across the carbon accounting system.
- The Protocol states that only certain human induced LULUCF activities in Articles 3.3 and 3.4 can be credited or debited against Parties' assigned amounts.
  - This means that full carbon accounting of all terrestrial sinks within a Party's borders is not required for the purposes of implementing Article 3.
- In line with key requirements in Article 3.3 and 3.4, to gain credit or debit for LULUCF activities in the first commitment period, Parties will need to show that changes in greenhouse gas emissions and carbon stocks during the commitment period resulted from a human induced activity which took place since 1990.
- Measurement of changes in emissions and/or carbon stocks will need to be transparent, facilitate verification and take uncertainties into account.
- An accounting approach based on the concept of Article 3.3 and Article 3.4 lands offers the best way to reflect key Article 3.3 and 3.4 requirements.
- The Article 3.3/3.4 lands accounting approach essentially refers to land based accounting which is directly linked to specific, eligible LULUCF activities.

Article 3.3/3.4 lands accounting approach

- Under the Article 3.3/3.4 lands accounting approach, Parties will be required to identify eligible LULUCF activities which will draw a given area of land into the Article 3.3/3.4 accounting system.
  - This will require specification of activities that are eligible under Articles 3.3 and 3.4; and
  - Identification (for the purposes of measurement and reporting) of land units on which these activities occur.
- Accounting for Article 3.3/3.4 lands will commence on those areas of land at the start of the activity.
  - As a general approach, once an area of land moves in to the Article 3.3/3.4 accounting system, then all greenhouse gas emissions or carbon stocks will need to be accounted for.
  - This would include both human induced and natural processes such as fire, pest invasion, harvesting and replanting cycles in commercial forestry, as well as indirect human effects like CO_2 fertilisation.
- The effects of multiple eligible LULUCF activities on greenhouse gas emissions occurring on an individual area of Article 3.3/3.4 land will therefore be accounted for under this approach.
- Once an area of land becomes subject to the Article 3.3/3.4 accounting system, full carbon accounting of relevant carbon pools and measurement of changes of non-CO_2 greenhouse gases (methane and nitrous oxide) on that land will be required.
  - Relevant carbon pools would include above ground biomass, litter and woody debris, below ground biomass, soil carbon and harvested materials.
- Accounting for Article 3.3 and 3.4 lands will be required across contiguous commitment periods under the Kyoto Protocol.
  - This will address incentives to concentrate LULUCF activities that may result in net emissions in time periods not covered by the accounting system.

Measurement methodologies and uncertainty

- Article 5.2 of the Kyoto Protocol establishes the 1996 IPCC Revised Inventory Guidelines as the methodologies for measuring and reporting of greenhouse gases under the Protocol for the first commitment period.
  - In some cases, these Guidelines will require elaboration to deal with the specific requirements of the Kyoto Protocol including for LULUCF activities in Articles 3.3 and 3.4.
- The IPCC work on good practice guidance should be extended to cover LULUCF activities under the Protocol including dealing with uncertainties. This would require development of a set of procedures that would allow Parties to address:
  - The choice of estimation methods appropriate to countries' national circumstances;
  - Quality assurance and quality control at a national level;
  - Quantification of uncertainties; and
  - Requirements for data archiving and reporting to promote transparency and facilitate verification.
- The IPCC Special Report shows that the technical capacity to measure changes in carbon stock and greenhouse gas emissions currently exists among Annex B Parties.
  - Australia is developing a specialised National Carbon Accounting System that will provide robust accounting for all changes in greenhouse gas emissions and/or carbon stocks associated with eligible LULUCF activities.

Reversibility

- The Article 3.3/3.4 lands accounting approach which encompasses ongoing full carbon accounting/measurement of emissions on identified Article 3.3/3.4 land areas across the first and subsequent contiguous commitment periods means that possible reversibility (and variability) of those LULUCF activities at some future time would be identified and accounted for:
  - Possible reversibility of LULUCF activities may arise from human action (eg harvesting under commercial forestry) or natural processes (eg. fire, pest invasion or El Nino cycles).

Natural effects

- Under the Article 3.3/3.4 lands accounting approach, changes in carbon stocks and greenhouse gas emissions resulting from natural effects such as fire, pest invasion and natural climate variability (eg the El Nino cycle) will be accounted for.
  - Changes in carbon stocks resulting from increased CO_2 and nitrogen fertilisation will also be captured under the Article 3.3/3.4 lands accounting approach.
  - These changes in carbon stocks and emissions will result in credits or debits under Parties' assigned amounts.

Linkage with Article 3.7

- Article 3.7 was an important part of the Kyoto Protocol outcome on LULUCF activities.
- Many Annex B countries have mature forests that are declining in sequestration capacity.
  - These Parties would have suffered a detriment if they were required to include the land use change and forestry sector in the calculation of their 1990 baselines and then account for emissions and sequestration from this sector during the commitment period.
- To address this issue, emissions and sequestration from land use change and forestry (LUCF) are excluded from the calculation of most Annex B Parties' assigned amounts - i.e. emissions from LUCF are generally not factored into the calculation of Annex B Parties 1990 emissions baseline.
- However all Annex B Parties can count net sequestration from certain eligible LULUCF activities towards their target commitments under Article 3.3.
- This approach created significant problems for Australia as, unlike most Annex B countries, it had a net source of emissions from LUCF in 1990.

– This means that emissions from LUCF (which includes emissions from land clearing) would not have been factored into the 1990 baseline yet Australia would be debited for these emissions under Article 3.3 during the commitment period.

- Article 3.7 was developed to address only this problem and was not designed to capture emissions from other sectors such as agricultural soils.
- It allows countries with a net source from land use change and forestry in 1990, such as Australia, to include emissions from land use change in the baseline used for calculating their assigned amounts.

Including emissions from land use change in Parties' 1990 baseline

- Under Article 3.7, countries can only include emissions from land use change in their 1990 baselines if they can demonstrate that they have a net source of emissions from the land use change and forestry inventory category in 1990, as laid out in the Revised 1996 IPCC Inventory Guidelines.
- In order to implement Article 3.7, elaboration of the term "land use change" in the second sentence of Article 3.7 is required.
- The meaning of the term land use change in Article 3.7 derives from the Revised 1996 IPCC Inventory Guidelines category *Land Use Change and Forestry* of which two sub-categories are *Forest and Grassland Conversion*, and *Abandonment of Managed Lands*.[1]

– The Guidelines identify these two sub-categories as "categories of land use change" and says land use change has occurred where there is a change in land cover.

- Parties seeking to utilise Article 3.7 are therefore required to show that they had a net source of emissions from LUCF in 1990. Such Parties are then required to include emissions from relevant carbon pools associated with the forest and grassland conversion and abandonment of managed lands sub-categories in the calculation of their 1990 baseline.
- On this basis, emissions occurring in the remaining subsectors *Changes in Forests and Other Woody Biomass Stocks, CO_2 Emissions and Removals from Soils* and *Other* are not included under the term land use change in the calculation of the 1990 baselines via Article 3.7.
- This approach establishes a direct linkage between the terms *deforestation* in Article 3.3 and *land use change* in Article 3.7.
- Article 3.7 cannot be used to include in the calculation of Parties' 1990 baselines greenhouse gas emissions from non-forest land use change such as conversion of pasture to crop lands.
- This means there is no need to address potential double counting that may arise between Article 3.7 and additional activities in the agriculture soils and land use change categories that may be agreed under Article 3.4.

Textual Proposal

Overall accounting approaches for Article 3.3 and 3.4

Parties are required to account for changes in greenhouse gas emissions that occur during the first commitment period on areas of land where eligible land use, land use change and forestry activities have taken place, commencing either in 1990 or in a year subsequent to 1990 but before the end of the commitment period.

For Article 3.3, eligible activities are direct human induced afforestation, reforestation and deforestation that have taken place in 1990 or in a year subsequent to 1990 but before the end of the commitment period. (Definitions for afforestation, reforestation and deforestation shall be as

[1] Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories, Greenhouse Gas Inventory Reference Manual Vol 3, Section 5.2.

provided in this submission (see section below)). To be directly human induced, afforestation, reforestation and deforestation must result from a deliberate human action or intervention.

For Article 3.4, for the first commitment period, eligible activities are specific, human induced activities in the agricultural soils, land use change and forestry categories, that have taken place in 1990 or in a year subsequent to 1990 but before the end of the commitment period. (Definitions for additional activities shall be as provided in this submission (see section below)). To be human induced, an additional activity must result from a process that includes a deliberate human action or intervention.

For eligible Article 3.3 and 3.4 activities in the first commitment period, since 1990 means on or since 1 January 1990 and the end of the commitment period means up to and including 31 December 2012.

An area of land shall be subject to accounting for changes in emissions and/or carbon stocks if it is subject to an eligible activity under Article 3.3 or 3.4. Any changes in carbon stocks and/or greenhouse gas emissions resulting from subsequent eligible LULUCF activities introduced on that specific area of land during the commitment period shall also be accounted for.

Changes in greenhouse gas emissions and/or carbon stocks on areas of land where direct human induced afforestation, reforestation and deforestation and agreed human induced specific additional activities in the agricultural soils, land use change and forestry categories occurred since 1990 must be accounted for over contiguous commitment periods.

For Article 3.3 carbon dioxide emissions are to be measured as changes in carbon stocks by comparing the carbon stocks in 2012 with the carbon stocks in 2008. In the event that an activity commences during the commitment period, the changes in carbon stocks are to be measured by reference to the carbon stocks at the start year. Changes in emissions for non-carbon dioxide gases (methane and nitrous oxide) shall also be accounted for. [2]

To measure carbon dioxide, relevant carbon pools shall include above ground biomass, litter and woody debris, below ground biomass, soil carbon and harvested materials. The methodologies for accounting for harvested wood shall be those given in the 1996 IPCC Revised Inventory Guidelines as required by Article 5.2.

For forestry activities under Article 3.3, the following accounting sub-rules shall be applied: [3]

Credits (for sequestration) calculated at the stand level from reforestation following deforestation will be awarded only to the extent that carbon stocks have increased above levels present before the deforestation event took place.

Debits (emissions) calculated at the stand level from harvesting and other natural and human induced effects following afforestation and reforestation will not be greater than credits earned from sequestration.
For some additional activities in the agricultural soils, land use change and forestry categories under Article 3.4, accounting methodologies will need to be elaborated. This elaboration of methodologies shall ensure that changes in emissions for non-carbon dioxide gases (methane and nitrous oxide) are accounted for. [4]

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[2] The SBSTA should invite the IPCC to develop such accounting methodologies as part of the IPCC work on methodologies on LULUCF as requested in the SBSTA 10 conclusions.
[3] Explanatory text on the accounting sub rules for Article 3.3 activities can be found in Section II.
[4] The SBSTA should invite the IPCC to develop such accounting methodologies as part of the IPCC work on methodologies on LULUCF as requested in the SBSTA 10 conclusions.

Methodologies shall also be elaborated to ensure that changes in emissions from additional activities in the agricultural soils, land use change and forestry categories are not also credited or debited in accounting for Parties' assigned amounts under Article 3.1[5]

Changes in carbon stocks and greenhouse gas emissions as a result of human induced and natural processes (including inter alia commercial forestry, fire, pest invasion, El Nino cycles, CO_2 and nitrogen fertilisation) during the commitment period shall be accounted for on each area of land where an eligible activity has taken place.

Reversibility
Changes in greenhouse gas emissions and carbon stocks on areas of land where human induced afforestation, reforestation and deforestation since 1990 or additional activities agreed under Article 3.4 have taken place must be accounted for over contiguous commitment periods. This means Parties shall account for any reversibility of sequestration or emissions reductions from eligible LULUCF activities under Articles 3.3 and 3.4 during commitment periods and over contiguous commitment periods.

Natural effects
Parties are required to account for all changes in greenhouse gas emissions and/or carbon stocks, including those that result from natural effects, that occur during the commitment period on areas of land where eligible land use, land use change and forestry activities have taken place.

Accounting interlinkages - Article 3.7
Parties with a net source of emissions from land use change and forestry in 1990 shall include in the calculation of their 1990 baseline emissions from land use change. Emissions from land use change are defined only as net emissions from the forest and grassland conversion and abandonment of managed lands sub-categories as laid out in the 1996 Revised IPCC Inventory Guidelines[6].

II. PROPOSED DEFINITIONS AND ACCOUNTING APPROACHES RELATED TO AFFORESTATION, REFORESTATION AND DEFORESTATION UNDER ARTICLE 3.3

Explanatory material

- Credits and debits that can be counted as a result of Article 3.3 activities towards Parties' assigned amounts will be determined on the basis of:
  - Definitions for afforestation, reforestation and deforestation; and
  - The accounting system used for Article 3.3.
- Definitions for afforestation, reforestation and deforestation activities under Article 3.3 should be chosen to support the operation of the overarching carbon accounting system.
- Under the definitional approach outlined below for afforestation, reforestation and deforestation, harvesting which occurs as part of the commercial forestry cycle would not be defined as deforestation. Similarly regeneration following harvesting would not be defined as reforestation.
  - Commercial forestry cycles would not therefore function to draw areas of land into the Article 3.3 accounting framework.
- Under Australia's approach to afforestation, reforestation and deforestation, there is no need for a stand-alone definition of a forest.
- Elements of a definition of a forest needed to operationalise afforestation, reforestation and deforestation have been incorporated into the definitions for afforestation, reforestation and

[5] ibid
[6] IPCC Guidelines for National Greenhouse Gas Inventories, Greenhouse Gas Inventory Reference Manual Vol 3, Section 5.2.

deforestation.

- The advantage of this approach is that it simplifies determination of whether an activity qualifies under Article 3.3 since the activity needs only to meet the requirements of afforestation, reforestation or deforestation without needing to meet an additional set of requirements posed by the definition of a forest.

Afforestation and reforestation

- For afforestation and reforestation, definitions that require a change of land use and the establishment of new forests on previously unforested land will facilitate identification and reporting of areas of land subject to eligible forestation activities under Article 3.3.
- Article 5.2 requires that the IPCC Revised 1996 Inventory Guidelines are used as methodologies for the first commitment period.
- The IPCC Revised 1996 Inventory Guidelines contain definitions for afforestation and reforestation which require a change in land use.

Deforestation

- A definition of deforestation needs to provide a basis for accounting for significant removal of trees or woody vegetation.
- If a definition of deforestation were to be tied solely to a change in land use significant changes in carbon stock where there is no change in land use will not trigger lands being drawn into the Article 3.3 accounting framework.
- Under Australia's approach to defining deforestation for Article 3.3, Parties will be required to determine canopy cover per area of land at the hectare level for their entire forest estate in 1990.
  - This can be done with remote sensing techniques.
- Deforestation will be accounted when the proportion of canopy cover per hectare on a given area of forested land is reduced by 30% or more through forest conversion (eg if forest canopy cover drops from 60% to 42%) as a result of direct human induced removal of trees.
- The area of land subject to deforestation then enters into the Article 3.3 accounting system.
- The advantage of this approach is that it provides flexibility in relation to the forest type that is captured by deforestation.
- This will reduce the potential for Parties to selectively report forested land so as to minimise accounting for deforestation.
- Under Australia's approach, significant deforestation and degradation events will both be captured for the purposes of accounting for deforestation under Article 3.3.

Carbon accounting on Article 3.3 lands

- Under the Article 3.3 lands accounting approach, Parties are required to identify afforestation, reforestation or deforestation activities. These activities will function to draw a given area of land into the Article 3.3 accounting system.
  - Identification of eligible activities would be done on the basis of the definitions for afforestation, reforestation and deforestation given below.
  - Land units on which these activities occur would then be identified.
- Under the definitional approach outlined above for afforestation, reforestation and deforestation, harvesting which occurs as part of the commercial forestry cycle would not be defined as deforestation. Similarly regeneration following harvesting would not be defined as reforestation.
- Commercial forestry cycles would not therefore function to draw areas of land into the Article 3.3 accounting framework.

- However under the Article 3.3 lands approach, once an area of land enters the Article 3.3 accounting system as a result of afforestation, reforestation and deforestation, Parties would be required to account for all changes in carbon stocks occurring on that area of land.
- This would include changes in carbon stocks and emissions that are the result of harvesting and replanting on areas of Article 3.3 lands subject to commercial forestry as well as other changes in emissions that are the result of human and non-human induced effects.

Accounting sub-rules for Article 3.3

- In relation to accounting for Article 3.3 activities, the IPCC Special Report notes that some important discrepancies could occur between actual and reported changes in carbon stocks. The IPCC has proposed two accounting sub-rules to deal with these discrepancies.

Accounting Sub-rule 1

- A discrepancy could occur where land is deforested, used for agriculture before 2008 and then direct human induced reforestation occurs. Credits could be gained even though carbon stocks in the commitment period are likely to be less than in 1990.
- This discrepancy could be addressed if carbon credits for reforestation are awarded only for increases in carbon stock above the level of carbon stock present at the forest stand level prior to the deforestation event taking place.

Accounting Sub-rule 2

- Another discrepancy could occur where afforestation or reforestation since 1990 has brought land into the accounting system but, as a result of harvesting, thinning or natural events (eg fire, pests or storms), carbon stocks decrease over the commitment period.
- Under these circumstances, debits could be assigned during the commitment period even if the afforestation or reforestation activity reduces atmospheric CO_2 in the long run and carbon stocks increase overall.
- This discrepancy could be overcome if carbon debits for afforestation and reforestation are limited to the amount of net credits (credits minus debits) received from carbon accumulating at the stand level.
- For textual proposals on accounting for non-CO_2 gases (methane and nitrous oxide) for Article 3.3 activities, see Overall Accounting Approaches (Section I above).

Textual proposal

Definition of a forest
There is no requirement for a definition of a forest for the purpose of implementing Article 3.3.

Afforestation, reforestation and deforestation
Afforestation is defined as the direct human induced establishment of new forests (trees and woody vegetation) on lands which historically have not contained forests. New forests established by afforestation must cover a minimum area of 1 hectare with a minimum stand width of 10 metres. Potential canopy cover at maturity under current management practices is not less than 20%.

Reforestation is defined as the direct human induced establishment of forests (trees and woody vegetation) on lands which historically have previously contained forests but which have been converted to some other use. Prior to reforestation, the land must have been under some non-forest use for a period of not less than 5 years. New forests established by reforestation must cover a minimum area of 1 hectare with a minimum stand width of 10 metres. Potential canopy cover at maturity under current management practices is not less than 20%.

To be directly human induced, afforestation and reforestation must result from a deliberate human action or intervention.

Establishment includes all deliberate human induced activities to establish trees including: direct planting, artificial seeding, site preparation (fire or mechanical) and protective fencing.

Deforestation will be accounted when the proportion of canopy cover per hectare on a given area of forested land (land with trees and woody vegetation) is reduced by 30% or more through forest conversion as a result of direct human induced removal of trees.

Deforestation is defined as direct human induced forest conversion which is frequently accompanied by burning. This does not include harvesting or other practices which occur as part of ongoing commercial forestry.

Forest conversion means the transition of forested land to non-forested land as a result of direct human induced removal of trees.

For the purposes of accounting for deforestation under Article 3.3, Parties shall determine canopy cover for each forested area within their borders to be accounted for on the basis of a minimum area of 1 hectare with a minimum stand width of 10 metres.

To be directly human induced, deforestation must result from a deliberate human action or intervention.

Carbon Accounting for Article 3.3 activities
Parties are required to account for changes in greenhouse gas emissions that occur during the commitment period on areas of land where afforestation, reforestation and deforestation have taken place, commencing either in 1990 or in a year subsequent to 1990 but before the end of the commitment period.

Changes in greenhouse gas emissions and carbon stocks as a result of human induced and natural effects (including inter alia commercial forestry, fire, pest invasion, CO_2 and nitrogen fertilisation) during the commitment period shall be accounted for on those areas of land where human induced afforestation, reforestation and deforestation since 1990 have taken place.

To measure changes in carbon stocks, relevant carbon pools shall include above ground biomass, litter and woody debris, below ground biomass, soil carbon and harvested materials. The methodologies for accounting for harvested wood shall be those given in the 1996 IPCC Revised Inventory Guidelines as required by Article 5.2.

Accounting methodologies shall be developed and agreed by the COP to ensure that changes in emissions for non-carbon dioxide gases (methane and nitrous oxide) are accounted for.[7]

Changes in greenhouse gas emissions and carbon stocks on areas of land where human induced afforestation, reforestation and deforestation since 1990 have taken place must be accounted for over contiguous commitment periods.

Carbon accounting baselines for Article 3.3 activities
The adjustment to a Party's assigned amount shall be equal to verifiable changes in carbon stocks and greenhouse gas emissions during the period 2008 to 2012 resulting from direct human induced activities of afforestation, reforestation and deforestation since 1 January 1990. Where the result of

[7] The SBSTA should invite the IPCC to develop such accounting methodologies as part of the IPCC work on methodologies on LULUCF as requested in the SBSTA 10 conclusions.

this calculation is a net sink, this value shall be added to the Party's assigned amount. Where the result of this calculation is a net emission, this value shall be subtracted from the Party's assigned amount.[8]

This means Parties shall calculate changes in carbon stocks by comparing the carbon stocks in 2012 with the carbon stocks in 2008.

Accounting sub-rules for Article 3.3 activities
Sub-rule 1
Credits (for sequestration) calculated at the stand level from reforestation following deforestation will be awarded only to the extent that carbon stocks have increased above levels present before the deforestation event took place.

Sub-rule 2
Debits (emissions) calculated at the stand level from harvesting and other natural and human induced effects following afforestation and reforestation will not be greater than credits earned from sequestration.

III. HOW AND WHICH ADDITIONAL HUMAN INDUCED ACTIVITIES MIGHT BE INCLUDED UNDER ARTICLE 3.4 INCLUDING MODALITIES, RULES AND GUIDELINES RELATED TO THESE ACTIVITIES AND THEIR ACCOUNTING

Explanatory material

- Article 3.4 requires that additional LULUCF activities be in the agricultural soils, land use change and forestry categories.
- In line with the requirements of Article 3.4, the selection of activities and the accounting approach adopted for additional activities must provide the means to determine whether the activity occurred since 1990 for the first commitment period and whether the activity is human induced.
- Article 3.4 requires that the activity rather than the resulting emissions are human induced ("as to how and which *additional human induced activities*…").
  - This is similar to the construction of Article 3.3 which links the requirement of direct human induced to the activities of afforestation, reforestation and deforestation rather than to the change in emissions.
- The IPCC Special Report shows that under the broad approach to the selection of additional activities, where activities are defined as broad systems of land use, both human induced and non-human induced activities alike will be eligible for crediting under Article 3.4.
- The narrow approach to the selection of additional activities will facilitate the implementation of additional activities that are specifically defined with reference to the key criterion of human induced.

Selection of additional activities

- Under the narrow approach, only certain specified activities such as fertilisation in the agricultural soils category or reduced impact logging in the category of forest management would be included under Article 3.4.
- Australia supports the narrow approach to the inclusion of additional activities in conjunction with the land based accounting approach (see below).
- Within the narrow approach to the selection of additional activities, Australia supports the inclusion of additional activities to the extent that changes in emissions and/or carbon stocks can be accurately measured and verified.

[8] As per COP decision 9/CP.4

- Australia supports the inclusion of revegetation as an additional activity under Article 3.4 as it demonstrably meets the criteria of human induced, measurability and verifiability.
  - In addition, revegetation can deliver improvements to biodiversity and land management and can address problems of land degradation such as salinisation of soils.
  - Revegetation is therefore in line with Australia's sustainable management objectives.
- Australia is working on methodologies to account for additional activities in the agricultural soils and forest management categories (including wood products) and will bring forward a further proposal on additional activities to address these issues.
- Australia is likely to support decision making at COP6 on specific additional activities in these categories for inclusion during the first commitment period if it can be demonstrated such activities also meet key tests of human induced, and are transparent, measurable and verifiable.
- For inclusion under Article 3.4, additional activities will also need to be in line with Australia's sustainable development objectives.

Accounting for Article 3.4

- Under the land based accounting approach, an area of land would be drawn into the Article 3.4 accounting system by the application of an eligible additional activity.
- A Party would then be required to account for all changes in greenhouse gas emissions on the area of land irrespective of whether changes in emissions result from a natural process (such as fire or pest invasion) or human activity.
- The narrow inclusion/land based accounting approach will simplify verification procedures and potentially reduce measurement and monitoring costs.
- It is also in line with the requirement that only eligible human induced additional activities since 1990 are counted towards Parties' assigned amounts for the first commitment period.
- Further work is needed to develop accounting methodologies to deal with additional activities under Article 3.4 including for the non-CO_2 gases. Australia may submit an additional proposal on these matters.
- Methane and nitrous oxide emissions from a range of land-use activities such as rice cultivation, agricultural soils, prescribed burning of savannas and field burning of agricultural residues are included in Annex A of the Kyoto Protocol and will therefore be captured in Parties' national inventories under Articles 5 and 7.
- As methane and nitrous oxide emissions from a range of land-use activities are included in Annex A, there is potential for double counting to occur if these emissions are also accounted for as a result of lands brought into the Article 3.4 accounting system.
- The IPCC should be invited to develop an accounting methodology as part of its methodological work on LULUCF to ensure that emissions reductions associated with Article 3.4 activities are not also credited in the accounting of Parties' assigned amounts under Article 3.1.

Textual Proposal

Selection of additional activities

Changes in greenhouse gas emissions from agreed specific additional activities in the agricultural soils, land use change and forestry categories may be added to or subtracted from a Party's assigned amount if that Party can demonstrate in its reporting under Article 3.4 that the specific activity is human induced, can be measured in a transparent fashion, is verifiable, is in line with that Party's sustainable management objectives and, for the first commitment period, that the specific activity has occurred since 1990.

Revegetation shall be included as an additional activity in the forest category for the first and subsequent commitment periods.

Revegetation is defined as the human induced establishment of woody vegetation that covers a minimum area of 0.5 hectare with a minimum width in any direction of 10 metres and does not meet the definitions of afforestation or reforestation under Article 3. Eligible revegetation activities include:

- *the establishment of woody vegetation to address sustainable land management;*
- *windbreaks and shelterbelts;*
- *environmental plantings or fencing off areas of native vegetation;*
- *agroforestry planting of trees or the development of new tree crop products such as tea tree oil to encourage a more diversified and sustainable production system that leads to social, economic and environmental benefits for land users; and*
- *changes in stock management practices to encourage regeneration of vegetation.*

If agreed by the COP, further specific additional activities in the agricultural soils, land use change and forestry categories may be included under Article 3.4 for the first commitment period

Accounting for Article 3.4 activities

Parties may account for changes in greenhouse gas emissions to be added to or subtracted from their assigned amounts on areas of land where agreed specific human induced additional activities in the agricultural soils, land use change and forestry categories have taken place, either in 1990 or in a year subsequent to 1990 but before the end of the commitment period.

Changes in carbon stocks and/or emissions as a result of human induced and natural effects (including inter alia commercial forestry, fire, pest invasion, CO_2 and nitrogen fertilisation) shall be accounted for on areas of land where agreed specific human induced additional activities in the agricultural soils, land use change and forestry categories have taken place, either in 1990 or in a year subsequent to 1990 but before the end of the commitment period.

For some additional activities in the agricultural soils land use change and forestry categories under Article 3.4, accounting methodologies will need to be elaborated. This elaboration of methodologies shall ensure that changes in greenhouse gas emissions for non-carbon dioxide gases (methane and nitrous oxide) are accounted for.[9]

Methodologies shall also be elaborated to ensure that changes in greenhouse gas emissions from additional activities in the agricultural soils, land use change and forestry categories are not also credited or debited in accounting for Parties assigned amounts under Article 3.1.

Changes in greenhouse gas emissions and carbon stocks on areas of land where eligible additional activities have taken place on or since 1990 must be accounted for over contiguous commitment periods.

IV. METHODOLOGIES FOR ACCOUNTING AND REPORTING IN RELATION TO ARTICLE 3.3 AND 3.4

Explanatory material

- Article 5.2 of the Kyoto Protocol establishes the 1996 IPCC Revised Inventory Guidelines as the methodologies for measurement and reporting of greenhouse gases under the Protocol for the first

[9] The SBSTA should invite the IPCC to develop such accounting methodologies as part of the IPCC work on methodologies on LULUCF as requested in the SBSTA 10 conclusions.

commitment period.

- In some cases, these Guidelines will require elaboration to deal with the specific requirements of the Kyoto Protocol including for LULUCF activities in Articles 3.3 and 3.4.

- The IPCC work on good practice guidance should be extended to cover LULUCF activities under the Protocol including dealing with uncertainties. This would require development of a set of procedures that would allow Parties to address:
- The choice of estimation methods appropriate to counties' national circumstances;
- Quality assurance and quality control at a national level;
- Quantification of uncertainties; and
- Requirements for data archiving and reporting to promote transparency and facilitate verification.

Textual Proposal

Methodologies
Methodologies for measuring and reporting on changes in emissions and/or carbon stocks for eligible LULUCF activities under Articles 3.3 and 3.4 shall be in line with requirements of Articles 5, 7 and 8 of the Kyoto Protocol.

Elaboration of methodologies for the implementation of Articles 3.3 and 3.4 shall take into account the methodological work of the IPCC[10], and should extend good practice guidance to land use, land use change and forestry activities including methodologies to ensure that measurement uncertainty is taken into account.

[10] As requested by the Subsidiary Body for Scientific and Technological Advice at its 10th session.

Table I Preliminary data and information provided by Australia on carbon stock changes and areas related to article 3.3 activities

Article 3.3 Country specific data	Definitions	Accounting framework	a_I (ha)	$\triangle C_I$ (Mt C)	a_{II} (ha)	$\triangle C_{II}$ (Mt C)	a_{cp} (ha)	$\triangle C_{cp}$(Mt C)	Methods and approaches	Data sources, data quality, and uncertainty (e.g. ranges)
Afforestation	IPCC	Activity based								
Reforestation		Land based	209,978	2.4	500,119	8.7	1,350,346	23.6		
Afforestation	FAO	Activity based								
		Land based								
Reforestation	FAO	Activity based								
		Land based I								
		Land based II								
Afforestation	Other	Activity based								
Reforestation		Land based								
Deforestation*	IPCC/FAO	Activity based								
		Land based	2,362,000	68.2	3,884,000	119.2	8,078,000	57.6		
	Other	Activity based								
		Land based								

a_I : Area (ha) afforested and reforested, or deforested since 1990 up to 1995 or possibly an earlier specific year.

$\triangle C_I$: Carbon stock change (t C) since 1990 up to the same year as used in a_I on land afforested, reforested, and deforested.

a_{II} : Area (ha) afforested and reforested, or deforested since 1990 up to 1999 or an earlier specific year.

$\triangle C_{II}$: Carbon stock change (t C) since 1990 up to the same year as used in a_{II} on land afforested, reforested, and deforested.

a_{cp}: Projected area (ha) afforested and reforested, or deforested since 1990 up to 2012.

$\triangle C_{cp}$: Projected carbon stock change (t C) over the first commitment period on land afforested, reforested, and deforested since 1990 up to 2012.

Methods and approaches

Specify:

a) Forest definition used;

b) Definitions for afforestation, reforestation and deforestation used;

c) Applied accounting approaches;

d) Included carbon pools;

e) Other.

EXPLANATORY TEXT (table I)

Parties should submit information under all headings listed below where the information is relevant to the approach taken in their submission and to the extent that data and methodologies exist.

1.Definitions and accounting:
   a) Forest,
   b) Afforestation, reforestation, and deforestation,
   c) Accounting approaches.
2.Carbon pools included (e.g. above-ground biomass, litter and woody debris, below-ground biomass, soil carbon, and harvested materials);
3.Stratification (e.g. biomes and regions);
4.Methodologies and data:
   a) Data sources,
   b) Sampling techniques,
   c) Models and key parameters,
   d) Uncertainties.
5.Treatment of non-CO_2 greenhouse gases.
6.Methods and key assumptions in projections for the first commitment period (2008–2012) and discussion, if possible, of trends beyond the first commitment period.

Table II - Preliminary data and information provided by Australia on carbon stocks and area estimates (First sentence of Article 3.4)

Land system	Area (Mha)	Carbon stock in 1990 (Mt C)
Forest lands	145	13157
Agriculture lands	45	1297
Rangelands/grasslands	564	10484
Wetland/tundra	2	571
Other	6	262
Total (as listed above)	**762**	**25771**

EXPLANATORY TEXT (table II)

Parties should submit information under all headings listed below where the information is relevant to the approach taken in their submission and to the extent that data and methodologies exist.

1.Description of land categories, including any land categories not covered.
2.Carbon pools - distinctions and assumptions.
3.Data sources.
4.Methods.
5.Possible changes in carbon stocks.
6.Uncertainties.

Table III - Preliminary data and information provided by Australia on Article 3.4 activities, related net GHG emissions, involved areas, and projected carbon stock changes (additional activities under Article 3.4)

Article 3.4 Country specific data	Accounting framework	a_{I} (ha)	$CO_{2,\ I}$ (t CO_2)*	$CH_{4,\ I}$ (t CO_2 equiv.)* §	$N_2O_{,\ I}$ (t CO_2 equiv.)* §	a_{II} (ha)	$CO_{2,\ II}$ (t CO_2)*	$CH_{4,\ II}$ (t CO_2 equiv.)*§	$N_2O_{,\ II}$ (t CO_2 equiv.)* §	a_{cp} (ha)	C_{cp} (t C)	$CO_{2,\ cp}$ (t CO_2)*	$CH_{4,\ cp}$ (t CO_2 equiv.)* §	$N_2O_{,\ cp}$ (t CO_2 equiv.)* §	Methods and approaches	Data sources, data quality, and uncertainties (e.g. ranges)	Other information relevant to decision-making
Revegetation activities	***Land based***									1,047,800	10,906,046	39,988,840	n/a	n/a	see explanatory text	see explanatory text	see explanatory text
	Activity based																
Activity 2	***Land based***																
	Activity based																
Activity 3	***Land based***																
	Activity based																
....																	
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***** These columns would contain the sum over the years concerned of net annual emissions by sources and removals by sinks for the Article 3.4 activities proposed.
A negative sign indicates either emissions by sources or a decrease in carbon stocks. A positive sign indicates either removals by sinks or an increase in carbon stocks.
To convert a carbon amount to CO_2 multiply it by 3.67.

§ CH_4 and N_2O emissions are converted to CO_2 equivalent emissions by using the global warming potential (GWP) values of 21 for CH_4 and 310 for N_2O (Source: Second Assessment Report of the IPCC, 199

a_I: Area (ha) in 1995 or possibly an earlier specific year involved in the Article 3.4 activity since 1990.
$CO_{2,\,I}$: Net CO_2 emissions (t CO_2) by sources and removals by sinks related to the Article 3.4 activity, accumulated from 1990 to the same year as used in a_I.
$CH_{4,\,I}$: CH_4 emissions (t CO_2 equivalent) by sources related to the Article 3.4 activity, accumulated from 1990 to the same year as used in a_I.
$N_2O_{,\,I}$: N_2O emissions (t CO_2 equivalent) by sources related to the Article 3.4 activity, accumulated from 1990 to the same year as used in a_I.
a_{II}: Area (ha) in 1999 or possibly an earlier specific year involved in the Article 3.4 activity since 1990.
$CO_{2,\,II}$: Net CO_2 emissions (t CO_2) by sources and removals by sinks related to the Article 3.4 activity,accumulated from 1990 to the same year as used in a_{II}.
$CH_{4,\,II}$: CH_4 emissions (t CO_2 equivalent) by sources related to the Article 3.4 activity, accumulated from 1990 to the same year as used in a_{II}.
$N_2O_{,\,II}$: N_2O emissions (t CO_2 equivalent) by sources related to the Article 3.4 activity, accumulated from 1990 to the same year as used in a_{II}.
a_{cp}: Projected area (ha) in 2012 involved in the Article 3.4 activity since 1990.
$\triangle C_{cp}$: Projected carbon stock changes (t C) over the first commitment period related to the Article 3.4 activity since 1990.
$CO_{2,\,cp}$: Projected net CO_2 emissions related contribution (t CO_2) of the Article 3.4 activity to the first commitment period assigned amount of the Party.
$CH_{4,\,cp}$: Projected CH_4 emissions related contribution (t CO_2 equivalent) of the Article 3.4 activity to the first commitment period assigne amount of the Party.
$N_2O_{,\,cp}$: Projected N_2O emissions related contribution (t CO_2 equivalent) of the Article 3.4 activity to the first commitment period assigned amount of the Party.

EXPLANATORY TEXT (table III)

Parties should submit information under all headings listed below where the information is relevant to the approach taken in their submissions and to the extent that data and methodologies exist.

1.Activities and accounting:
a) Definitions and descriptions of all activities proposed,
b) Scope of activities and how they fit into broader managed land categories,
c) Accounting approaches,
d) Proposals for key accounting features, e.g. assumptions on baselines, basis for the area estimates covered by activity.
2.Carbon pools included (e.g. above ground biomass, litter and woody debris, below-ground biomass, soil carbon, and harvested materials).
3.Methodologies and data:
a) Data sources,
b) Sampling techniques,
c) Models and key parameters,
d) Uncertainties.
4.Treatment of non CO_2 greenhouse gases.
5.Methods and key assumptions in projections for the first commitment period (2008–2012) and discussion, if possible, of trends beyond the first commitment period.

TABLE 1 (ARTICLE 3.3) EXPLANATORY TEXT

1. Definitions and accounting

(a) Under Australia's approach to afforestation, reforestation and deforestation, there is no need for a stand-alone definition of a forest.
(b) Afforestation, reforestation and deforestation - the definitions used are consistent with those contained in the accompanying Australian submission.
(c) Accounting approaches - this analysis was undertaken using the IPCC land based accounting framework.

Australia has proposed, in the accompanying submission, two accounting subrules should be implemented for afforestation, reforestation and deforestation activities under Article 3.3 to prevent discrepancies between actual and reported stock change. This analysis does not include the effects of these subrules in estimating changes in carbon sequestration for afforestation, reforestation or deforestation activities.

2. Carbon pools included

All relevant carbon pools were taken into account in this analysis including above ground biomass, litter and woody debris, below ground biomass, soil carbon and on and off site harvested materials.

3. Stratification

Stratification of afforestation/reforestation activities is based on Australia's National Plantation Inventory regions. These regions (fourteen in all) are stratified by species, management regime and productivity class.

Areas of clearing (deforestation) are stratified by vegetation structural classes according to the Carnahan (1988) digital data sets (AUSLIG 1990). Areas of clearing are assigned to a vegetation class which is in turn assigned a typical soil carbon and biomass estimate. For more information on the methods, refer to the supporting methodology supplements to Australia's National Greenhouse Gas Inventory, Workbook 4.2.

Reference
Australian Surveying and Land Information Group (1990) *Atlas of Australian Resources, Vegetation, Third Series Volume 6,* Department of Administrative Services, Canberra

4. Methodologies and data

(a) Data sources

For afforestation and reforestation activities, data has been taken from the National Plantation Inventory, with information on growth, yield and management regimes sourced from wood flow analyses completed for the National Greenhouse Gas Inventory.

Data on land clearing (deforestation) is largely drawn from remote sensing using LANDSAT TM data. Data and methods conform to those used in the National Greenhouse Gas Inventory.

(b) Sampling techniques

Data and information on areas, yield and management regimes for afforestation and reforestation activities have been derived using surveys of growers.

The remote sensing data used to estimate deforestation activities was based on ground truthed continental sampling. Other methods are described in the supporting methodology supplements to the National Greenhouse Gas Inventory, Workbook 4.2.

(c) Models and key parameters

Modelling of afforestation and reforestation emissions and sequestration was completed using the Australian Greenhouse Office's CAMFOR forest accounting model. Model parameters were drawn from relevant published literature.

The models and parameters used to estimate emissions associated with deforestation are described in the supporting methodology supplements to Australia's National Greenhouse Gas Inventory Workbook 4.2.

(d) Uncertainties

While there may be some variance in model parameters used for afforestation and reforestation, overall uncertainty is considered to be relatively small. This is because the large sample size used produces a tendency for over and under estimates to balance out and centralise around the mean. There is no reason to believe that any bias is present which may alter this assumption.

An analysis of the uncertainties present in estimating emissions associated with deforestation is described in the supporting methodology supplements to the National Greenhouse Gas Inventory, Workbook 4.2.

5. Treatment of non-CO_2 greenhouse gases.

Non CO_2 gases were not considered in this analysis.

6. Methods and key assumptions in projections for the first commitment period (2008-2012)

Afforestation and reforestation

Projections of afforestation and reforestation activities assume a linear continuation of the average rate of establishment for new plantings over the period 1995-1999 (approximately 65,402 hectares per year), excluding establishment of second rotation forests. Product allocation and management regimes for the period 2000-2012 are also assumed to be consistent with the allocations and practices during the 1995-1999 period. These estimates are considered to be realistic.

Deforestation

Projections of future land clearing activity (deforestation) are mid range estimates based on expert judgement and implementation of the current policy framework.

In accordance with the scope of Table 1, estimates of deforestation are generated in accordance with the implementation of Article 3.3 using the IPCC land based accounting framework. It is, however, expected that Australia's emissions from the Land Use Change and Forestry Sector in 1990 would constitute a net source and therefore Article 3.7 would operate in conjunction with Article 3.3.

TABLE II–(1990 CARBON STOCKS) EXPLANATORY TEXT

1. *Description of land categories.*

As per Table**.**

2. Carbon pools

The following carbon pools (biomass, litter, soils to 30cm and organic carbon (charcoal)) were considered in this analysis.

In considering this information it should be noted that the stock of carbon in Australian ecosystems at any time can vary considerably due to climatic and fire events. For example, it has been estimated that between 25-80 Mt C can be released by fires each year. Assigning the 609 million ha of cropping, grazing and rangelands into productivity categories can also vary across time because productivity is significantly affected by rainfall.

3. Data sources.

Information and data were drawn from a range of published literature. Please see the reference list below.

References

AUSLIG (1990): Atlas of Australian Resources. Volume 6: Vegetation. Commonwealth of Australia, 64 pp.

Gifford, R.M., Cheney, N.P., Noble, J.C., Russell, J.S., Wellington, A.B., and Zammit, C. (1992): Australian land use, primary production of vegetation and carbon pools in relation to atmospheric carbon dioxide concentration. In Gifford, R.M. and Barson, M.M. (Eds.) Australia's Renewable Resources: Sustainability and Global Change. Bureau of Rural Resources Proceedings No. 14, AGPS, Canberra, pp. 151-187.

Grierson, P.F., Adams, M.A. and Attiwill, P.M. (1992): Estimates of carbon storage in the above-ground biomass of Victoria's forests. Australian Journal of Botany 40: 631-640.

MIG (1997): Australia's first approximation report to the Montreal Process. Montreal Process Implementation Group for Australia, Commonwealth of Australia, 104 pp.

NGGI (1998): Land Use Change & Forestry. Workbook for Carbon Dioxide from the Biosphere. Workbook 4.2 with Supplements. National Greenhouse Gas Inventory Committee, 96 pp.

Olson, J.S., Watts, J.A. and Allison, L.J. (1985): Major world ecosystem complexes ranked by carbon in live vegetation: a database. United States Department of Energy, Oak Ridge, Tennessee, Report NDP-017.

Snowdon, P., Eamus, D., Gibbons, P., Khanna, P.K., Keith, H., Raison, R.J. and Kirschbaum, M.U.F. (2000): Synthesis of allometrics, review of root:shoot ratios, and design of future woody biomass sampling strategies. Client Report No. 819, CSIRO Forestry and Forest Products (In preparation).

McKenzie, N. and J. Hook, Interpretations of the Atlas of Australian Soils: Consulting Report to the Environmental Resources Information Network, Tech. Rep. 94/1992. CSIRO, Division of Soils, Canberra, 1992.

4. Methods

Estimates were modelled using a calibrated model running in a geographic information system with area statements derived from national datasets. Vegetation systems formed the primary spatial stratification and were taken from the 1990 Atlas of Australian Resources – Volume 6.

TABLE III – (ARTICLE 3.4) EXPLANATORY TEXT

1. Activities and accounting

a). Definitions and descriptions of all activities proposed.

Activity 1 = Revegetation activities.

Revegetation is defined as the human induced establishment of woody vegetation that covers a minimum area of 0.5 hectare with a minimum width in any direction of 10 metres and does not meet the definitions of afforestation or reforestation under Article 3. Eligible revegetation activities include:

- the establishment of woody vegetation to address sustainable land management;
- windbreaks and shelterbelts;
- environmental plantings or fencing off areas of native vegetation;
- agroforestry planting of trees or the development of new tree crop products such as tea tree oil to encourage a more diversified and sustainable production system that leads to social, economic and environmental benefits for land users; and
- changes in stock management practices to encourage regeneration of vegetation.

b) Scope of activities and how they fit into broader managed land categories.
See item a) above.

c) Accounting approaches.
The data presented in Table III assumes a land-based accounting framework, in which an area of land would be drawn into the Article 3.4 accounting system when an identified revegetation activity has occurred post 1990.

d) Proposals for key accounting features, e.g. assumptions on baselines, basis for the area estimates covered by activity.

The area estimate assumes a continuation of revegetation rates as reported in the Australian Bureau of Agriculture and Resource Economics (ABARE)'s Survey of Trees on Farms.

2. Carbon pools included (e.g. above ground biomass, litter and woody debris, below ground biomass, soil carbon and harvested materials)

The data presented are preliminary estimates based on the above ground biomass pool. Estimates are being developed which will include other carbon pools.

3. Methodologies and data

a) Data sources
Areas of revegetation were estimated from the Australian Bureau of Agriculture and Resource Economics (ABARE)'s Survey of Trees on Farms.

c) Models and key parameters
A rate of carbon sequestration of 2.3 tonnes of carbon per hectare per year was used for revegetation areas, based on analysis by the Bureau of Resource Sciences. This is the average rate of carbon sequestration rate for the current mix of revegetation activities in Australia, including wide spaces trees, trees in windbreaks and shelterbelts, trees in alley plantings, salt bush, tea tree and oil mallee (BRS, 2000 *Revegetation as an Additional Activity for Greenhouse Gas Emission Reduction under Article 3.4 of the Kyoto Protocol.* Draft consultancy to the Australian Greenhouse Office).

This estimate is likely to be a significant over-estimate because it does not fully reflect the impact of regional variability on growth rates and hence carbon sequestration.

d) Uncertainties

Revegetation activities have been assigned on the basis of broad classes of activity, some of which may or may not fit within the designated class.

4. Treatment of non-CO_2 gases

Non CO_2 gases were not considered in this analysis.

5. Methods and key assumptions in projections for the first commitment period (2008-2012) and discussion, if possible, of trends beyond the first commitment period

Initial emissions reductions and sequestration associated with revegetation activities during the first commitment period were derived by ABARE using a mathematical programming model of Australia's broadacre agricultural sector based on farm level data collected in ABARE's Australian agricultural and grazing industries survey.

The model maximises profits, derived as the difference between revenue and estimated cost (subject to constraints on land area and uptake of new management practices). Emissions and sequestration calculations are based on the land area under the management practice.

The model assumes that existing extension and land care activities result in ongoing small increases in the rate of revegetation. Adoption rates are calculated at the national level, thus do not vary between regions.

The modelled estimates presented here are preliminary, and should be treated with caution.

PAPER NO. 2: BOLIVIA

LAND USE, LAND USE CHANGE AND FORESTRY

1. General principles

The Bolivian Government recognizes the importance of the fluxes and stocks of greenhouse gases in the Land Use, Land-Use Change and Forestry sector (LULUCF), as a part of the general system of exchange of greenhouse gases between terrestrial ecosystems and the atmosphere, including those coming from the energy sector. A comprehensive treatment should be applied to emissions by the energy and the LULUCF sectors, as well as to removals by the LULUCF sector, according to the objective and the principles stated in Articles 2 and 3 of the UNFCCC.

LULUCF activities can play an important role in the compliance system of the Kyoto Protocol (KP), as well as in the project-based flexibility mechanisms of the KP, especially in the Clean Development Mechanism (CDM). However, even when we recognize the importance of LULUCF activities, noting that these could open the possibility of substantive participation, through the CDM, to the great majority of developing countries, we also recognize that the stabilization of greenhouse gases in the atmosphere to the 1990 level[1], will only be reached by applying the most important part of the mitigation effort to the abatement of emissions by sources in the energy sector in Annex I countries, in an adequate combination with removals by sinks in LULUCF activities.

Emissions coming from the LULUCF sector reached 1.7 to 2.0 Gt of carbon a year during the 1980s and nearly 1.6 Gt of carbon in the 1990s, according to the assessment provided by the IPCC *Special Report on Land Use, Land-Use Change and Forestry*[2]. These emissions amounted to roughly 30% of the global emissions in the 80s and 25% of the present emissions (from 1990 onwards). Being an important part of global emissions, these should be treated with a comprehensive approach together with the emissions from the energy sector, as part of the global warming problem.

Of course, reducing emissions in the LULUCF sector (which are caused mainly by deforestation, but also by other LULUCF activities) in Non-Annex I countries can also play an important role in meeting the desired GHG concentration levels in the short and medium term. The Parties will have to define the necessary terms and provide the necessary accounting rules so that they give incentives for increasing carbon storage in the terrestrial biosphere while recognizing the other important roles played by the terrestrial biosphere[3]. It is very important that the rules do not give credits or other rewards for practices that damage forests and other ecosystems, terrestrial or marine.

We fully acknowledge that the UNFCCC and the KP are part of a broader legal framework and share its general spirit, which includes the guidelines already negotiated in Agenda 21 and the major Multilateral Environmental Agreements (MEA). In this respect, it is of the utmost importance to coordinate and mutually support actions with the Convention on Biological Diversity (CBD), *inter alia*. At it's 5th Conference of the Parties, the CBD adopted a decision on forest diversity which urged the UNFCCC and its Kyoto Protocol to ensure that future carbon sequestration activities are consistent with and supportive of the conservation and sustainable use of resources of biological

[1] It is possible that it may be considered in the future, that even this level is insufficient to stop global climate change caused by anthropogenic sources. This of course depends on future scientific assessment. In this case, a greater effort to reach lower levels of GHG concentration in the atmosphere will have to be met with a combination of further reduction of emissions by sources and removals by sinks.

[2] These figures can be somewhat higher if the estimates are revised according to the last data given for tropical forests in the Amazonian region, as it is already mentioned later in this document.

[3] Cited from Schlamadinger & Marland, *Land Use & Global Climate Change; Forest, Land Management and the Kyoto Protocol*, Pew Center on Global Climate Change, Arlington, VA, June 2000.

diversity[4]. As a matter of comprehensiveness and environmental coherence, the Government of Bolivia would like to add that activities directed to the protection and management of GHG sinks should as well be consistent with the major objectives of Agenda 21 and the MEA.

At the same meeting, the CBD Parties endorsed the ecosystem approach as an integral part of the Convention and agreed to principles for its implementation. In view of the coherence with UN principles on environmental conservation and sustainable development, these principles should be applied to carbon sequestration and sinks protection activities.

In this respect, the UNFCCC should reach an agreement in definition and procedures that envisages the activities and effects of human activities in the LULUCF sector as processes which derive from complex socio-economic and environmental factors, and should not be registered from a simple administrative point of view.

2. Proposed definitions and accounting approaches related to ARD activities under Article 3.3.

The definition of these activities should start with a proper definition of the concept of *forest*, from the point of view of a complex biotic system, which is consistent with an ecosystem approach, and not a definition that considers a forest to be a simple group of trees. The latter, incomplete definition, would lead to the consideration of scattered plantations as forest. All the fluxes of GHG in the affected portions of a forest should be counted, crediting and debiting only those, which come from direct human – induced activities, which should have commenced after the 1st January 1990, as the PK states[5].

There are two levels of definition of a forest. One general level is useful for the purpose of determining that the activities reported are implemented on a forest, which type of forest and which ancillary benefits (sustainable development benefits) can be attained by implementing sequestration or protection activities, and which type of hidden costs (socioeconomic and environmental) will have to be reported in case of deforestation. The second level is an accounting definition, in terms of average biomass density and carbon contents per area unit of the different types of forests, and it is useful for the purposes of reporting and monitoring GHG fluxes

Definition for the 1st level: A forest is a dynamic complex of plant and animal communities, composed of trees and its associated vegetation and biophysical fluxes, interacting as a functional unit, with highly diverse characteristics depending of the biophysical attributes or features of every ecosystem and biome. Forests ecosystems and their soils provide fundamental ecological services such as watershed protection, the regulation of water regimes, the maintenance of regional climates and habitats for wildlife and genetic resources, as well as a wide range of social and cultural benefits[6].

Definition for the 2nd level: A forest is composed by a mix of species of trees and other above ground vegetation, as well as wildlife and genetic resources. It has specific carbon contents of aboveground biomass (dead and alive), belowground biomass and soil carbon per area unit, as well as other non - carbon GHG fluxes, specified in every ecosystem. For accounting approaches, the average carbon contents in above-ground and below-ground biomass and soil carbon per area unit, en every major biome type, is the following:

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[4] Cited in an IUCN Information Paper: *Carbon Sequestration, Biodiversity and Sustainable Livelihoods*, Working Draft 2.2., July 2000.

[5] Note that **if** the definition of a forest is not taken from an ecosystem approach, thus enabling simple gatherings of trees to be considered as a forest, the adoption of a full accounting system such as proposed here will allow to report all fluxes without really specifying if they are coming from a forest or not. The ecosystem approach will make the definition of a forest necessary, even with full carbon accounting.

[6] Adapted from IUCN, op. cit.

[Here, Parties will have to agree on a list of average C carbon per area unit, based on the work of SBSTA, IPCC and other relevant organisms]

Afforestation: Afforestation is the establishment of trees in an area of land, which previously had no forest cover, taking into account historical times. The differentiation with re- forestation is important because of its implications on management, environmental impacts and carbon sequestration potentials, mainly. For the purposes of the KP, the period in which this land was not covered by forests should be counted since 1990.

Re – forestation: Re-forestation is the establishment of trees in an area of land previously had forest or a forest ecosystem, taking into account historical times. The differentiation of this activity with afforestation is important because of its implications on management, environmental impacts and carbon sequestration potentials, mainly. For the purposes of the KP, the period in which this land was covered by forests should be counted since 1990.

Deforestation: Deforestation is **the process** in which a human-induced loss in the quantity of biomass of a forest occurs, with a tendency to convert a land covered by forest in a land with no forest or forest ecosystem. As a process, deforestation has many stages, from the initial thinning to the total clearing of the forest. Deforestation is caused by many activities, e.g. timber extraction (without sustainable forestry management), clear-cutting for agriculture or other means, burning, etc. Sustainable management of forests for timber production, although generally resulting in a biomass loss, and thus in a release of carbon to the atmosphere, should not be considered deforestation.

Prevention (avoidance) of deforestation: Prevention of deforestation is a comprehensive group of activities which starts a process contrary to deforestation, and directed to its deterrence. For accounting purposes, it reduces emissions by sources, by addressing one of the main sources of GHG emissions in the LULUCF sector. Avoidance of deforestation results in conservation of the biomass in a forest.

All direct human – induced loss of forest cover, other than sustainable forestry management, should be reported as deforestation. If the definition of deforestation does not cover **all** losses of forest biomass, then an equivalent activity (forest degradation) should be added to Article 3.4. In any case, these activities should not be overlooked from the accounting system, as according to a recent estimate[7], they could account for an amount between 33% and 43% for the total emissions from forests.

It is important to note that the potential carbon pool conserved in the case of avoidance of deforestation, when we take into account primary forests, is greater in almost all cases than the carbon sequestration potentials of the activities of afforestation and reforestation.

For a proper accounting of emissions coming from deforestation and partial deforestation, committed carbon emissions from soils must be properly addressed, either debiting all committed emissions in the period of deforestation or assigning them to subsequent periods.

The term “direct human induced” applied to LULUCF activities should be read as **every activity which is a product of an unequivocal and instant human action**, which generates GHG emissions by sources and/or removals by sinks, that should be accounted for in the way stated in point 4 below.

[7] Houghton, R.A. and Ramakrishna, Kilaparti. *A review of National Emissions Inventories from Select Non-Annex I Countries*, in Annual Review on Energy and Environment, 1999.

3. Additional human – induced activities in the LULUCF sector and modalities of inclusions in the accounting system

All other human induced activities, different from ARD, should be counted in Article 3.4. For accounting purposes, all direct human – induced activities which produce emissions should be reported, and its emissions of GHG gases should be quantified. Only the direct human - induced activities which produce significant removal of GHG should be reported. All activities should seek to differentiate natural fluxes from those which are directly human - induced. For climatic coherence, the reference to "human induced" activities in Art. 3.4 should be read as "direct human – induced", as defined in point 2 above.

Annex I countries should be allowed to count on these 3.4 activities (and report about them for compliance purposes), for the first commitment period, only if they compare the net emissions in 1990 (emissions by sources minus removals by sinks) against net emissions in the first commitment period, with a reliable certainty (90% interval of confidence on 10% error range). Otherwise, they should be allowed to count on theses activities only from the start of the second commitment period onwards. Commitment periods should be contiguous, in order to avoid perverse incentives for the release of GHG from 3.4 activities and its subsequent absorption, thus claiming credits.

However, activities other than ARD should be allowed for an early start of the CDM, but they could be limited to the activities proposed in point 6.1 below.

If partial deforestation is not included in Article 3.3, then an equivalent activity should be added to Article 3.4, as forest degradation. In this case, forest protection from degradation should be added to the activities qualifying for the CDM, from the beginning of the operation of this Mechanism.

4. Methodologies for measuring and reporting of LULUCF activities related to Annex B compliance

In view of the issues concerned, which involve a more accurate carbon flux and stock accounting system, new Measurement and Reporting Guidelines for the implementation of the relevant Articles of the KP (i.e. Articles 3.3 and 3.4) will have to be developed by the relevant Bodies of the COP, with the technical assistance of the IPCC. The aim is to advance to a balance of the changes in stocks of carbon that reflects the real fluxes of carbon between the terrestrial ecosystems and the biosphere, aimed to a system that counts all the changes in above-ground and below-ground biomass, as well as the carbon contents in soils to a depth of 1 meter, including delayed emissions from soils. For the GHG other than carbon, only fluxes will have to be counted.

The measuring and reporting of changes in carbon stocks, for Annex B countries, in relation the compliance of commitments acquired under the KP, should be done on a national basis (land-based accounting system) with a very specific definition of activities, in an analogous form as in current national inventory methodologies, just as done until now, but only adjusting the definitions of forest and deforestation, and the Guidelines to properly report changes in biomass and soil carbon.

All emissions by sources from 3.3 and 3.4 activities should be reported, as it is not consistent with the objectives and principles of the UNFCCC to count only removals, while not counting for emissions.

At the same time, only the substantial removals by sinks (i.e. only those which are expected to grow very fast and/or become a large sink with time, under unequivocal direct human action) should be reported for the means of determining Annex B Parties' net emissions level, in compliance of their commitments acquired under Article 3 of the KP.

Reports of Annex B Parties should be made using, as applicable under national circumstances, remote sensing of data accompanied by methodical in–site verification. This measuring and reporting should

be transparent and open to verification by third parties, including UNFCCC organisms. The reporting system should penalize evident inaccuracies, by the means of the compliance system, as stated in point 5 below.

5. Overall accounting approaches

Annex I countries should use their best estimate on emissions by sources and/or removals by sinks, to arrive to a net figure for their LULUCF sector, employing state-of-the art technology combined with on-the-ground plot analysis. The guiding principle is to count all emissions, while counting only the relevant uptakes or removals, as already stated in point 4 above, at the national level. This principle should be applied also to projects, only taking into account that their baseline can be narrower than the national level.

The accounting system should avoid, by all means and methods possible, that Annex B Parties are credited for removals by sinks due to the natural variability of their forests and other terrestrial ecosystems. These means and methods should be updated as often and practicable thereafter.

It is indispensable to establish a system of carbon accounting which reflects the directly human-induced exchanges of GHG between the terrestrial biosphere and the atmosphere, with the greater accuracy as practicable, clearly establishing direct human-induced effects, crediting only real and measurable efforts in climate change mitigation, through LULUCF activities that go beyond *"business as usual"* activities in Annex I countries.

For a proper accounting of emissions coming from deforestation and partial deforestation, committed carbon emissions from soils must be properly addressed, either debiting all committed emissions in the period of deforestation or assigning them to subsequent periods.

Moreover, the estimations on biomass coming from tropical forests will have to be refined, with the last data coming from on/ground studies. There is an outstanding controversy on the measurement of above- and below-ground biomass which has to be resolved with an objective analysis by the IPCC. Recent estimates indicate that the data on biomass in tropical forests might be underestimated. The differences in estimates are substantial enough to deserve an impartial analysis of these disparities.

The accounting system, together with the reporting methodologies for Annex B Parties, will have to be linked to the compliance system, developing the appropriate procedures to penalize inaccuracies in reporting, as well as subsequent losses in previous reported removals by sources, increasing the Assigned Amount Units by a level equal to this inaccuracy/loss, on the next commitment period.

Annex B parties will be permitted to include 3.4 activities in the first commitment period only if they are able to make available comparable figures for net emissions in 1990 (emissions by sources minus removals by sinks) against net emissions in the first commitment period, with a reliable certainty (90% interval of confidence on 10% error range), and still maintain their level of committed reductions, in relation to net emissions figures Otherwise, Annex B Parties will only be allowed to include 3.4 activities from the second commitment period onwards.

CDM and JI projects shall have a very specific definition of activities. For the carbon credit accounting system they should use: **a)** Stock – change crediting with ton – year liability assessment, meaning that all credits should be assigned at the commencement of the project, discounting the credits lost in any eventuality by the ton/year accounting system; b) Ex – ante ton – year crediting, with an analogous mechanism for the allocation of the carbon credits. The temporal scale for full crediting should be set to 46 years, as a result of discounting the climatic effects of 1 ton of sequestered/conserved carbon over a period of 100 years. ARD activities, as well as 3.4 activities, should be included in the CDM projects, from the commencement of operation onwards. 3.4 activities

should only be included for Annex I countries provided they comply with the requirements outlined above.

Projects should be defined as very specific and delimitated activities. The baseline for projects should be defined in a case-by-case basis, according to their nature and to the necessity to take into account the requirements on additionality, verifiability, transparence, leakage control or avoidance, and permanence (duration). Baselines considered for the CDM shall include project-specific, regional and multi-project baselines. In some cases, sectoral baselines and standard baselines for project categories for each host Party may be applied. A multi-project, regional or sectoral baseline for a given project type or specific area defines what the emissions by sources or removals by sinks would have been in the absence of the CDM project, using a performance standard approved by the Executive Board.

According to this baseline, all emissions by sources should be counted, while only the substantial removals by sinks should be credited to the projects.

6. LULUCF activities in the Clean Development Mechanism.

6.1. LULUCF Activities in the context of the Flexibility Mechanisms

As already stated in point 1 above, LULUCF activities can play an important role in the compliance system of the Kyoto Protocol (KP), as well as in the project-based flexibility mechanisms of the KP, especially in the Clean Development Mechanism (CDM). A proper combination of projects in the LULUCF sector with those in the energy sector will provide Non-Annex I countries with a balanced regional participation. Excluding LULUCF activities from the CDM will deny the great majority of Non – Annex I countries with the possibility of participation in the CDM, and this would be inconsistent with the principles agreed in Article 3 of the UNFCCC.

For the early commencement of the CDM, the following activities are proposed for initial qualification in the CDM:

a) Afforestation
b) Reforestation
c) Reduction of emissions by prevention (avoidance) of deforestation
d) Improvement of management in forest and agricultural soils[8]
e) Rehabilitation/restoration of severely degraded lands

Projects of utilization of biomass as an energy source should be considered combined energy/LULUCF projects, with methodologies applicable on a case-by-case basis, according to the relative importance of each of the components of the project.

To avoid incentives for activities that are harmful from an environmental, socioeconomic and cultural point of view, minimum criteria of defining baselines, in accordance to the principles and guidelines already negotiated in Agenda 21 and the Multilateral Environmental Agreements, should be applied for the certification of CDM projects.

This issue links directly with the issue on how to define sustainable development criteria for CDM projects. Although this is to remain a subject of sovereign definition of the Parties involved, a general

[8] These activities include, but are not limited to, the following:
- Improvement in Sustainable Forestry Management to a point below certain agreed standards;
- Enhancement of natural regeneration of forests;
- Agro-forestry, including windbreakers and yield of trees in combination with cattle management;
- Sustainable soil management, in accordance to its use capacity;

framework must be established, thus avoiding perverse incentives to undertake activities aimed e.g. solely at carbon sequestration, without taking into account the additional socioeconomic, cultural and environmental effects of the projects itself. This is also why we propose that no project activity should have effects that go against the objectives of the Multilateral Environmental Agreements (MEA) and the principles already agreed in Agenda 21 and the UN Commission on Sustainable Development.

In addition, LULUCF projects in the CDM must receive a similar treatment as energy projects, in respect to on additionality, verifiability, transparence, and leakage control. The only distinctive issue for LULUCF projects will be the one on avoiding the reversibility on the carbon benefits of each projects which should be taken care of with a proper involvement of all stakeholders of the projects, creating socioeconomic alternatives to the carbon release and the appropriate accounting methods, already addressed in point 5 above, in the paragraphs relative to CDM/JI projects.

Other general CDM principles applicable to LULUCF projects, aimed at assuring practicability and a balanced regional participation, are the following:

I. In addition to traditional Annex I financing of projects, public and private entities from Non-Annex Parties may finance and implement projects under the guidelines of Article 12 of the KP. Project financing may be provided by other sources, including international financial entities. The Certified Emissions Reductions (CERUS) generated by these project could be then transferred to an Annex I entity or Party for compliance with their assigned amounts, according to Article 3.12 of the KP.

II. The adaptation fund of the CDM should be funded, *inter alia*, by a portion of the proceeds from CDM, JI and IET transactions. Impact assessment and adaptation activities must be very closely coordinated. Developing country Parties, according to their needs and priorities identified in their national communications and other programs and strategies, should be assisted with capacity building at all levels in order to be able to carry out such activities. The administrative expenses of the Flexibility Mechanisms shall also be covered on an equitable basis by all CDM, JI and IET transactions.

III. A project activity initiated before the COP/MOP, with the agreement of the participating Parties, shall be eligible for validation and registration as a CDM project activity if it meets the criteria approved for CDM. Following project validation and registration, resultant reductions in emissions by sources and/or removals by sinks, will be eligible for certification since 1st January 2000.

IV. Once generated, CERUS can be transferred to any Annex B Party, and can be used by any Annex B Party, to comply with their assigned amounts, according to Article 3.12 of the KP.

6.2. Legal grounds for including LULUCF activities in the Clean Development Mechanism

Some Parties have made comments made suggesting that Land Use, Land Use Change and Forestry (LULUCF) projects are ineligible under Article 12 of the Protocol, which defines the Clean Development Mechanism (CDM of the Kyoto Protocol). In our view, these comments do not have any valid legal or scientific basis, and have become an unwelcome distraction from efforts to develop the rules necessary to ensure that the CDM fulfills its purposes of assisting Non-Annex I Parties in achieving sustainable development, and assisting Annex I Parties in achieving compliance with their quantified emission limitation and reduction commitments, with a contribution to the ultimate objective of the Convention.

A submission on these issues was made on June 2000 by a group of 14 Latin American countries, Bolivia among them[9], and the arguments exposed there are essentially the same as those exposed in the present item.

LULUCF activities should be included in the CDM, first of all, because the UNFCCC and the KP are an integral part of the same legal framework, which involves Agenda 21, the Convention on Biodiversity and other MEA. From this point of view, the principle of sustainable development requires the qualification of LULUCF projects in the CDM provided they comply with the approved rules on additionality, permanence, leakage management or avoidance, verifiability and long-term climate benefits.

Consistency between UN Agreements and Conventions calls for the inclusion of forest conservation and regeneration activities, as well as other LULUCF activities, within the CDM, taking into account the necessary compatibility of objectives between Agenda 21, the UNFCCC, and the Conventions on Biodiversity, Desertification, and Wetlands (also known as Ramsar). Forest conservation and regeneration projects, as well as recovering degradated soils and improving agricultural management, have very significant and positive collateral results, such as improving life quality[10], biodiversity and soil conservation, protection of river basins, and the promotion of the development of indigenous and local populations.

To this effect, questions of interpretation of the Kyoto Protocol must be resolved in accordance with Article 2 of the Convention which states: *«The ultimate objective of this Convention and any related legal instruments that the Conference of the Parties may adopt is to achieve, in accordance with the relevant provisions of the Convention, stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system»*. Consistent with this objective, we remark that LULUCF projects are eligible under the Article 12 CDM, because Article 12 does not explicitly or implicitly exclude LULUCF projects from eligibility. The plain language of Article 12 does not contain *any* explicit exclusion of any category of projects.

Some legal points on the inclusion of LULUCF activities in the CDM are the following:

a) Inclusion of LULUCF activities in the CDM is consistent with the guiding principles of the Kyoto Protocol. The Preamble to the Protocol states that the Parties to the Protocol will be *«guided by Article 3 of the Convention»*, which defines the Convention's principles. One of the most important Article 3 principles is the one that sets forth that the policies and measures undertaken by the Parties *«should take into account different socio-economic contexts, be comprehensive, cover all relevant sources, sinks and reservoirs of greenhouse gases and adaptation, and comprise all economic sectors»*. Reading into Article 12 an implicit exclusion of LULUCF projects is inconsistent with this guiding principle of the Protocol. Obviously, the drafters of the PK intended to preserve this principle of comprehensiveness established in the text of the Convention.

b) Inclusion of LULUCF activities in the CDM is consistent with Article 2 of the Protocol. Article 2 of the Kyoto Protocol sets forth how each Annex I Party is to achieve its quantified emission limitation and reduction commitments (QELRCs) under Article 3 while promoting sustainable development. Paragraph 1 of Article 2 states that each Annex I Party shall *«… [i] implement and/or further elaborate policies and measures in accordance with its national circumstances, such as: …(ii) [p]protection and enhancement of sinks and reservoirs of greenhouse gases*[11] *not*

[9] See document FCCC/SB/2000/MISC.1/Add.2, dated 16th June 2000

[10] Resulting from positive socioeconomic effects, direct and indirect.

[11] This includes, naturally, primary forests (Note by the submission authors).

controlled by the Montreal Protocol taking into account its commitments under relevant environmental agreements[12]*, promotion of sustainable forest management practices*[13]*, afforestation and reforestation; …and (iii) promotion of sustainable forms of agriculture in light of climate change considerations».* Given that the purposes stated in Article 12 are to provide a means for Annex I Parties to achieve their QELRCs and to contribute to sustainable development, it is coherent to assume that Article 2 dictates the scope of activities eligible under Article 12.

c) The Convention, in its Article 4, paragraph 1, defines the mandatory activities that the Parties have to undertake, in stating that *«All Parties, taking into account their common but differentiated responsibilities, and their specific national and regional development priorities, objectives, and circumstances shall ...d) promote sustainable management and promote and cooperate in the conservation and enhancement, as appropriate, of sinks and reservoirs of all greenhouse gases not controlled by the Montreal Protocol,* ***including biomass, forests and oceans as well as other terrestrial, coastal and marine ecosystems***»[14].

d) The term "emission reductions" as it is used in Article 12 does not imply that only projects that reduce emissions, and not projects that remove emissions, may be considered under Article 12 of the CDM. The term "emission reductions" is not explicitly defined in either the Convention or the Protocol. Throughout the Protocol, it is used as a term of art to refer **to particular kinds of units of account** rather than particular types of activities.

The term "emission reductions" appears for the first time in Articles 3.10, 3.11 and 3.12. Articles 3.10 and 3.11 use the term "emission reductions units" as the Article 6 unit of account to adjust the assigned amounts of the Parties involved. Similarly, Article 3.12 uses the term "certified emission reductions" as the unit of account to adjust the assigned amount of the acquiring Party in a CDM transaction. The text uses the word "certified" to distinguish the emissions reduction units of account obtained under Article 12 from those obtained under Article 6.

The next appearance of the term "emission reductions" is in Article 6. The plain language of Article 6 states that "emission reduction units" may *«result […] from projects aimed at* ***reducing anthropogenic emissions by sources or enhancing anthropogenic removals by sinks in any sector of the economy****»* (emphasis added).

Accordingly, the Protocol uses the term "emission reductions" in connection with the project-based mechanisms to describe the impact of projects on Parties' accounts, **not the type or category of project**. Moreover, Article 6 makes clear that the drafters contemplated that "emission reduction units" could result from projects that enhance removals by sinks. Where the drafters intended to distinguish among categories of eligible activities and projects, they did so explicitly, e.g., the reference in Article 6 to "projects aimed at reducing anthropogenic emissions by sources or enhancing anthropogenic removals by sinks"; and the reference in Article 3.3 to "afforestation, reforestation, and deforestation."

Additionally, it is important to note that not all LULUCF projects are sinks projects. As the IPCC has recognized, forests can be sources, sinks, or reservoirs. Many LULUCF projects slow, reduce, or avoid deforestation. Such projects reduce anthropogenic emissions by sources.

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[12] For example, the Biodiversity Convention (Note by the submission authors).

[13] Includes forest conservation and regeneration, *inter alia*. (Note by the submission authors).

[14] It is important to note that, in including sinks, we are addressing forests, primarily, but also, according to other IPCC documents, additionally other terrestrial ecosystems (such as wetlands, savannas, etc.) and marine ecosystems, such as coral reefs. Coastal wetlands are important carbon sinks in the boundaries between those two habitats.

e) Inclusion of LULUCF activities in the CDM is consistent with the mandatory and comprehensive accounting framework for Annex I Parties established under Articles 3.3. and 3.4. Article 3.3 states that *«… net changes in greenhouse gas emissions by sources and removals by sinks, resulting from direct human-induced land-use change and forestry activities, limited to afforestation, reforestation and deforestation since 1990, measured as verifiable changes in carbon stocks in each commitment period, **shall** be used to meet the commitments under this Article of each Party included in Annex I»* (emphasis added). Accordingly, Article 3.3 establishes explicitly that Annex I Parties must take into account certain LULUCF activities in meeting their commitments under Article 3. Since Article 3.3 refers explicitly to "net changes" -a phrase which automatically includes **emissions by sources and removals by sinks**- and since one of the purposes of Article 12 is to assist those Parties in meeting their commitments under Article 3, it would be inconsistent with the mandatory Article 3.3 accounting framework to exclude LULUCF projects from Article 12. **Accordingly, the scope of projects eligible under Article 12 should correspond to the activities eligible under Articles 3.3 and 3.4**.

To the extent that arguments against the eligibility of LULUCF projects under Article 12 represent a "back-door" effort to renegotiate Article 3 or any other provisions of the Protocol, this would undermine the efforts make towards ratification and entry into force of the PK. As Article 26 of the Protocol makes clear, the text of the Protocol is final and whole. It is not subject to renegotiation.

f) Inclusion of LULUCF activities in the CDM is consistent with the purpose of the CDM of assisting Non-Annex I countries in achieving sustainable development and meeting the costs of adaptation measures. The sustainable management of natural resources, including land use, land-use change and forestry activities, is deemed critical for the achievement of sustainable development as well as for addressing, in an effective way, vulnerability to climate change. Conversely, deforestation and land degradation increase the vulnerability of Non-Annex I countries, their local communities and indigenous people to the global climate change. Not including LULUCF activities in the CDM conflicts fundamentally with the ultimate objective of the Convention expressed in Article 2 and conflicts with the principles expressed in Article 3.1 (*«The Parties should protect the climate system for the benefit of present and future generations of humankind, on the basis of equity and in accordance with their common but differentiated responsibilities and respective capabilities»*).

g) Some observers have asserted that a lack of full scientific certainty about the validity of LULUCF projects justifies making such projects ineligible under Article 12. This argument is inconsistent with the guiding principles of the Protocol as expressed in Article 3 of the Convention. Article 3.3 of the Convention states that: *«The Parties should take precautionary measures to anticipate, prevent or minimize the causes of climate change and mitigate its adverse effects. Where there are threats of serious or irreversible damage, **lack of full scientific certainty should not be used as a reason for postponing such measures**, taking into account the policies and measures to deal with climate change should be cost-effective so as to ensure global benefits at the lowest possible cost»* (emphasis added).

Moreover, even if there was at one time a lack of full scientific certainty about the merits of projects from the LULUCF sector, particularly compared to projects from the energy sector, this uncertainty has been resolved by the authoritative IPCC Special Report on Land Use, Land Use Change, and Forestry, as stated in point 6.2. below.

In conclusion, according to the letter of the Protocol, the spirit of the negotiations, and the purpose of the Clean Development Mechanism, LULUCF projects are eligible to receive certified emissions reductions. The scope of eligible LULUCF projects should correspond to the activities established under the Article 3.3 and those under Article 3.4. Projects that effectively and credibly avoid, slow, or

reduce deforestation are covered under Article 3.3, whether the project includes total protection or forest management, as an alternative to deforestation. Excluding LULUCF projects and other related activities from the CDM will go against the spirit, objectives and principles of the Convention and the Kyoto Protocol.

6.3. Climatic grounds for inclusion of LULUCF activities in the CDM

Deforestation and other land use changes have resulted, from 1850 through 1990, in accumulated emissions of 124 Gt of carbon into the atmosphere[15], a majority of which (60%) was produced in tropical ecosystems. Net emissions from this sector reached approximately 1.7 to 2.0 Gt of carbon per year, during the 80's. Some estimates indicate that, nowadays, deforestation causes roughly 25% of global GHG emissions, which accounts for the second most important cause of emissions, after energy sector and industrial process emissions[16]. It was also estimated, as a result of deforestation, more than 75 Gt million of carbon equivalent tons will be emitted into the atmosphere, from 1998 through 2050, which represents more than 1 Gt of equivalent carbon per year[17].

In that view, given the relative importance of the LULUCF sector, which could be greater if a proper adjustment is made, even with the present figures we can see that most of the substantive action in Non - Annex Parties could only be achieved with activities in the LULUCF sector. For the great majority of Non-Annex I Parties, the major share of their emissions come from the LULUCF sector.

For the case of Bolivia, approximately 90% of its GHG emissions come from the LULUCF sector[18], so its main possibilities of participation are precisely in this sector. As for the scale of its energy sector, even taking into account that technologies in Bolivia are not always state-of-the-art, the emissions of the whole country are so small, that only one urban area from the United States, namely Manhattan, has 26.74 times the emissions of the energy sector of Bolivia[19].

Some other facts that substantiate the inclusion of LULUCF activities in the CDM are the following:

- By the year 2010, annual reductions from approximately 1.5 to 3.23 Gt of carbon can be achieved[20] with an appropriate combination of activities of conservation of tropical and temperate forests, regeneration, reforestation, land management and fuelwood consumption.

- Climate effects of preventing CO_2 emissions due to forest clearing are the same as those attained

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[15] The error rank for these figures, either by excess and/or defect, is 40 billion tons of carbon (source*: IPCC, 1994, CO2 and the Carbon Cycle*).

[16] Estimates for the rank of accumulated emissions related to land use and forestry activities under *business as usual* scenarios, from 1990 to 2100, oscillate between 30 Gt and 320 Gt of carbon. For scenarios under an emission reduction policy, estimates oscillate between 30 Gt to 150 Gt of carbon, for the same period. (Source: *An Evaluation of the IPCC 1992, Emission Scenarios,* IPCC, 1994). Some recent studies on biomass in the Amazonian forests suggest that the previous figures might have to be revised, because they underestimate the density of biomass in tropical forests (Source: Fearnside, *Greenhouse gases from Deforestation in Brazilian Amazonia: Net Committed Emissions,* 1997; Fearnside, *Biomassa das Florestas Amazònicas Brasileiras,* 1994)

[17] These figures coincide with those provided by the IPCC which, in its 1995 Second Evaluation Report indicates that, for the period 1995-2050, some conservation and carbon sequestration measures can be implemented, thus enabling a reduction of 60 Gt to 90 Gt of equivalent carbon emissions in the forestry sector. One ton of equivalent carbon corresponds to 3,67 tons of CO2.

[18] Taken from the national GHG emissions inventory developed by the Bolivian National Program on Climate Change.

[19] First rough estimate based on national inventories from the US and Bolivia.

[20] Source: IPCC, *Special Report on Land Use, Land-Use Change and* Forestry, Cambridge University Press, US, 2000. The figure is taken from the potentials estimated from the figures given in Table 3-16 (page 173) for deforestation and fuelwood consumption, and in table 4-1 (page 184) for additional activities under Article 3.4 of the KP. According to other estimates, this could account for between 12% and 15% of equivalent carbon emissions caused by fossil fuel burning.

by preventing CO_2 emissions from the industrial and energy sectors, with a relatively lower marginal cost, at least in the first 50 years of implementation of the KP.

With regards to quantification of benefits at the project level, as well as additionality, baselines and leakages, these do not represent a significant analytical problem, as formerly supposed, since more accurate measurement and control techniques are becoming widely available, and the remaining uncertainties can be solved in a relatively short term.

On the other hand, the IPCC Special Report on Land Use, Land-Use Change and Forestry made no exclusionary conclusion on LULUCF in the CDM. This report cites with approval a review and comparison of projects from both sectors. The IPCC Report states:

> *«This assessment found that LULUCF and energy projects face parallel, comparable issues in measurement and in ensuring social and environmental benefits.* ***In general, it is not possible to assert that energy projects are superior as a class to LULUCF projects on these grounds***[21]*»* (Emphasis added).

The IPCC report identified only one significant difference between projects in the two sectors. This issue, duration, is associated with only certain types of LULUCF projects and can be addressed through project design. All in all, the IPCC Special Report does not provide any scientific basis for excluding the entire category of LULUCF projects from eligibility under the CDM.

To address the issue of duration, it is important to quote Paragraph 81 of the Summary for Policymakers of the Special Report, which states that *«risk reduction could be addressed through a variety of approaches internal to the project, such as introduction of good practice management systems, diversification of project activities and funding sources, self-insurance reserves, involvement of local stakeholders, external auditing and verification […] external approaches for risk reduction include standard insurance services, regional carbon pools, and portfolio diversification»*[22].

6.4. Other environmental and sustainable development grounds for inclusion of LULUCF activities in the CDM

It is well known that the inclusion of projects of forest conservation and regeneration, as well as other LULUCF projects, meets the CDM objective of promoting sustainable development of the countries involved in such specific projects, by means of protecting the biodiversity and the environmental services of terrestrial ecosystems. On the other hand, projects that are aimed at the restoration/rehabilitation of severely degraded lands preserve and recover local biodiversity and agro-biodiversity, thus increasing the quality of life for local communities and indigenous people.

Deforestation, on the other hand, is a complex socioeconomic phenomenon which is caused, mainly, by two major causes:

a) Overexploitation of forest resources, mainly timber, but also water and soils by major corporations and private capitals (e.g. expansion of the agricultural frontier by big agro-industrial enterprises).

b) Clear cutting or burning of small portions of forests, which become large on the aggregate, by local communities searching for land, engaging in migratory agriculture for survival purposes (1-2 years maximum per patch of deforested land).

[21] IPCC, Ibídem, Chapter 5.
[22] IPCC, Ibídem, page 16.

In this light, projects that aim to carbon sequestration and/or emissions avoidance in forests, coupled with the proper community activities, may offer an alternative means for improving these communities' quality of life without destroying forest habitats, and thus increasing GHG emissions to the atmosphere.

Including LULUCF activities in the CDM, either if they are in forests or other terrestrial ecosystems, will have the following ancillary benefits[23]:

I. The ecological complexity of forests and other terrestrial ecosystems will be recognized, emphasizing the importance of functional relationships, processes and structure of these ecosystems, tending to a sustainable use of water, soil, wildlife and genetic resources.

II. Mass-scale deforestation could be avoided and afforestation and reforestation could be encouraged, where they would contribute to environmental, cultural and social values.

III. Management activities in forests and other terrestrial ecosystems could be set for the long-term period including the need to enhance resiliency of ecosystems to future climate change, designing mechanisms to account for environmental conditions that limit natural productivity, ecosystem structure and diversity.

IV. Projects that maximize ecological and socio-cultural benefits, minimizing costs at the same time, could be favored, managing all possible trade-offs to obtain the best possible mix of climatic, environmental, economic and socio-cultural results.

6.5. Economic grounds for inclusion of LULUCF activities in the CDM

Among the economic grounds to include LULUCF projects in the CDM we can name the following:

- Inclusion of LULUCF activities, especially those listed in point 6.1. above, meets the purpose of minimizing costs derived from the complying of commitments in the KP for the global reduction of GHG emissions, in general.

- One of the main economic arguments to include LULUCF activities in the CDM is that the lower marginal cost for unit of carbon ton of these activities makes this option a very competitive option in front of other CDM options. These other options would presumably be in disadvantage with JI projects, due to higher transaction costs deriving from the KP provisions[24]. To level the opportunities, only projects with lower marginal cost per reduced ton of equivalent carbon will be able to compete against JI projects, and these are precisely forest conservation projects.

- If only energy projects are allowed to qualify in the CDM, the great majority of projects will go to a couple of Non-Annex I Parties[25]. The energy sector of the great majority of Non-Annex I parties is very small and not comparable in scale to the market of these limited number of Parties. Competitiveness will be impossible for this majority of countries because of the economies of scale involved. The only possibility of a broader participation will be to qualify LULUCF projects for the CDM[26].

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[23] Taken from the IUCN Discussion Paper, already mentioned.

[24] These transaction costs are higher for CDM, because this mechanism has to meet administrative expenses and assistance to developing countries that are particularly vulnerable to the adverse effects of climate change to meet the costs of adaptation (so called *"adaptation costs"*). To level the opportunities, these costs shall be applied to all projects and transactions of the CDM, the JI and the IET.

[25] Namely China and India will have roughly 75% of the CDM "market".

[26] Which will reduce the market share for China and India to 30%, thus leaving a larger portion of it for the smaller Parties (smaller in relation to the scale of their energy sector).

- There are favorable circumstances to include these activities, as well as **great opportunity costs derived from its omission**. It would not be a realistic approach to expect that the major Annex I Parties would ratify the Kyoto Protocol without including LULUCF activities under the CDM. If there is a serious intention to promptly implement the KP ratification process, this reality must be taken into account. On the other hand, the Joint Implementation mechanism, *inter alia*, already permits Annex I countries to include sinks in their net reductions accounting.

- There is no sensible rationale in trying to force high compliance costs on the Annex B countries, or in denying those countries to use their LULUCF sector or LULUCF projects in the CDM to comply with their commitments. It is a reasonable economic behavior to look for the lowest cost for compliance, in general, and establishing high "barriers to entry" in the Kyoto Protocol could only lead to delay its ratification, or to the desistance of the major Annex I countries to ratify it at all, thereby undermining the efforts to reach a practicable system of climate change mitigation.

- Many G77 countries are interested in the inclusion of LULUCF projects within the CDM, because this constitutes the only means to have a real opportunity of participation. If some other G77 members adopt positions that are too inflexible in this issue, disagreement and frictions between its members are likely to appear, hence undermining the unity of the Group and its possibilities of negotiation.

PAPER NO. 3: CANADA

PROPOSALS RELATED TO KYOTO PROTOCOL ARTICLES 3.3 AND 3.4

CONTENTS

1. INTRODUCTION

1.1 Goals for CoP6

At CoP4 Parties decided to recommend draft decisions on Article 3.3 and 3.4 at CoP6 (FCCC/CP/1998/16/Add.1, Decision 9/CP.4). Subsequently, at CoP5, Parties decided to endorse a work programme and elements of a decision-making framework with a view to CoP6 recommending draft decisions on Articles 3.3 and 3.4 (FCCC/CP/1999/6/Add.1, Decision 16/CP.5). Therefore the objective of CoP6 is to make decisions on the two Articles as a package. For many countries, including Canada, a clear understanding of the implications of both Articles 3.3 and 3.4 together, based on decisions at CoP6, is needed as we consider ratification of the Kyoto Protocol.

At CoP6, clear decisions are needed with reference to:

1) definitions of afforestation, reforestation and deforestation (ARD) under Article 3.3;
2) agreement on additional activities to be included in the accounting under Article 3.4; and
3) agreement on the framework of an accounting system for Articles 3.3 and 3.4, including how additional activities will be included.

We stress that we strongly support a package of decisions on Articles 3.3 and 3.4. We also believe that further rules of the accounting system can be negotiated at CoP7, once an accounting framework has been established. This could include; for example, further rules designed to ensure transparency and verifiability, and to account for uncertainty.

1.2 Scope of this Submission

To aid decision-making at CoP6, Parties agreed at SBSTA 11 (FCCC/SBSTA/1999/14) to provide submissions on:

1) proposals for definitions of activities under Article 3.3, including information on the methodologies that a Party intends to use to measure and report on the verifiable carbon stock changes associated with the activities, and an assessment of the verifiable changes in stocks resulting from the activities;
2) preliminary data and information as specified in the first sentence of Article 3.4; and
3) proposals for additional activities to include under Article 3.4, including information on methodologies that a Party intends to use to measure and report on the greenhouse gas emissions and removals associated with the activities, and an assessment of these emissions and removals.

SBSTA 12, in June 2000, gave further guidance on the preparation of the submissions. In its conclusions, SBSTA:

1) requested that Parties provide textual proposals on Articles 3.3, 3.4 and 3.7;
2) agreed on data formats for Parties' preliminary data and information; and
3) provided the Chairman and the Secretariat with guidance on preparing a consolidated synthesis of proposals.

This submission outlines Canada's proposals for a comprehensive approach to protect and enhance sinks and reservoirs in order to assist the achievement of the ultimate objective of the Convention. It outlines solutions to address the weaknesses inherent in Article 3.3 through a "package" approach to Articles 3.3 and 3.4, with a view to providing a comprehensive inclusion of forestry in the Protocol. It also presents proposals to include agricultural and forestry activities that provide benefits to the global environment as well as a wide range of other environmental, social and economic benefits. These proposals should be considered in their entirety. Data tables and explanatory notes are included in Annex 1. A consolidated textual proposal is provided in Annex 2. Additional details on agricultural data are in Annex 3.

1.3 Canada's Approach to Articles 3.3 and 3.4

Canada's approach is based on eight principles, which should guide decision-making in relation to land-use, land-use change and forestry (LULUCF).

Support the objective and commitments of the UNFCCC. Decisions on Articles 3.3 and 3.4 should support the UNFCCC objective to stabilize greenhouse gas concentrations in the atmosphere at a level that avoids dangerous anthropogenic interference with the climate system. Both emission reductions and increased carbon removals can help achieve this objective. Furthermore, in both the Convention (Article 4.2a) and Protocol (Article 2) Parties have agreed to protect and enhance relevant sinks and reservoirs of greenhouse gases. In making decisions, Parties should support incentives to fulfill this commitment, and to remove disincentives that work against its attainment.

Accommodate national circumstances. The economic, social, environmental, cultural, historical and geographic characteristics of Parties vary greatly, as do the nature, extent and use of their land resources. Agreement will be reached on Articles 3.3 and 3.4 only if all Parties carefully consider the circumstances of other Parties as negotiations proceed, and if all Parties make clear their national circumstances. Article 2.1(a) of the Protocol is clear that national circumstances are to be taken into account when examining policies and measures, including the protection and enhancement of sinks and reservoirs. This has a number of implications for the package of decisions on Articles 3.3 and 3.4.

a) No Party should be penalized as a result of an approach that does not accommodate its national circumstances. This is a point of particular concern to Canada, as outlined below.
b) It is very unlikely that a single set of detailed definitions, accounting approaches and measurement systems can adequately account for the circumstances of all Parties.
c) Decisions that account for the differing circumstances of all Parties will facilitate involvement, encourage ratification, and promote efforts to meet UNFCCC and Protocol commitments by all Parties.

From the point of view of reaching decisions on LULUCF, Canada believes that an attempt to derive detailed and universally applicable definitions, accounting approaches and measurement systems will not be successful. Instead, Parties should focus on constructing frameworks within which the national circumstances of all Parties can be appropriately accommodated. This would help to ensure cost-effective implementation of Articles 3.3 and 3.4 as part of Parties' broader land management, resource assessment and environmental policies. It would also provide scope for Parties to employ terms and definitions consistent with those used for these policies and for forestry and other land management practices in their country.

No decrease in agreed assigned amounts due to unbalanced accounting. At Kyoto, Annex B Parties agreed to legally binding commitments for the first commitment period with real and environmentally responsible targets, based on an understanding of what was and would likely be included in the Protocol. Parties will find it difficult to agree to decisions on Articles 3.3 and 3.4 that: a) decrease their assigned amounts in the first commitment period due to unbalanced accounting for LULUCF; or b) do not incorporate a framework within which their national circumstances are accommodated. By unbalanced accounting we mean accounting that does not provide an accurate reflection of relevant carbon stock changes.

Achieve a balanced and comprehensive approach to both sinks and sources. Such an approach would include all anthropogenic sinks and sources. It would provide incentives for the full range of activities that can significantly affect carbon stocks and result in enhancement of sinks and reductions in sources, including land-use activities and **not** just land-use change activities. Instead of such a balanced and comprehensive approach, Article 3.3 takes a very limited and piecemeal approach to achieving the objective of the UNFCCC. As the IPCC Special Report described in some detail (e.g. Section 3.3), Article 3.3 can create perverse incentives that encourage emissions of carbon or discourage removals of carbon, and it also results in an accounting system that does not reflect the impact of human activities on the landscape. A more comprehensive approach would minimize these perverse effects. Thus Canada strongly believes that decisions on Article 3.3 and 3.4 must be made simultaneously and treat the two articles in a single framework, in recognition of the linkages between the two and the opportunities provided by Article 3.4 to correct some of the imbalances associated with Article 3.3.

Strive for consistency. Parties should strive for consistency in a number of ways.

a) The LULUCF provisions of the Protocol will be difficult to operationalize if there is not full consistency within the Protocol. There are inconsistencies within Article 3, as well as between Articles 2, 3, 5, 6, and 12, and in terms of the approaches that some Parties are taking. For example, it is inconsistent to hold LULUCF to a higher standard of measurement than that required for some of the source categories already included in Annex A of the Protocol, which have very high levels of uncertainty associated with them. It is also inconsistent to include agricultural sources but not agricultural sinks.

b) The manner in which LULUCF is included in the Protocol, and the incentives that result, should be consistent with other relevant international environmental agreements, such as the Convention on Biological Diversity and the Convention to Combat Desertification.

c) Decisions on LULUCF should be consistent with and promote sustainable forest management and agriculture practices by Parties.

d) While we propose that Parties should have some flexibility to use definitions and accounting approaches that are most practical for them, within the rules and principles agreed by Parties, the definitions and approaches should be internally consistent and applied consistently within a country and over time.

Base decisions on sound science. To ensure the integrity of the UNFCCC, decisions should be based on recent and accepted scientific and technical literature. Parties should employ the best practical methods for measuring carbon and other greenhouse gas emissions and removals related to LULUCF, and ensure that the emissions and removals reported can be monitored, measured

and verified. The IPCC Special Report makes it clear that techniques and methods already exist, or are being developed, to address measurement issues.

Adopt flexible but credible accounting rules. A key objective of any accounting system is that it results in credible estimates. It also should be simple and cost effective. Accounting approaches should comply with principles of good practice guidance, transparency, consistency, accuracy, and verifiability. They should provide estimates of uncertainty and should allow valid comparisons between Parties' emissions and removals. Canada believes that Parties can ensure compliance with these principles while adopting rules that allow for some flexibility in accounting approaches suitable to the national circumstances of individual Parties, as is the case with national greenhouse gas inventory reporting.

Recognize that measurement systems and levels of understanding related to LULUCF will improve with time. Parties can expect that the quality of their data will improve as they refine their emission and removal inventories and track sources and sinks. Methodologies will improve with scientific and technical research, reducing accounting uncertainties. The onus should be on Parties to ensure transparency and verifiability of their estimates for the emissions and removals they report under Articles 3.3 and 3.4, subject to the accounting rules agreed by Parties. This means that Parties can make decisions at CoP6 on those elements of Articles 3.3 and 3.4 that are subject to some level of uncertainty, either in measurement ability or our level of understanding.

2. CANADA'S NATIONAL CIRCUMSTANCES - FORESTS

Canada's forest has no analogue among the forests of other Parties. This is due partly to the natural history of our forest and partly to Canada's youth as a country. The unique features of Canada's forests determine, inter alia:

a) Canada's forest management practices;
b) the potential impacts of Article 3.3 on Canada;
c) our views on the need for a balanced, flexible combined approach to Articles 3.3 and 3.4;
d) our approach to developing a rigorous, effective and yet feasible measuring, monitoring and verification system; and
e) domestic policies to enhance sinks and protect reservoirs.

All Parties possess unique forest and forest management variables that will need to be accommodated in Protocol decisions. Canada's forests and forest management differ from most countries and decisions should not penalize us as a result of our national circumstances. For example, relative to Canada, trees in some other countries may be substantially faster growing, and it may make more ecological and economic sense to suppress natural disturbances fully or very substantially. In some other countries, there may be a much longer history of forest management and relatively less natural forest and the forest industry activity may rely on significant areas of plantations and/or the use of intensively managed 'non-natural' forests. And relative to Canada, many other countries may have a much longer history of development, and therefore of forest clearing. It is important that Parties fully understand these differences based on differing biophysical characteristics and history, to appreciate the Canadian position on LULUCF.

Size of forest and history of development. Canadian forests cover 418 million hectares, almost half of the country and about 10 per cent of the world's forests. At the same time, Canada is a

young and very large country, with a relatively small population (30 million people) concentrated in an area along the southern perimeter of the country. Much of this area has been settled for less than 100 years. These characteristics mean that there is **no current or planned access to, or management of, a very substantial portion of the total forest due to its remoteness**. This means that our ability and resources to fight natural disturbances outside the accessible forest are minimal, and even within the accessible forest our ability to fight natural disturbances can be limited by vast distances and the size of the forest. These characteristics of our forest and history also mean that we are still removing forest cover as infrastructure is developed and agricultural and urban expansion occurs. While the area involved is only a small proportion of the forest, the rate of deforestation may be higher than in those countries that have developed over many centuries or millennia.

Forest characteristics. Canada's forest grows very slowly and is primarily natural, comprised of species that, in most regions of the country, typically take up to 100 years or so to reach their maximum carbon storage potential. The forest has an uneven age-class distribution skewed to the older age-classes as a result mainly of natural disturbances that have affected the forest over the last century. This means our forest currently stores a great deal of carbon but, as the age-class distribution changes, biomass carbon stocks could fall. The greatest share of the forest is boreal forest that is subject to highly variable natural disturbance patterns, resulting in significant carbon stock changes over extended periods of time. For example, in 1990-97, wildfire burned 0.6 to 6.3 million ha / year of the total forest (average of 2.6 million ha / year, or 0.6% of the total forest). Insects and diseases disturbances in 1990-97 affected 4 to 41 million ha / year (average of 17.5 million ha / year, or 4% of the total forest). We would like to emphasize that the classification 'boreal forest' lumps together many different types of northern forest ecosystems dominated by conifers. These forests differ from one another in their vegetation (e.g. composition, dynamics, and architecture), disturbance regimes, and climatic, geologic, pedogenic and anthropogenic histories. As a result of these differences, boreal forests around the world are not comparable in terms of their capacity as either a carbon sink or a reservoir.

Forest management. The very large size of our forest, its slow-growing nature, the relatively young age of Canada, and our relatively small population have meant that Canada has developed a largely export-oriented forest products industry which relies on extensive (rather than intensive) forest management. Long-term sustainability is the management objective. Compared to intensive management, extensive management involves a lower intensity of management over a larger area. Almost no afforestation (planting or seeding of trees on land that did not recently contain forest) has occurred. About 0.25% of the forest is harvested each year, with harvesting and silvicultural practices often designed to emulate average natural disturbance patterns and frequencies to the extent possible. Natural forest regeneration, a portion of which involves site preparation to assist regeneration, is used successfully as the means of reforestation for about 55% of harvested areas. Efforts to suppress natural disturbances have a significant impact within the managed forest area but Canada does not have the resources to significantly increase this effort. The figures noted above for natural disturbances reflect areas affected after efforts to suppress disturbances at significant cost – for example, the average annual expenditure by governments and industry on fire suppression is about CDN$0.5 billion per year. It is neither ecologically advisable nor economically feasible to fully suppress disturbances such as wildfire, which are a fundamental part of boreal forest ecology and biodiversity.

Impact of climate change. Of particular concern to Canada is the possible net impact of climate change on our forest. Because of the geography and biophysical characteristics of our forest, we are concerned about the possibility of significant net emissions resulting from climate change

impacts. For example, see the discussion in the recent IPCC report on the regional impacts of climate change (Shriner and Street 1998) of the potential impacts of climate change on North American forests, and particularly the boreal forest. The hypothesized positive impact of CO_2 fertilization may occur in some areas but pollution (e.g. O_3), increased susceptibility to insect infestations, and drought and nutrient deficiencies may negate or overwhelm the effect. Furthermore, while CO_2 fertilization increases growth in seedlings under optimal laboratory conditions the IPCC Special Report noted that the long term effect on carbon in trees and soil as a forest stand matures is uncertain (Section 1.3.2.3). The location and extent of the forest may also be changed by climate change. Over time, the tree line may advance into arctic and alpine regions but this progress may be slowed by nutrient and moisture limitations, while drought and temperature changes may cause retreat northward of the southern tree line. At the same time, increased natural disturbances (fires, insects, herbivory, windthrow), and a hypothesized increase in rare or extreme weather events (e.g., severe storms), may negatively affect the forest. The net effect could be a transitory loss of a potentially significant area of forest, and related carbon, lasting decades or even centuries, which may be countered partially by incentives for intensive forest management and other adaptive strategies.

3. ARTICLE 3.3

3.1 Proposed Definitions for ARD

In making decisions on definitions and accounting for Article 3.3 Parties should recognize that the goal should not be just one of defining what is included and how it is included. The broader goal is to advance the objective and commitments of the UNFCCC and the Protocol. No particular set of ARD definitions discussed in the IPCC Special Report is completely suited to the formulation of Article 3.3 in a way that addresses the particular circumstances of all Parties, while at the same time providing incentives to protect and enhance sinks and reservoirs. From Canada's perspective, there are two ways to address the problems created by Article 3.3 in this regard. One is to treat Article 3.3 in isolation, construct definitions unrelated to common usage and practice in forest management, and deal with potential perverse incentives by establishing complex accounting rules that in practice may be difficult to implement. The alternative is to adopt definitions that have been well established and to address the problems of Article 3.3 through a broader approach to forests using Article 3.4. Canada believes the latter option is the right choice and is the option that will maximize incentives to achieve the objective of the UNFCCC.

In terms of Article 3.3, Canada believes that Parties should not support the adoption of definitions and accounting approaches which unfairly penalize any Party by not reflecting the characteristics of their forest and forest management, and therefore failing to reflect carbon stock changes due to management of the broader landscape. For example, this would happen if the harvest-regeneration cycle were included under Article 3.3, because of the requirement that only activities since 1990 can be included. As well, the IPCC Special Report (Section 3.3.1) notes that immediate emissions due to deforestation but slow removals due to afforestation and reforestation can create pronounced imbalances resulting in reporting ARD emissions in a commitment period, even though the forest as a whole may be in balance. It further notes that avoiding this effect does not seem possible within Article 3.3, and that such an imbalance may be particularly pronounced for boreal forests. This is of great concern to Canada, as it does not reflect the broader reality of Canada's forest management.

Canada believes that there likely is no one set of definitions and accounting approaches for Article 3.3 that fits all Parties. At the same time we strongly believe that activities under Articles 3.3 and 3.4 must be treated as a complete package, rather than a piecemeal set of activities defined and measured in isolation from one another. Our proposals for the definitions and accounting for ARD, and in particular our definition for reforestation, therefore cannot be separated from our proposals for Article 3.4 and for overall accounting rules, discussed in Sections 5 and 6 respectively. Before discussing our proposals for Article 3.3 it is useful to set the context by explaining the implications of our proposals for Article 3.4. **In brief, our proposals for definitions and accounting for the two articles mean that the full harvest-regeneration cycle would be included under the activity of forest management in Article 3.4.** All source and sink activities that involve the use of the managed forest, such as harvesting and reforestation (using our definition of the term) would be accounted for in the accounting for forest management under Article 3.4. This would also be true of all activities that add to the managed forest area, such as a large portion of afforestation activity, if not all. Deforestation would still be accounted for under Article 3.3.

Canada believes that ARD definitions should reflect those commonly used at an operational level by individual Parties in order to facilitate verifiable measurement of emissions and removals. We believe this means adopting definitions similar to those of the FAO but allowing for a degree of flexibility for Parties to use definitions most suited to their circumstances. The FAO for decades has been the expert UN body charged with collection and synthesis of forest information using definitions that broadly reflect the circumstances of all countries. We note also that the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories do not explicitly define forest and encourage national experts to use characteristics of their own ecosystems in doing so. Moreover, national forest agencies have developed databases based on their own definitions so that arbitrary new definitions could add unnecessarily to the cost of measuring, monitoring and reporting.

Based on these considerations, Canada proposes the following text for ARD definitions**.**

Definitions for Article 3.3

Parties may define **forest** in accordance with their own circumstances and must take into account published definitions. Parties may choose to use different definitions of forest to account for different forest types in their country. The definition or definitions must be used consistently in the accounting in the first and subsequent commitment period. Parties shall provide information on the source and suitability of their definitions under Article 7. Their definitions shall be reviewed in accordance with Article 8 of the Protocol.

For the purposes of Article 3.3, the following definitions shall apply:

(a) **Afforestation** is a change in land-use that, through the establishment of a stand of trees, forms a forest.

(b) **Reforestation** is a land-use practice that, through the establishment of a stand of trees, forms a forest.

(c) **Deforestation** is a land-use change that removes a forest.

We believe it will be impossible for Parties to agree on a definition or set of definitions for forest that accommodates the national circumstances of individual Parties for the purposes of a legally binding agreement. Subject to expert review, our proposal therefore allows Parties to tailor their definition to the particular characteristics of their forests and forest management. While we do not follow the wording of the FAO definitions for ARD we believe our definitions to be consistent with the FAO definitional scenario outlined in the IPCC Special Report. As well, our definitions capture what we feel should be a key feature of the approach to ARD - their relationship to land use and to land-use change. Canada believes that definitions that describe activities in terms of land use and land-use change will most directly and clearly provide incentives to enhance carbon sinks.

Afforestation is the establishment of forest on land that previously was being used for other purposes. Reforestation is the establishment of forest on land that is already being used as forest. We note that when a forest is temporarily non-stocked after harvesting it is still being used as a forest. Also, since a land-use practice necessarily involves human activity, unassisted natural regeneration of forest after natural disturbances is not included. Deforestation is a change in land use that removes forest. For each definition, direct human intervention is required, in keeping with the Article 3.3 specification that the verifiable carbon stock changes be the result of direct human-induced activities. Finally, we note that forest aggradation and degradation in the managed forest is included in our proposal to add forest management under Article 3.4. Again underlining the importance of a package on Articles 3.3 and 3.4.

3.2 Accounting for ARD

Canada believes that all relevant carbon pools should be included in the accounting for Article 3.3 and that once land enters the accounting for the Kyoto Protocol it should remain in the accounting system in future commitment periods. We propose a flexible approach to accounting to allow Parties to use the approach most suitable to their unique circumstances, subject to general accounting rules and principles agreed by Parties. Our accounting approach for Article 3.3 would be part of an overall accounting framework for forests for Articles 3.3.and 3.4 combined. Treating Article 3.3 in isolation, and establishing complex accounting rules to address unbalanced accounting, will serve only to increase the complexity and cost of verification and accounting.

The IPCC Special Report discussed three accounting approaches: Land-Based I, Land-Based II and Activity-Based. We believe the division of accounting into land-based and activity-based approaches is too limited. While use of either approach, or even a hybrid, may be most suitable for some situations, it may be unsuitable for others. Canada proposes that Parties agree on an accounting framework that: 1) provides general and simple rules for accounting; 2) requires conformity with principles related to verifiability, transparency, accuracy, comparability, cost effectiveness and complete coverage of pools agreed by Parties; and 3) does not prescribe specific detailed accounting approaches. Such a framework would provide credible accounting while allowing Parties some flexibility in their approach. We emphasize that, because of our proposed broad approach to Article 3.4, which results in a large portion of afforestation and all reforestation being included as part of forest management, the distinction between land-based and activity-based approaches for ARD is really of most relevance in Article 3.3 for deforestation. However, we believe that the distinction has little meaning even for deforestation.

Each Party should be required to submit information on its accounting approach as per Article 7 of the Protocol, and the approach would be subject to review as per Article 8 to ensure that it conformed to the agreed general accounting rules and conformed to the accounting principles.

Canada proposes the following general accounting rules related to Article 3.3. The rules shown here **cannot** be separated from the rules presented for Article 3.4 in Section 5, or from the additional accounting rules shown in Section 6. In particular, in Section 6 we propose an accounting rule to deal with inter-linkages between Article 3.3 and 3.4. The accounting for ARD must be seen in relation to the full set of accounting rules we propose, and the implications are discussed more fully in Section 6. The complete set of accounting rules is shown together in Annex 2.

Accounting Rules for Article 3.3

For the purposes of Article 3.3, the following accounting rules shall apply:

(a) Subject to paragraph 4 (b), in accounting for afforestation, reforestation and deforestation since 1990, Parties shall include verifiable changes in all carbon stocks in the first and all subsequent commitment periods. Once land enters the accounting it shall be included in the first and all subsequent commitment periods.

(b) Parties shall account for all carbon pools that are sources as a result of afforestation, reforestation and deforestation since 1990, but may choose not to account for a given pool in a commitment period if they provide transparent and verifiable information demonstrating that it is not a source.

(c) Verifiable changes in carbon stocks which Parties include in their accounting and which result from afforestation, reforestation and deforestation since 1990 shall be measured as the change in carbon stocks between the beginning and end of a commitment period.

Under some definitions the three accounting approaches described in the IPCC Special Report can yield very different results, and in this regard we note again that our proposed accounting under Article 3.3 cannot be separated from our proposal related to Article 3.4. This is particularly true for reforestation which, under the Canadian proposal, would be entirely encompassed by the proposed additional activity of forest management under Article 3.4. **Under this approach all activity on the managed forest, and therefore all source and sink activities including harvesting and reforestation, would be included in the accounting**. Canada generally proposes to take a land-based approach to accounting for Articles 3.3 and 3.4 combined, but may use activity-based accounting where the circumstances warrant it (for example, for some types of deforestation) and subject to the broad accounting rules agreed by Parties. We note that non-CO_2 greenhouse gas reporting, if Parties decide to include it, likely will rely primarily on activity-based accounting.

3.3 Preliminary Estimates for ARD

Table I in Annex 1 uses the data format agreed at SBSTA 12 to present preliminary estimates for ARD activities under both the IPCC and FAO definitional scenarios for Canada. Afforestation under these or any definitions is negligible, with a carbon stock change in the first commitment period of less than 0.5 Mt C. This estimate also applies to afforestation and reforestation combined, under the IPCC definitional scenario. Deforestation over the 1990-2012 period is

estimated to total just over 1 million ha (0.25% of the total forest area) based on estimates from the early to mid 1990s. The result is a carbon stock change in the first commitment period of about -22 Mt C. Based on these preliminary estimates, an IPCC approach to ARD definitions therefore results in a source of about 16 Mt CO_2 / year in 2008-12, a significant subtraction from Canada's assigned amount. We note also that use of the IPCC definitions means that only a small portion of Canada's forest is included, providing no incentives to enhance sinks and protect reservoirs on the large remainder of the managed forest.

For reforestation under the proposed Canadian definition, based on the FAO definitional scenario, the accounting framework chosen has a major impact on the accounted carbon stock change, as the IPCC Special Report demonstrated. Reforestation area in 1990-2012 using the proposed definition amounts to about 21 million ha, similar to the harvest area over the 23-year period. Our preliminary estimate for Activity-Based accounting shows that the change in carbon stocks is –3 Mt carbon in the first commitment period. This reflects the fact that emissions associated with soil disturbances from planting activity are not yet balanced by biomass from regenerating trees, which may take decades to reach significant sequestration rates in Canada. In later commitment periods Activity-Based accounting gives a sink.

Land–Based I and II accounting show very significant reductions in carbon stocks due to the inclusion of emissions associated with harvesting. These large negative carbon stock changes are an artifact of the accounting method as demonstrated in the IPCC Special Report (Section 3.5.2) and bear no relationship to the actual changes in the managed forest. The characteristics of Canada's forest, tree growth and forest management are such that harvesting results in large emissions over a relatively short period while the subsequent regeneration takes up to 100 or more years to sequester an equivalent amount of carbon. Only a broader accounting approach which considers the carbon stock changes over the managed forest estate can adequately reflect this reality, or provide incentives to enhance forest carbon sinks in Canada. Our proposal for including forest management under Article 3.4 takes this approach.

4. ARTICLE 3.4, FIRST SENTENCE

Although Canada has provided preliminary estimates of its 1990 carbon stocks in Table II of Annex 1, we do not understand the purpose of the information specified in the first sentence of Article 3.4, or its relevance either to Article 3.3 or to the remainder of Article 3.4. Carbon stocks in 1990 bear no obvious relevance to activities included under Article 3.4. Changes in subsequent years will be highly variable as a result of anthropogenic and natural influences occurring both before and after 1990.

The principal carbon reservoirs in the Canadian terrestrial landscape currently or potentially affected by direct human activities, are forest lands, agricultural lands, rangelands/grasslands and wetlands. The area and carbon content of some of these reservoirs have not yet been comprehensively assessed. Thus, estimation of Canada's carbon stocks is still in progress. The estimates of carbon stocks provided in Table II are therefore preliminary, and will be refined as measurement methodologies improve.

In 1990, Canada's forest covered 418 million ha. Canada's agricultural land base covered 61 million ha, including lands annually cropped, summer-fallow land, improved pastures and natural rangelands and grasslands. Wetlands in 1990 are estimated to have covered 148 million ha. The monitoring of wetland restoration or conversion rates in Canada is fragmented; hence this estimate should be interpreted as a maximum value. The Canadian tundra is a mosaic landscape

of various treeless land covers, including wetlands, uplands, polar deserts and ice. There is no reliable data on the area of tundra that excludes northern wetlands.

Our preliminary estimate of the total 1990 carbon stock on the land systems shown in Table II is more than 297 Gt. Carbon stocks of forest and agricultural lands represent approximately 30% of the total terrestrial carbon stocks reported. We emphasize that the magnitude of the carbon stock on any land system is not necessarily indicative of 1) the system's capacity to sequester carbon rapidly; 2) its vulnerability to anthropogenic activities and environmental changes; or 3) our ability to enhance carbon sequestration under current or future climate conditions. These attributes have yet to be assessed. The large quantity of carbon stored in Canadian wetlands, for example, is the outcome of a very slow accumulation process that took place over the last 10,000 years. Scientific evidence indicates that the carbon source or sink status of wetlands is sensitive to climatic factors, suggesting that the potential impact of climatic change on carbon storage in wetlands could equal or exceed the anthropogenic impact.

5. ARTICLE 3.4, ADDITIONAL ACTIVITIES

Parties should strive to ensure cost effective and comprehensive inclusion of all relevant sinks and sources under Article 3.4 in the first commitment period. In doing so, Parties would be encouraged to reduce anthropogenic emissions and enhance anthropogenic removals. The IPCC Special Report noted that, generally speaking, additional activities could be included under Article 3.4 in terms of narrowly defined individual practices or in terms of land-based broadly defined activities.

Canada supports a broad approach because it:

- ensures that the net effect of all relevant sources and sinks on a given area of land are included in the accounting;
- ensures consistency in the treatment of sources and sinks;
- minimizes the possibility of inadvertently creating incentives which negatively affect the environment, or which encourage manipulation of individual activities to maximize sinks and minimize sources in a given commitment period, simply because some activities are included while others are not;
- limits the possibility of leakage within a country;
- minimizes differences between actual and reported carbon stock changes due to activities, and between reported and landscape level carbon stock changes.

Canada believes that additional land-use activities should not be subject to a higher standard of measurability, measurement certainty and verifiability than sources already included in the Protocol. Uncertainty should not be a criterion for including or excluding an additional activity, since appropriate rules can be devised to account comprehensively and equitably for uncertainties in sinks and sources for the purposes of determining compliance.

The use of uncertainty as a screening criterion for the inclusion of 3.4 activities would create a double standard relative to the activities included under Article 3.3. At CoP3, Parties agreed to include ARD activities in the Protocol without consideration of the uncertainty of their estimates, nor has this consideration been applied to any of the source categories listed in Annex A of the Protocol. For example, in the Canadian case, there are very significant uncertainties with deforestation estimates. In contrast, while there still remain uncertainties for estimates in the agricultural soils category, which Canada believes should be added to the Protocol under Article

3.4, these uncertainties are no greater than, and in some cases less than, those associated with other sources we report in our inventory. We note also that UNFCCC Article 3.3 established the principle that lack of full scientific certainty should not be used to postpone policies, such as those covering all relevant sinks and reservoirs of greenhouse gases. We believe that measurement uncertainties can be best addressed by the development of good practice guidance for LULUCF measuring, monitoring and reporting.

5.1 *Additional Activities and Rationale for Inclusion*

Canada proposes the following decision related to the addition of additional activities under Article 3.4.

Inclusion of Additional Activities under Article 3.4

The human-induced activities of forest management, cropland management, grazing land management and shelterbelts ('agricultural land management') shall be used to meet the commitments under Article 3 of each Party included in Annex I in accordance with Article 3.4.

5.1.1 Forest Management

The characteristics of Canada's forest and forest management mean that unbalanced accounting will occur if the choice of ARD definitions, additional activities and accounting approaches includes only some activities occurring over a limited time period (i.e. since 1990). Accounting for only a limited range of activities means that the accounting will bear little relation to the actual impact of direct human activity on forest carbon stocks. Including the broadly defined activity of forest management under Article 3.4 is the most appropriate way to address this problem and to create incentives to fulfill the ultimate objective of the Convention.

For the purposes of Article 3.4, forest management is the broad set of management activities in the forest related to multiple use values including, especially, timber production. In terms of a land base, this is equivalent to the managed forest, and our accounting would be based on this area. We emphasize that the managed forest provides very significant values other than timber, but that the advantage of focusing on an area that includes all timber production activity is that this is the forest use that is of greatest significance for carbon stock changes. The definition of forest for Article 3.3 would be used for Article 3.4. We note that the Revised 1996 IPCC Greenhouse Gas Guidelines provide for forests to be designated as managed or unmanaged, with the latter excluded from the accounting framework.

One issue of particular concern raised by the IPCC Special Report is whether and how to include forest aggradation and forest degradation. Inclusion of broadly defined forest management ensures that emissions related to forest degradation, and increases related to forest aggradation, are included, relative to the definition of forest adopted by a Party.

5.1.2 Agricultural Land Management

Historically, as Canada's natural forests and grasslands were broken for agricultural production, a large amount of the organic soil matter was mineralized and lost as CO_2 emissions to the

atmosphere. Excessive or unnecessary cultivation can further accelerate these losses of CO_2 and loss of organic C due to erosion. Adoption of more sustainable land management practices that reduce these losses can actually reverse this process, so that CO_2 is removed from the atmosphere and sequestered in the soil. Carbon sequestered in agricultural lands is directly human induced by farmer's choices in applying land management practices such as reduced tillage, restoring marginal or degraded land through revegetation to native species or forage crops, shelterbelts, extended cropping systems, legumes, yield enhancement through intensification, improving pasture and grassland management and reducing summer fallow.

Canada proposes that the broadly defined activities of cropland management, grazing land and livestock management and shelterbelts be included under Article 3.4. Management of these lands to enhance soil carbon is an important, direct human-induced removal of CO_2 from the atmosphere, which makes a legitimate and important contribution to the UNFCCC goals. **Canada believes the current accounting for agricultural activities is unbalanced because agricultural emissions of nitrous oxide and methane are included in the accounting for the Kyoto Protocol, while the positive things farmers do on the same landscapes to sequester carbon are not included**. Furthermore, the measurement uncertainties for the included emissions of non-CO_2 gases are higher than for the excluded removals of CO_2. We view this asymmetrical treatment of greenhouse gas sinks and sources in the Protocol as illogical and counterproductive in terms of encouraging environmentally sound farm management practices. For Canada, including agricultural land management in Article 3.4 is essential for attaining symmetrical and balanced treatment of sources and sinks, and for ensuring that farmers are encouraged to managed their landscape in an integrated way for all sources and sinks.

Direct agronomic benefits (increased food and fibre production) will result from including these land management practices under Article 3.4, as well as positive environmental impacts (for example, reduced erosion, less silt deposition and phosphorous runoff in waterways, improved wildlife habitat). These additional benefits to sustainable food production and a healthier environment are too important to ignore. These benefits are a direct, strong and positive link between the goals of the UNFCCC and other conventions on desertification, biodiversity and wetlands (RAMSAR).

Enhancing soil carbon is an important conservation measure to encourage because healthier soil is more resilient and better able to hold moisture, which means it will aid farmers to maintain food production, as they adapt to the effects of climate change. In other words, recognition of soil sinks in the Kyoto Protocol is a way to facilitate more effective agricultural adaptation to climate change.

In Canada, farming practices that build up soil carbon are encouraged through public policy and industry innovation. There continues to be a significant public investment in soil science to better understand the relationship between land management systems and soil carbon dynamics, and the communication of this knowledge to farmers. Innovative farmers, assisted by researchers and equipment manufacturers, have developed alternatives to traditional tillage. Canadian farmers and manufacturers have become world leaders in the conservation tillage movement. The adoption of practices that build up soil carbon is important to Canadian agriculture, particularly in the Prairie region, which represents 80% of Canada's farmland.

Innovative farmers in Canada see the Kyoto Protocol as an opportunity to encourage good soil conservation practices. Naturally our farmers have a keen interest in climate change and they want to be active participants in mitigating against the variability that is often associated with

climate change scenarios. These farmers are asking their government to secure the inclusion of good soil management practices in the Kyoto Protocol. They see the Kyoto Protocol as a means for encouraging good public policy on soil conservation. –They believe inclusion of land management practices under Article 3.4 would send positive signals to adopt environmentally beneficial farming practices and could lead to economic incentives to encourage even greater adoption of these practices.

5.2 Rules, Modalities, Guidelines and Accounting for Additional Activities

With respect to the accounting framework for additional activities, Canada believes that:

- the activities should be accounted for by Parties in the first commitment period and subsequent periods;
- in a commitment period the accounting should be based on the land area subject to the additional activities at the end of the period;
- all relevant carbon pools should be accounted for; and
- emissions and removals of CO_2 should be measured as verifiable changes in carbon stocks while emissions and removals of other greenhouse gases also should be measured.

Canada proposes the following general accounting rules for Article 3.4. The rules shown here **cannot** be separated from the rules presented for Article 3.3 in Section 3, or from the additional accounting rules shown in Section 6. In particular, in Section 6 we propose an accounting rule to deal with inter-linkages between Article 3.3 and 3.4. The accounting for ARD must be seen in relation to the full set of accounting rules we propose, and the implications are discussed more fully in Section 6. The complete set of accounting rules is shown together in Annex 2.

Accounting under Article 3.4

For the purposes of Article 3.4, the following accounting rules shall apply:

(a) Accounting for changes in greenhouse gas emissions by sources and removals by sinks shall be based on the land area subject to forest management and agricultural land management at the end of each commitment period.

(b) Verifiable changes in carbon stocks that Parties include in their accounting shall be measured as the change in carbon stocks between the beginning and end of a commitment period. The carbon dioxide equivalent emissions and removals of the other greenhouse gases included in Annex A of the Protocol shall be measured between the beginning and end of a commitment period.

(c) Subject to paragraph 5 (d), the net greenhouse gas emissions by sources and removals by sinks of carbon dioxide resulting from forest management and agricultural land management shall be measured as the verifiable changes in all carbon stocks in the first and all subsequent commitment periods on land subject to these activities. The carbon dioxide equivalent emissions and removals of the other greenhouse gases included in Annex A of the Protocol and directly resulting from land subject to forest management and agricultural management shall also be measured and included in the accounting for the first and all subsequent commitment periods

(d) Parties shall account for all carbon pools that are sources as a result of forest management and agricultural land management, but may choose not to account for a given pool in a commitment period if they provide transparent and verifiable information demonstrating that it is not a source. Parties shall account for all emissions of greenhouse gases included in Annex A other than carbon dioxide as a result of forest management, but may choose not to account for a potential source in a commitment period if they provide transparent and verifiable information demonstrating that it is not a source.

5.3 Preliminary Estimates for Additional Activities

Table III in Annex 1 uses the data format agreed at SBSTA 12 to present preliminary estimates for the additional activities Canada proposes for inclusion under Article 3.4 – forest management, cropland management, grazing land management and shelterbelts.

5.3.1 Forest Management

With respect to forest management we note first that the area of land subject to forest management – the managed forest – has not been legally or administratively defined in Canada. For the purposes of the accounting for Article 3.4, discussions within Canada will be needed to determine what areas would be classified as subject to forest management, especially as much of the forest is owned by provinces and under provincial jurisdiction. Our preliminary estimate for the area subject to forest management is the accessible stocked timber productive forest, 134 million ha. We assume this area most closely relates to the area subject to forest management using currently available information. Over time the area subject to forest management will change due to deforestation, afforestation and expansion of management activities. However, these changes occur only slowly, so for the purposes of Table III we assume that the area remains constant in the 1990-2012 period. Under our accounting approach a large portion of afforestation would be included in the accounting for forest management while deforestation would be accounted for separately.

The estimated carbon stock change associated with the managed forest in the first commitment period is a removal of about 48 Mt carbon (177 Mt of $CO_{2)}$. Non-CO_2 greenhouse gas emissions and removals associated with all fires in the managed forest amount to estimated emissions of 9 Mt CO_2-equivalent in the first commitment period. The net effect of the carbon stock changes and the non-CO_2 gases amounts to about 33 Mt CO_2-equivalent per year in the first commitment period. We note that this would be offset to a large degree by emissions from deforestation of 16 Mt CO_2-equivalent per year in the first commitment period.

We derived these estimates using a methodology that follows closely the *Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories*, but we made adjustments as described in the notes for Table III. The estimates reflect the full effect of activities and wildfires on biomass carbon pools in the managed forest estate. We assumed that the recent fire disturbance pattern of 1980-1990 continues through to 2012, although as we have already noted, we are concerned that in fact climate change may exacerbate fires in our forests. We recognize that use of the IPCC methodology results in only rough estimates, and our analysis is on going to develop better estimates.

Our estimates include the full harvest-regeneration cycle, and therefore include reforestation as Canada proposes it should be defined. We assumed that all biomass associated with harvesting is emitted immediately upon harvesting in keeping with the IPCC guidelines, although we believe Parties need to agree on a more realistic approach for accounting for forest products and other products which can serve as long-term stores of carbon such as strawboard. Under our proposed accounting framework (see Section 6) most or all afforestation activity would also fall within the managed forest and therefore should be included in our estimate. While we have not explicitly included afforestation in the estimate, the very limited extent of the activity in Canada means that its inclusion would not significantly affect the result.

5.3.2 Cropland Management, Grazing Land Management and Shelterbelts.

Inclusion of agricultural cropland management, grazing land and livestock management, and shelterbelts in Article 3.4 will help Canada encourage soil conservation practices that will restore some of the 1 billion tonnes of carbon that we have lost since our lands were first broken some 100 years ago. Depending on international and domestic policies, our preliminary estimates in Table III show Canadian farmers could sequester on cropland, grazing land and shelterbelts a total of between 20 Mt and 100 Mt CO_2 over the course of the first commitment period, or between 4 and 25 Mt CO_2 per year. The lower range of these estimates reflects low adoption rates of sink-enhancing practices. The higher estimates reflect ambitious adoption rates, for which our estimates are more uncertain.

The above estimates are for gross removals and do not include the impact of the other greenhouse gases from agricultural activity, nitrous oxide and methane. As shown in Table III, we estimate that inclusion of agricultural land management in Article 3.4 will cause an increase in our methane and nitrous oxide emissions of between 0 and 14 Mt CO_2-equivalent over the first commitment period, depending on the adoption rates of the activities. This will partially offset the removals of CO_2 in soil carbon.

6. OVERALL ACCOUNTING APPROACHES

6.1 Decisions on an Accounting Framework for Articles 3.3 and 3.4

Rules agreed to by Parties for an accounting framework should incorporate sufficient flexibility to accommodate national circumstances. The accounting system must also be designed to ensure transparent, verifiable, comparable, cost effective, accurate and consistent estimates in order to assure all Parties that the accounting is fair and in accordance with the rules agreed by Parties. We believe that Parties should agree on an accounting system in two-stages:

1) At CoP6 Parties agree on an overall accounting framework for Articles 3.3 and 3.4. In this submission we propose a set of general accounting rules we believe should be incorporated in such a framework.

2) At CoP7 Parties could then agree on further rules as necessary, including rules or criteria related to demonstrating conformity with various accounting principles, such as transparency and verifiability. All sources and sinks reported by Parties would need to conform to these conditions in order to be included in the accounting in a commitment period.

6.2 Overall Issues for Accounting

A number of issues need to be addressed in an accounting system for Articles 3.3 and 3.4. One issue is the treatment of forest products in the accounting. Others noted by the IPCC Special Report include issues related to reversibility and permanence, uncertainty, accounting for natural effects, and accounting inter-linkages between Articles 3.3 and 3.4.

We believe the issues of reversibility and permanence of reductions in sources and increases in sinks are best addressed by agreement that, once land enters the accounting in a commitment period because an Article 3.3 or 3.4 activity has occurred, it will be included in all future commitment periods. This ensures a continual incentive to protect and enhance the carbon reservoirs on the land, enhance sinks and reduce sources. Our proposals for accounting for Articles 3.3 and 3.4 incorporate this principle.

With respect to uncertainties related to Article 3.4 activities, Canada's view is that they could and should be addressed in the same way as they would be with the emission categories included in Annex A of the Protocol. The onus should be on a Party to ensure its reported emissions and removals meet agreed accounting and reporting criteria for transparency, verifiability and compliance.

With respect to dealing with natural effects in the accounting for Article 3.4 activities, some Parties have expressed a concern that natural and indirect emissions and removals may be included in the accounting for additional activities. We emphasize that such effects can be both negative (e.g. wildfire and insect disturbances, pollution) and positive (e.g. possible N and CO_2 fertilization effects). The effect of climate change itself could be either negative (e.g. increased natural disturbances, drought) or positive (e.g. increased growing season), with any effect likely to be highly variable both spatially and temporally. However, at this point the scientific ability to predict the magnitude or frequency of such effects is limited. In the discussion of Canada's national circumstances (Section 2) we described our concern that the effects of climate change may result in Canada's total forest becoming a net source for an extended period of time as it adjusts to climate change. Parties' understanding of such effects, and methodologies for accounting for them, will improve over time and we believe it would be appropriate for SBSTA to request that the IPCC study methods for accounting for natural and indirect effects in more detail. At this point Canada's view is that we should take a comprehensive approach to the accounting for such effects on land areas included in Article 3.4, but we are open to further discussion on this issue.

With respect to accounting inter-linkages between Articles 3.3 and 3.4, we note that including the activities of forest management and agricultural land management under Article 3.4 means that there is an overlap between the area subject to these activities and ARD area. We believe it makes most sense to therefore adopt a single accounting framework for the overlapping areas. In particular, we believe ARD land that is also part of the land subject to forest or agricultural management should be accounted for under the rules for Article 3.4.

Based on these considerations, Canada proposes some further general accounting rules in addition to those we proposed in Section 3 for Article 3.3 and Section 5 for Article 3.4.

Further General Accounting Rules

6. For the purposes of accounting under Articles 3.3 and 3.4, the following rules shall apply.

(a) If an area of land is subject to afforestation, reforestation or deforestation since 1990 under Article 3.3 and qualifies as land subject to forest management or agricultural land management under Article 3.4, it shall be accounted for under Article 3.4 and shall not be accounted for under the provisions for accounting related to Article 3.3.

(b) Carbon stocks in forest products or agricultural products derived from land subject to afforestation, reforestation and deforestation since 1990, or from forest management or agricultural land management shall be included in the accounting based on rules agreed at the first session of the Conference of the Parties serving as the meeting of the Parties to the Protocol.

(c) Accounting approaches used by Parties for accounting under Articles 3.3 and 3.4 shall conform to additional rules for the accounting as agreed at the first session of the Conference of the Parties serving as the meeting of the Parties to the Protocol.

(d) Supplementary information on the accounting by a Party under Articles 3.3 and Article 3.4 shall be submitted in accordance with Article 7 of the Protocol and shall be sufficient to ensure transparency and verifiability during the expert review process established by Article 8. It shall also be sufficient to demonstrate consistent application of definitions and land areas subject to accounting within and between commitment periods, and to demonstrate compliance with the accounting rules agreed by Parties.

With respect to the inter-linkages between Article 3.3 and Article 3.4, the additional accounting rules proposed here must be considered along with our proposals in Sections 3 and 5 for accounting rules for Articles 3.3 and 3.4, as an integrated accounting framework. It is worthwhile to explain some of the implications of our proposed approach.

First, all reforestation occurs on the managed forest since reforestation under the Canadian proposal is simply a human land-use practice in the forest and thus by definition occurs in the managed forest. It would therefore be included in the accounting for the area subject to forest management.

Second, the area subject to forest management increases over time due to afforestation, which is a change in land use from some other use to one that involves establishment of a forest and subsequent use. In Canada, the area subject to forest management also may increase slowly over time as a result of the extensive (rather than intensive) nature of Canada's forest management. One of our proposed accounting rules for forest management is that the accounting would be done for the area subject to forest management at the end of the commitment period. Many areas subject to afforestation in 1990-2007 would already be part of the managed forest in 2012 and so would be included in Article 3.4 accounting. Many areas afforested in a commitment period would also be included in Article 3.4 accounting since they would be part of the managed forest at the end of the period. The same is true of the small amount of the non-managed existing forest that might be brought into the managed forest during a commitment period.

Third, deforestation will decrease the area subject to forest management. Whether it occurs in the 1990-2007 period or in a commitment period, it would not be part of the area subject to forest management at the end of the commitment period. Some deforestation during a commitment period may be part of the land subject to agricultural management at the end of the commitment period, and therefore would be included in the accounting for Table 3.4. The remainder would fall under the accounting for Article 3.3.

We note that this approach to accounting has the additional benefit of reducing the costly measurement and accounting processes needed to track and account for carbon stock changes on individual areas of ARD land that is in the managed forest. This will reduce the operational complexity of carbon accounting.

6.3 Further Work on Accounting and Methodological Issues

As stated above, Canada believes that further decisions on accounting and methodological issues relevant to Articles 3.3 and 3.4 will be needed at CoP7. In relation to work between CoP6 and CoP7, Canada proposes that Parties consider the following issues, taking into account the conclusions of SBSTA 13 and 14, and decisions at CoP6.

1) ***Methodological issues related to the IPCC inventory guidelines.*** At SBSTA 10, Parties invited the IPCC to develop a workplan as soon as practicable after the completion of the IPCC Special Report (FCCC/SBSTA/1999/6, para. 41(e)). At SBSTA 11, Parties invited the IPCC to provide a progress report on the subject at SBSTA 13 (FCCC/SBSTA/1999/14/46(m)). SBSTA 12 invited the IPCC to include good practice guidance in LUCF in the workplan requested at SBSTA 10 (FCCC/SBSTA/2000/L.3). Canada believes this work is essential. For example, as noted by SBSTA 12, good practice guidance will help Parties to prepare higher quality greenhouse gas inventories in which uncertainties are identified and reduced as far as practicable. It also will help ensure accounting that is transparent, consistent, complete, comparable and accurate. SBSTA should request that Parties make submissions on these subjects in early 2001.

2) ***Woods products accounting rules.*** SBSTA 11 requested that Parties provide views in submissions on 15 March 2001 on approaches for estimating and accounting for emissions of CO_2 from harvesting and wood products, for consideration at SBSTA 14 in 2001 (FCCC/SBSTA/1999/14 para. 69). We note that there are also other products not made of wood, such as strawboard, which can store carbon for long periods of time and for which the accounting issues are identical to those for wood products. Canada emphasizes the importance of making decisions on these issues at CoP7.

3) ***Other accounting rules.*** Development of further rules for Articles 3.3 and 3.4 will be necessary. For example, Parties need to agree on rules and criteria related to the meaning of such terms as verifiable and transparent. SBSTA should request that Parties make submissions on these subjects in early 2001.

7. MEASURING, MONITORING AND REPORTING

7.1 ARD and Forest Management

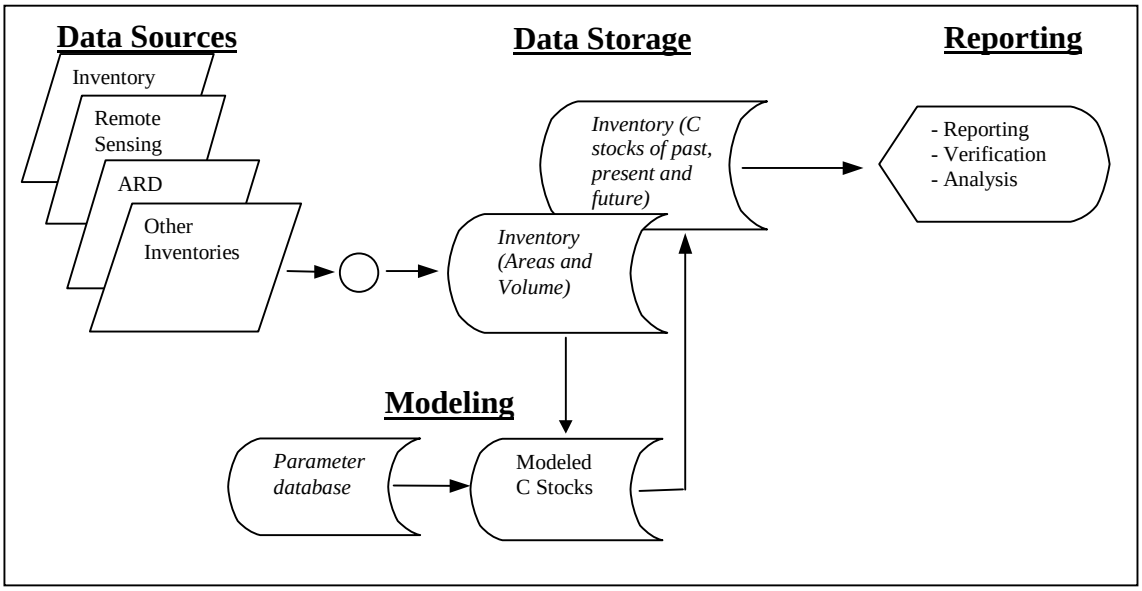
Parties should recognize that most current measurement systems were not designed to measure and monitor carbon stock changes but that systems will continually evolve and improve once requirements are known. As well, there is unlikely to be one system that fits the circumstances of all Parties, especially in light of the fact that the way to most cost effectively provide required measurements is to create an approach which builds upon existing systems.

Canada's proposed systems for measuring, monitoring and reporting on ARD under Article 3.3, and forest management under Article 3.4, are designed to be transparent, consistent, comparable, complete, accurate, verifiable and efficient - characteristics stressed by the IPCC Special Report (e.g. Sections 2.4 and 3.4). We will ensure that our framework for measurement of areas and carbon stock changes, and non-CO_2 emissions and removals (if included), is in accordance with Article 5.1 of the Protocol on national greenhouse gas inventory and reporting systems, and with Article 5.2 on methodologies for estimating sinks and sources. We will also ensure that our approach is consistent with accounting and other rules agreed by Parties. The extent to which a Party meets agreed requirements related to measuring, monitoring and reporting during the first and subsequent commitment periods will be determined as part of the compliance evaluation process.

7.1.1 Measurement Framework

Our currently existing tools (forest inventories, remote sensing, models, etc.) by themselves cannot satisfy the reporting requirements of the Kyoto Protocol. We therefore will combine existing and new methodologies into a land-based 'unified accounting framework'. Such a framework was discussed in Kurz and Greenough (1999), and is summarized in Figure 1.

Figure 1. Unified Accounting Framework for Canada's Carbon Stocks and Carbon Stock Changes



In this framework, inventory data from numerous sources will be standardised and used to determine area and volume statistics. The volume data will be converted to biomass and then to carbon in a consistent manner using standardised and peer-reviewed models and parameters. These models and parameters can also be applied to derive estimates of past and future carbon stocks and stock changes. Finally, with the appropriate components in place, the framework will provide a reporting function and the foundation for subsequent analysis and verification. We will also be able to provide estimates scaled to meet local, regional, provincial and national carbon accounting requirements, produced in a consistent fashion across scales.

7.1.2 Carbon Data Modeling and Reporting

Canada plans to apply a mixture of methods for the collection of data, including many described in Sections 2.4.2 and 3.4 of the IPCC Special Report. The most important contribution of our national

system will be the integrating framework that can accommodate and combine data from the various sources. Data sources will include:

- ***Forest Inventories***
  - *National Forest Inventory*: a new forest inventory is currently under development and will involve a systematic grid of permanent photo and ground plots to assess and monitor the extent, state and sustainable development of Canada's forests in a timely and accurate manner. The landbase for the inventory will be all of Canada, not just forests.
  - *Provincial Inventories*: information on stand volume, site quality or other information that can be used to determine growth rates and stand dynamics.
- ***Remote Sensing***: data on land cover and inferred utilization through aerial photography or satellite imagery for sample points or large areas.
- ***ARD Activity Reporting***: data on ARD activities obtained through census, registries and any other approaches found to be cost effective and efficient.
- ***Other Inventories***: direct measures of carbon stocks or carbon fluxes.

We will apply two spatially referenced databases in the national accounting framework. The first will contain the compilation of standardized relevant raw inventory information, from the above sources. It will include information on the location and the area subject to forest management (the managed forest), managed forest activities including reforestation, and areas subject to afforestation and deforestation activities. The second database will contain derived inventory information on the carbon stocks of these areas, computed from models that extrapolate measurements in space and time, as discussed in the IPCC Special Report (Section 2.4.5). Both databases will be spatially referenced.

We believe four types of models probably will be required for the accounting framework:

- models for the extrapolation of measurements of volume or carbon stocks in space;
- growth and yield models to project volume dynamics over time;
- ecosystem carbon dynamics models with which to project above-ground and below-ground biomass and dead organic matter pools of individual ecosystems; and
- landscape-level carbon dynamics that project the age-class distribution and dynamics of many ecosystems.

These models will be initialised with raw inventory information to determine the past, present and/or future carbon stock. We will use a database that contains standard, peer reviewed parameters, methods, and other information that will be required for all analyses of forest ecosystem carbon dynamics (including conversion of volume to biomass and biomass to carbon), and that will be easily reviewed for verification purposes. The parameter database will allow the system to adapt to improvements in methodology as they occur; though a change in parameters will require a re-calibration of the system. The models used will be documented and archived in the form that they were used for measurement reporting for Canada, to will assist in verification, as suggested in the IPCC Special Report (Section 2.4.5).

Reporting tools will be used to query and summarize the information contained in the database of areas and carbon stock estimates. In addition to providing national estimates for areas subject to ARD and forest management, we could also use the tools to report carbon stock changes for sub-national areas, such as regions, provinces, or the total forest area of Canada. Reporting tools will be designed with flexibility to allow adjustments if Parties change accounting rules.

7.1.3 Application of the Unified Accounting Framework for Forest Carbon Stocks

The framework described above outlines Canada's land-based approach to meet our measuring, monitoring and reporting commitments as required under Article's 3.3 and 3.4. Currently, information on forest management (which includes forest regeneration – reforestation under the Canadian proposed definitions) and afforestation and deforestation activities can be derived from existing records, but these are not comprehensive or structured for this purpose. As well, they come from many disparate sources, are difficult to compile and may be inconsistent over time. The uncertainty associated with the estimates we show in Tables I, II and III in Annex 1 reflect these difficulties. Site-specific accounting for every relevant individual area will never be practical in Canada but estimates for all such areas can be approximated with acceptable statistical confidence using a carefully designed sampling scheme.

The new National Forest Inventory (NFI) forms the core of our sample design. The NFI consists of a national network of 2x2 km plots on a 20-km grid, which forms a 1% sample of the land base. Within each plot forest parameters are interpreted from aerial photographs. The NFI provides a strong basis for measurement of the managed forest. For rare, small or distributed events such as afforestation and deforestation, the sample may be enlarged using satellite remote sensing to increase the reliability of results. The survey will be supported by provincial inventories, land use records and other data sources. This statistical sampling approach will insure that neither accuracy nor precision is compromised in measurements needed for Articles 3.3 and 3.4 accounting, for the managed forest and for afforestation and deforestation (see Section 2.4.1.1 and 2.4.2 of the IPCC Special Report).

Surveys of afforestation and deforestation activities will be conducted on a sample basis within strata. We expect that measurement of deforestation will be particularly important, as this activity will be reported separately under our proposed accounting approach, while a large portion of afforestation and all reforestation will be part of the broad accounting under forest management. For deforestation, the country will be divided into strata of different expectations of deforestation level ("high" and 'low"). The "high" strata would generally be large contiguous regions of areas of higher populations (e.g., Southwest Ontario) as opposed to small, localized units. For afforestation, zones of afforestation will be stratified into "high" (agriculture fringe) and "low" (areas with low forest establishment potential). In keeping with the discussion in Section 3.4.4 of the IPCC Special Report, sampling intensity will be appropriate to the expected distribution and frequency of afforestation and deforestation activities.

Canada will use satellite data to provide information on an enlarged sample over that of the NFI within the high strata designation. Full satellite coverage will be acquired, but only 2x2 km sample plots on a 10-km grid spacing would be assessed. The sample size and frequency can be increased if necessary, all the way to complete coverage. Areas of change (potential afforestation and deforestation) will be detected on the satellite imagery. When there is some uncertainty about whether afforestation or deforestation has occurred we propose to use local records or knowledge, and a double sampling system using the NFI plots (see Section 3.4.1 of the IPCC Special Report). The core sample intensity of 1% will be used for the low strata designation.

The biomass volume on each identified deforestation site prior to deforestation will be determined directly by reference to forest inventory information for that site or from an average volume for similar stand types in the region of the deforestation.

In the future, voluntary or legislated reporting of afforestation and deforestation and other forest management activities or other incentives may lead to good site specific information and compilation capability. This would then be the source of reported measurements. However, the NFI, satellite imagery, and the system described above would still be useful for verification, audit and confirmation purposes, and to detect these activities.

We will make use of models such as the Canadian carbon budget model (CBM-CFS2) to produce estimates of carbon stocks at different time periods based on the standardized input data sources. The CBM-CFS2 also provides a potential accounting framework for the managed forest and reforestation on the managed forest, and for afforestation and deforestation activities. Estimates of areas affected by ARD activities and the immediate changes in carbon stocks associated with these activities are required to initiate the accounting within the model. The CBM-CFS2 then simulates the changes in carbon stocks from the time of the activity through subsequent five-year commitment periods. For carbon stock changes associated with harvesting, we will use assumptions about the fate of the harvested biomass (e.g., burned on-site, made into forest products or piled and left to decay), in keeping with any decisions made by Parties on how to account for forest products. We will also use knowledge of local practices and regional summaries of product mixes from certain forest types. For post-deforestation carbon accounting, we first will determine new use of the land (e.g., crop, pasture, abandoned open field, road, urban, industrial, right-of-way) and then use available information to make credible assumptions about the fate of the biomass. Typical regional carbon accumulation in relevant carbon pools for deforested sites will be determined and subtracted from any net loss due to deforestation.

As noted in Section 4, the purpose of the first sentence of Article 3.4 is not clear to us. However, required information will be provided as follows. For carbon stock estimates in 1990, provincial forest inventories coupled with historical remote sensing information will provide the baseline data on area and forest volume. We will use this information to estimate above ground biomass. We will then use models to estimate below ground biomass (e.g. Kurz et al. 1996) and the initial sizes of the dead organic matter carbon stocks (i.e., litter, coarse woody debris, and soil carbon), none of which are included in existing forest inventory databases.

Release of carbon from the soil will be accounted for, if Parties so decide, by using modeling and/or regional averages for various cover types and land uses. We expect that soil carbon information will improve considerably over time, and certainly this will be the case if it must be accounted for under the Kyoto Protocol.

7.1.4 Uncertainty and Verification

Uncertainties of estimates within our approach may arise in a number of ways. These include: the use of retrospective information, inconsistencies in sampling schemes and approaches (which we will strive to minimize), timing of measurements, mis-classed information, sampling intensity, the use of models, and reporting errors. We note that stability of definitions and accounting approaches within and across commitment periods will help to reduce uncertainties.

Uncertainty related to the use of retrospective information arises because of the need to determine the status of lands since 1990. Canada's approach will be to use archived remotely sensed data, forest inventory data and/or retrospective models. We expect difficulties in evaluating the uncertainty of such estimates, as the IPCC Special Report suggested would be the case (Section 3.4.4), reflecting the fact that our current and past measurement systems were not designed for the purposes of Kyoto Protocol measurements.

With respect to uncertainty resulting from measurement timing, we note that data collection on forests in Canada is time consuming and generally a multi-year process, because of the large size of the forest and the number of jurisdictions involved. Accurate verifiable estimates of stock changes may be difficult to obtain for a specific point in time though estimates over longer periods of time, such as commitment periods, will be feasible. Uncertainty in these estimates will be addressed through repeated measurements over subsequent reporting periods or through a delayed reporting timeframe.

With respect to uncertainty from use of models, we believe that our land-based approach, based upon a continuous forest inventory design, will result in a modeling framework that is stable, and therefore

provides consistent reporting over time. In turn this should increase transparency and verifiability. Uncertainty will be reduced further through research and development in relation to models and other components of our system.

The uncertainty involved in activity reporting is primarily due to reporting errors or mis-classed information that could lead to errors of omission or commission. For example, in the case of remote sensing, a clear-cut could be confused with deforestation activities. Canada plans to use two methods to resolve these uncertainties: 1) local records or knowledge where practical and 2) a double sampling system using the NFI plots.

Verification of the national accounting framework will be accomplished through peer-reviewed data and acquisition procedures, models, parameter sets and reporting methods. Our system is based on a continuous forest inventory design with the plots being geo-referenced and relocatable, which facilitates quality assurance. Remote sensing data add independence to the system for detecting land use changes. Relevant remote sensing and modeling information will be archived in the form that they were used.

7.2 Agricultural Land Management

Canada recognizes that addressing measurement uncertainty of agricultural soil carbon change is an important issue. The IPCC Special Report noted that options exist to deal with uncertainty, as well as permanence. Canada's current and future investments in soil science and modelling give us the confidence that we can report our soil carbon stock changes during the first commitment period with a high degree of confidence.

Canada regards the measurement and verification of soil carbon stock changes to be feasible for the first commitment period. Canada already uses remote sensing to verify crop types and farmers' commitments to a permanent cover program. Canada has a model framework for scaling-up, but recognizes there are some challenges and important opportunities ahead to accomplish this goal. To scale-up from research to national reporting, Canada will:

- take advantage of some the recent advances in remote sensing technology;
- develop cost-effective verification protocols with representative land based monitoring;
- integrate imagery and land-use census information using graphical information systems (GIS) and carbon models; and
- continue work to validate the accuracy of process models and scaling-up protocols.

Technically, we are confident these issues can be addressed successfully and relatively quickly. Additional investments to address these issues promptly will be motivated by inclusion in the Kyoto Protocol of land management activities which improve soil sinks, whereas delayed inclusion will have the effect of discouraging such investments by governments and the private sector. This will then delay obtaining environmental benefits of increased LULUCF activities and attaining the objectives of the UNFCCC.

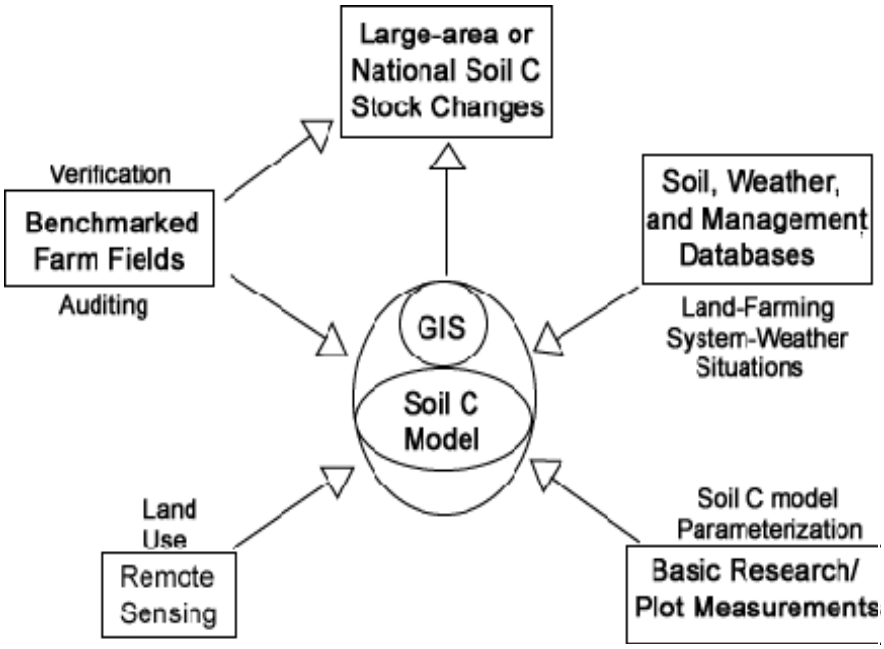
Scientific investments are also aimed at reducing the measurement uncertainty of non-CO_2 greenhouse gases. Canada agrees that non-CO_2 gases in agricultural production need to be reported along with the carbon sequestration as this sends the appropriate signal to farmers to manage their landscape for all greenhouse gases. The issue of permanency of sequestration can be dealt with through contiguous commitment periods and a rigorous accounting scheme that addresses changes in land management and their impact on sources and sinks. The IPCC Special Report confirmed that LULUCF activities can have broad positive environmental, social and economic impacts. Canada believes these benefits are too important to ignore or to allow resolvable technical impediments to delay their implementation.

7.2.1 Measurement Framework

Canada's has a viable framework for quantifying and verifying soil carbon gain. This framework consists of the following elements:

- Benchmark data and long-term research studies for various agro-ecosystems to confirm that carbon stock changes are human induced;
- Spatial databases of climate, soils, land-use and remote sensing;
- Quantitative models to assess soil C change combined with expert opinion;
- Process studies to refine understanding of the carbon and nutrient cycling;
- Selective on-farm monitoring using GPS on representative soil landscapes.

The diagram below shows how these elements are drawn together into a measurement and verification system.



8. REFERENCES

Apps, M.J., W.A. Kurz, S.J. Beukema and J.S Bhatti (1999). Carbon budget of the Canadian forest product sector. ***Environmental Science and Policy*** 2: 25-41.

ArborVitae and Woodrising (1999). Estimating the carbon sequestration associated with reforestation in western Canada. Prepared by ArbourVitae Environmental Services Ltd. and Woodrising Consulting Inc. for the Sinks Table and Forest Sector Table of the National Climate Change Process, Ottawa.

Bonnor, G.M. (1985). ***Inventory of Forest Biomass in Canada***. Canadian Forestry Service. Petawawa National Forestry Institute, Chalk River, ON. 63 pp.

Bruce, J.P., M. Frome, E. Haites, H. Janzen, R. Lal, and K. Paustian (1999). Carbon sequestration in soils. ***J. Soil and Water Conservation*** 54: 382-389.

Dumanski, J., R.L. Desjardins, C. Tarnocai, C. Monreal, E.G. Gregorich, V. Kirkwood, and C.A. Campbell (1998). Possibilities for future carbon sequestration in Canada agriculture in relation to land use changes. ***Climate Change*** 40:81-103.

Janzen, H.H., R.L. Desjardins, J.M.R. Asselin and B. Grace (1999). The health of our air. Research Branch, Agriculture and Agri-Food Canada, Sir John Carling Building, Ottawa, Ontario, Catalogue No. A53-1981/1998E.

Kurz, W.A. and J.A. Greenough (1999). Assessing options for measurement of verifiable changes in carbon stocks from reforestation, afforestation, and deforestation and other potential forestry activities. Final report prepared by ESSA Technologies Ltd., Vancouver, BC for National Sinks Issues Table. 42 pp.

Kurz W.A. and M.J. Apps (1999). A 70-year retrospective analysis of carbon fluxes in the Canadian forest sector. ***Ecological Applications*** 9(2): 526-547.

Kurz, W.A., S.J. Beukema and M.J. Apps (1996). Estimation of root biomass and dynamics for the carbon budget model of the Canadian forest sector. ***Canadian J. Forest Research*** 26: 1973-79.

Lacelle B (1998). Canada's Soil Organic Carbon Database. pp. 93-101 in Lal, R. et al. (eds.***), Soil Processes and the Carbon Cycle***, CRC Press, Boca Raton.

Lowe J.J., K. Power and S.L. Gray (1996). ***Canada's Forest Inventory 1991: The 1994 Version – An Addendum to Canada's Forest Inventory 1991***. Information Report BC-X-362E. Pacific Forestry Centre, Canadian Forest Service, Natural Resources Canada, Victoria BC

NCCP (1998). Foundation paper: A survey of the forest sector and forest sector options. Prepared for the National Climate Change Process by the Forest Sector Table, Ottawa.

NCCP (1999a). Options for the Forest Sector to Contribute to Canada's National Implementation Strategy for the Kyoto Protocol.. Prepared for the National Climate Change Process by the Forest Sector Table, Ottawa.

NCCP (1999b). Sinks Table Options Paper: Land-Use, Land-Use Change and Forestry in Canada and the Kyoto Protocol. Prepared for the National Climate Change Process by the Sinks Table, Ottawa.

Neitzert, F., K. Olsen and P. Collas (1999***). Canada's Greenhouse Gas Inventory: 1997 Emissions and Removals with Trends***. Environment Canada, Ottawa.

Peterson, E.B., G.C. Robinson, and N.M. Peterson. (1999). Prairie Provinces and British Columbia Forestry Options. Prepared for the Agriculture and Agri-Food Issues Table on Climate Change.

Robinson, D.C.E, W.A. Kurz and C. Pinkham (1999). Estimating the carbon losses from deforestation in Canada. Prepared by ESSA Technologies Ltd. for the Sinks Table and Forest Sector Table of the National Climate Change Process, Ottawa.

Robinson, G.C., E.B. Peterson, S.M. Smith and G.S. Nagle (1999). Estimating the carbon sequestration associated with reforestation in western Canada. Prepared by Nawitka Renewable Resource Consultants for the Sinks Table and Forest Sector Table of the National Climate Change Process, Ottawa.

Rubec, C. (2000). Canadian Wetland Inventory: Hard issues and realities. Wetland Inventory Workshop, January 24-25, 2000. Ottawa, ON.

Sellers, P. and M. Wellisch (1998). Greenhouse gas contribution to Canada's land-use change and forestry activities: 1990-2010. Final Draft. According to the Intergovernmental Panel on Climate Change (IPCC) Guidelines for Land-Use Change and Forestry. Description of IPCC LUCF Worksheets. Prepared by MWA Consultants for Environment Canada, Environmental Protection Division, Hull, PQ.

Shriner, D.S. and R.B Street (1998). North America. In ***The Regional Impacts of Climate Change: An Assessment of Vulnerability***. Special Report of IPCC Working Group II, Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, U.K.

Statistics Canada (1997). Agricultural profile of Canada. In ***1996 Census of Agriculture***, Ottawa, Catalogue No. 93-356-KPB.

Tarnocai C. (1998). The amount of organic carbon in various soil orders and ecological provinces in Canada. pp. 81-92 in Lal, R. et al. (eds.), **Soil Processes and the Carbon Cycle**, CRC Press, Boca Raton.

Tarnocai, C. (1994). Amount of organic carbon in Canadian soils***. Transactions of the 15th World Congress of Soil Science***, Volume 6a, Commission V. Acapulco, Mexico. pp. 67-82.

Turnock, R. (2000). The carbon sequestration potential of the Prairie Shelterbelt Program and its possible role in a national greenhouse gas mitigation strategy. Draft MS. Prepared at Prairie Farm Rehabilitation Centre, Agriculture and Agri-Food Canada, Indian Head, SK.

PROPOSALS RELATED TO KYOTO PROTOCOL ARTICLES 3.3 AND 3.4
CANADIAN SUBMISSION TO THE UNFCCC

ANNEX 1

DATA TABLES AND EXPLANATORY TEXT

1 AUGUST 2000

PLEASE NOTE THAT CARBON STOCK CHANGES HAVE BEEN ENTERED IN MEGATONNES RATHER THAN TONNES

Table I Preliminary data and information provided by Canada on carbon stock changes and areas related to article 3.3 activities

Article 3.3 Country specific data	Definitions	Accounting framework	a_I (ha)	$\triangle C_I$ (Mt C)	a_{II} (ha)	$\triangle C_{II}$ (Mt C)	a_{cp} (ha)	$\triangle C_{cp}$(Mt C)	Methods and approaches
Afforestation	**IPCC**	**Activity based**	< 9,000	< 0.5	< 15,000	< 0.5	< 34,500	< 0.5	Definitions as shown in the submission. Estimates indicative of the impact of the definitions but may not exactly match the definitions due to lack of data. Area based on very rough approximation using available information on urban planting, industry plantations and shelterbelts. Assumed annual afforested area for early to mid 1990s applies in 1990-2012. Only above ground tree biomass included. Other pools expected to be very small. a1 is 1990-95. a2 is 1990-99.
Reforestation		**Land based**	< 9,000	< 0.5	< 15,000	< 0.5	< 34,500	< 0.5	
Afforestation	**FAO**	**Activity based**	< 9,000	< 0.5	< 15,000	< 0.5	< 34,500	< 0.5	
		Land based	< 9,000	< 0.5	< 15,000	< 0.5	< 34,500	< 0.5	
Reforestation	**FAO**	**Activity based**	5,080,000	-15	8,760,000	-25	21,030,000	-3	Definitions as shown in the submission. Estimates indicative of the impact of the definitions but may not exactly match the definitions due to lack of data. Area based on harvest area as regeneration of all harvest areas is required. Carbon stock change estimates derived separately for Eastern Canada using a modified version of the GORCAM model, and for Western Canada using a spreadsheet model. All carbon pools included, with the components included in the national estimates varying on the accounting approach and the original studies. Regeneration activity based on assumptions about the mix of species and planting versus natural regeneration of harvested areas. a1 is 1990-95, a2 is 1990-99.
		Land based I	5,080,000	-250	8,760,000	-425	21,030,000	-226	
		Land based II	5,080,000	-132	8,760,000	-221	21,030,000	-115	
Afforestation	**Other**	**Activity based**							
Reforestation		**Land based**							
Deforestation	**IPCC/FAO**	**Activity based**	276,000	-26	460,000	-43	1,057,000	-22	Definitions as shown in the submission. Estimates indicative of the impact of the definitions but may not exactly match the definitions due to lack of data. Average reported based on compilation of available information and expert opinion to derive estimated low and high ranges of areas deforested as a result of various activities in each province. Includes above and below ground biomass, litter and woody debris and soil carbon. Assumed that annual rate and carbon stock change for early to mid 1990s applies in 1990-2012. a1 is 1990-95. a2 is 1990-99.
		Land based	276,000	-26	460,000	-43	1,057,000	-22	
	Other	**Activity based**							
		Land based							

a_I : Area (ha) afforested and reforested, or deforested since 1990 up to 1995 or possibly an earlier specific year.

$\triangle C_I$: Carbon stock change (Mt C) since 1990 up to the same year as used in a_I on land afforested, reforested, and deforested.

a_{II} : Area (ha) afforested and reforested, or deforested since 1990 up to 1999 or an earlier specific year.

$\triangle C_{II}$: Carbon stock change (Mt C) since 1990 up to the same year as used in a_{II} on land afforested, reforested, and deforested.

a_{cp}: Projected area (ha) afforested and reforested, or deforested since 1990 up to 2012.

$\triangle C_{cp}$: Projected carbon stock change (Mt C) over the first commitment period on land afforested, reforested, and deforested since 1990 up to 2012.

Methods and approaches

Specify:

a) Forest definition used;

b) Definitions for afforestation, reforestation and deforestation used;

c) Applied accounting approaches;

d) Included carbon pools;

e) Other.

EXPLANATORY TEXT (table I)

Parties should submit information under all headings listed below where the information is relevant to the approach taken in their submission and to the extent that data and methodologies exist.

1. Definitions and accounting:
   a) Forest,
   b) Afforestation, reforestation, and deforestation,
   c) Accounting approaches.
2. Carbon pools included (e.g. above-ground biomass, litter and woody debris, below-ground biomass, soil carbon, and harvested materials);
3. Stratification (e.g. biomes and regions);
4. Methodologies and data:
   a) Data sources,
   b) Sampling techniques,
   c) Models and key parameters,
   d) Uncertainties.
5. Treatment of non-CO_2 greenhouse gases.
6. Methods and key assumptions in projections for the first commitment period (2008–2012) and discussion, if possible, of trends beyond the first commitment period.

Table II - Preliminary data and information provided by Canada on carbon stocks and area estimates (First sentence of Article 3.4)

Land system	Area (million ha)	Carbon stock in 1990 (Gt C)
Forest lands	418	86
Agriculture lands	45.5	6
Rangelands/grasslands	15.5	
Wetlands	148	>150
Tundra		55
Total (as listed above)	**>627**	**>297**

EXPLANATORY TEXT (table II)

Parties should submit information under all headings listed below where the information is relevant to the approach taken in their submission and to the extent that data and methodologies exist.

1.Description of land categories, including any land categories not covered.
2.Carbon pools - distinctions and assumptions.
3.Data sources.
4.Methods.
5.Possible changes in carbon stocks.
6.Uncertainties.

PLEASE NOTE THAT EMISSIONS/REMOVALS HAVE BEEN ENTERED IN MEGATONNES RATHER THAN TONNES, AND THAT AREAS ARE IN MILLIONS OF HA

Table III - Preliminary data and information provided by Canada on Article 3.4 activities, related net GHG emissions, involved areas, and projected carbon stock changes (additional a

Article 3.4 Country specific data	Accounting framework	a_{I} (M ha)	$CO_{2,\ I}$ (Mt CO_2)*	$CH_{4,\ I}$ (Mt CO_2 equiv.)* §	$N_2O_{,\ I}$ (Mt CO_2 equiv.)* §	a_{II} (M ha)	$CO_{2,\ II}$ (Mt CO_2)*	$CH_{4,\ II}$ (Mt CO_2 equiv.)* §	$N_2O_{,\ II}$ (Mt CO_2 equiv.)* §	a_{cp} (M ha)	Δ_{cp} (Mt C)	$CO_{2,\ cp}$ (Mt CO_2)*	$CH_{4,\ cp}$ (Mt CO_2 equiv.)* §	$N_2O_{,\ cp}$ (Mt CO_2 equiv.)* §
Forest Management	***Land based***	134	477	-8	-6	134	730	-11	-10	134	48	176	-4	-5
	Activity based													
Cropland Management														
low adoption	***Land based***	34.7	-22.1	See note	See note	34.4	-22.2	See note	See note	34.2	3.1	11.3	0.0	0.0
medium adoption		34.7	-22.1	See note	See note	34.4	-22.2	See note	See note	33.4	13.1	48.0	-0.1	-7.0
high adoption		34.7	-22.1	See note	See note	34.4	-22.2	See note	See note	33.3	20.5	75.1	-0.1	-8.5
	Activity based													
Grazing Land Management & Livestock														
low adoption	***Land based***	26.2	3.6	See note	See note	26.8	8.7	See note	See note	26.5	2.1	7.6	0.0	0.0
medium adoption		26.2	3.6	See note	See note	26.8	8.7	See note	See note	27.3	7.1	25.9	-3.3	-2.4
	Activity based													
Shelterbelts														
low adoption	***Land based***	0.02	0.3	See note	See note	0.03	0.6	See note	See note	0.07	0.4	1.4	0.0	0.0
high adoption		0.02	0.3	See note	See note	0.03	0.6	See note	See note	0.12	0.6	2.2	0.0	0.0
	Activity based													

Note: non-CO2 emissions associated with agricultural land management are already included in the greeenhouse gas accounting for the Kyoto Protocol. This Table shows only those <u>additional</u> emissio accounting for the Protocol if cropland management and grazing land management & livestock are included under Article 3.4. See the explanatory notes.

To convert a carbon amount to CO_2 multiply it by 3.67.

§ CH_4 and N_2O emissions are converted to CO_2 equivalent emissions by using the global warming potential (GWP) values of 21 for CH_4 and 310 for N_2O (Source: Second Assess

$CO_{2,\ I}$: Net CO_2 emissions (t CO_2) by sources and removals by sinks related to the Article 3.4 activity, accumulated from 1990 to the same year as used in a_I.
$CH_{4,\ I}$: CH_4 emissions (t CO_2 equivalent) by sources related to the Article 3.4 activity, accumulated from 1990 to the same year as used in a_I.
$N_2O_{,\ I}$: N_2O emissions (t CO_2 equivalent) by sources related to the Article 3.4 activity, accumulated from 1990 to the same year as used in a_I.
a_{II}: Area (ha) in 1999 or possibly an earlier specific year involved in the Article 3.4 activity since 1990.
$CO_{2,\ II}$: Net CO_2 emissions (t CO_2) by sources and removals by sinks related to the Article 3.4 activity,accumulated from 1990 to the same year as used in a_{II}.
$CH_{4,\ II}$: CH_4 emissions (t CO_2 equivalent) by sources related to the Article 3.4 activity, accumulated from 1990 to the same year as used in a_{II}.
$N_2O_{,\ II}$: N_2O emissions (t CO_2 equivalent) by sources related to the Article 3.4 activity, accumulated from 1990 to the same year as used in a_{II}.
a_{cp}: Projected area (ha) in 2012 involved in the Article 3.4 activity since 1990.
$\triangle C_{cp}$: Projected carbon stock changes (t C) over the first commitment period related to the Article 3.4 activity since 1990.
$CO_{2,\ cp}$: Projected net CO_2 emissions related contribution (t CO_2) of the Article 3.4 activity to the first commitment period assigned amount of the Party.
$CH_{4,\ cp}$: Projected CH_4 emissions related contribution (t CO_2 equivalent) of the Article 3.4 activity to the first commitment period assigne amount of the Party.
$N_2O_{,\ cp}$: Projected N_2O emissions related contribution (t CO_2 equivalent) of the Article 3.4 activity to the first commitment period assigned amount of the Party.

EXPLANATORY TEXT (table III)

Parties should submit information under all headings listed below where the information is relevant to the approach taken in their submissions and to the extent that data and methodologies exist.

1.Activities and accounting:
  a) Definitions and descriptions of all activities proposed,
  b) Scope of activities and how they fit into broader managed land categories,
  c) Accounting approaches,
  d) Proposals for key accounting features, e.g. assumptions on baselines, basis for the area estimates covered by activity.
2.Carbon pools included (e.g. above ground biomass, litter and woody debris, below-ground biomass, soil carbon, and harvested materials).
3.Methodologies and data:
  a) Data sources,
  b) Sampling techniques,
  c) Models and key parameters,
  d) Uncertainties.
4.Treatment of non CO_2 greenhouse gases.
5.Methods and key assumptions in projections for the first commitment period (2008–2012) and discussion, if possible, of trends beyond the first commitment period.

I. TABLE I EXPLANATORY TEXT

1. Definitions and Accounting

Definitions for forest, afforestation, reforestation and deforestation are given in Section 3 of the submission. We consider the preliminary estimates given here to be indicative of the impact of the definitional scenarios shown in Table I.

Areas subject to afforestation (and reforestation with the IPCC definition) and deforestation, and the associated changes in carbon stocks, have not been measured or monitored in Canada to date. Under the IPCC definitions, it is not possible to distinguish afforestation and reforestation in Canada, making the distinction between the two of little practical use in Canada. Areas subject to reforestation under a FAO-type definition are much better known. We have used a variety of assumptions, methodologies and currently available data to derive the estimates shown in Table I, but we emphasize that these approaches do not reflect the systems that Canada proposes to use to measure and monitor ARD and forest management activities. These systems currently are being assessed and will be implemented as required once decisions have been made on what is acceptable.

As stated in the submission, we propose that Parties agree to an accounting system with some degree of flexibility, allowing Parties to use approaches most suitable to their circumstances, provided the approach conforms to rules to be agreed by Parties, such as those related to tranparency, verifiability and comparability. For the preliminary estimates shown in Table I we did not attempt to differentiate between Activity-Based accounting and Land-Based accounting for deforestation and afforestation, given the data available at present. Therefore in Table I we do not show differences between the two types of accounting for these two activities, and we expect that in practice the differences will be small.

2. Carbon Pools Included

The preliminary estimates in the Table do not include all carbon pools, or include certain pools using simplifying assumptions, reflecting the information currently available. We emphasize that, in terms of actual accounting for the purposes of the Protocol, Canada proposes that all carbon pools be included, subject to the proposed rule that Parties must report all sources but may choose to not report a pool if they can verifiably demonstrate that the pool is not a source.

Only above-ground tree biomass is included in the preliminary estimates of afforestation (and reforestation with the IPCC definitions). Due to the minimal level of afforestation activity the effect of including other carbon pools in the estimates shown also would be minimal. For deforestation, above-ground tree biomass, litter and woody debris, below-ground tree biomass and soil are included according to the assumptions outlined below.

For reforestation using a FAO-type definition, the estimates in Table II reflect inclusion of different components of specific pools depending on the accounting approach. Each accounting approach includes all biomass pools associated with planting or natural regeneration after harvest, plus the effects on soil and on-site vegetation of the activity in parts of the country for which estimates for these pools were available. Land-Based II accounting also includes the emissions ocurring during a measurement period as a result of dead biomass left on site after harvesting. Land-Based I accounting then adds to the Land-based II estimates the emissions associated with the harvested biomass removed from the site.

3. Stratification

Due to the minimal level of afforestation activity no stratification was attempted. For reforestation using a FAO-type definition, the estimates use detailed information on growth curves of tree species typically involved in regeneration in each province in Eastern and Western Canada. The set of

parameters and conversion factors used to relate tree biomass to the other organic carbon pools generally were based on broad national or regional values, and differed between Eastern Canada and Western Canada.

In deriving the estimates for deforestation, we stratified deforestation areas based mainly on administrative regions (provinces) and, where possible, on forest cover type (softwood, mixwood, hardwood). Average forest carbon density ranges from 27 t C / ha to 79 t C / ha, depending on the province (see Bonnor 1985), though the variation may be larger if differences in forest type, forest stand age and ecozone for specific deforested areas could be considered. This is not possible with the limited data currently available on the spatial location of deforestation in Canada.

4. Methodologies and Data

Afforestation (and Reforestation with the IPCC Definition)

Land use change due to tree planting or seeding activities (i.e. on land that has not recently held forest) is minimal in Canada, and consequently information is limited. Since 1992 the Tree Canada Foundation has supported a tree planting program aimed largely at urban tree planting, but we assume that little would qualify as forest although it results in carbon sequestration. Forest products companies have planted a total of approximately 6 10^3 ha to 10 10^3 ha in plantations in the last two decades (NCCP 1998, 1999a, 1999b), but only the portion that was planted after 1990 would be included in the accounting. Estimates based on Turnock (2000) suggest shelterbelt plantings in Prairie provinces in 1990-99 amounted to about 3 10^3 ha per year, but we expect that some of this would not qualify as forest under the Canadian proposed definitions – how much might qualify has not yet been established. Shelterbelts could also be included under Article 3.4 additional activites related to agricultural land management, and for the purposes of this submission they have been included there.

For Table I we therefore assume an approximate annual rate of 1.5 10^3 ha / yr in the early to mid 1990s for tree planting or seeding on land that has not recently held forest. We assume this rate applies to the whole 1990-2012 period, and stress that these estimates are highly uncertain. Detailed information on the species planted is not readily available, and information on the growth of most trees species in the early years of their lives is imprecise. The available information suggests that, because of the slow growth of many of the trees planted, the carbon sequestered will be under 0.1 Mt C / yr in the first commitment period, and less in earlier years.

Reforestation (FAO-Type Definition)

The preliminary estimates in Table I are based on separate studies done for Eastern and Western Canada (Robinson G.C. et al. 1999, ArborVitae and Woodrising 1999) using different methodologies and somewhat different assumptions. For Eastern Canada a modified version of the stand-based GORCAM carbon budget model was used. For Western Canada a spreadsheet model was developed.

Only regeneration after harvest is included in the estimates – planting and seeding of areas naturally disturbed are not included and account for less than five percent of total activity under the Canadian definition. Areas are based on harvest area statistics. Information associated with regulation of post-harvest regeneration activity by provincial forest agencies was used in setting assumptions. Regeneration delay following harvesting was assumed to be 0-2 years for planting/seeding and 0-7 years for natural regeneration, depending on the region. Assumptions about regenerating species were based on information on actual planting mixes or on typical species mixes in an area, and used growth curves for medium quality sites. The mix between planting/seeding and natural regeneration after harvest is based on data from the early to mid 1990s.

The different accounting approaches require estimation of carbon stock changes associated with the various pools. The estimates in the original studies were adjusted to provide the estimates for the three accounting approaches. Emissions from on-site carbon after harvest of a given area will occur over

several years to several decades in Canada, and emissions from the off-site carbon taken from the area will occur over a period of 100 years or more. For the purposes of Land-Based I and Land-Based II accounting we assumed that harvesting in a given year results in very quick emissions from a large portion of the biomass left on-site, and from soil disturbances related to harvesting. We assumed that emissions from harvested material taken off-site for products occur in the same year as harvest, and amount to 55% of the material, with the remainder going into the forest products carbon pool. This assumption is consistent with Apps et al. (1999) who found that in 1989 the net carbon accumulation by the forest products pool was 45% of the annual harvest in Canada (eg. the net of emissions from the pool and additions to the pool). These assummptions mean that estimates for Land-Based I and II accounting may be biased upward, the closer is the period of carbon stock change estimates to 1990. Overall carbon stock change estimates under the various accounting approaches are of low confidence.

Deforestation

Deforestation rates currently are not monitored or recorded explicitly in Canada so the location, area, source and carbon impact of deforestation are uncertain. The preliminary estimates in Table I are based on compilation of information from a variety of sources and employing a variety of methodological assumptions. Information sources include published reports and Agricultural Census data plus the results of interviews and a questionnaire distributed in early 1999 to representatives from industry, provincial and federal governments (Robinson, Kurz and Pinkham 1999). The estimates include the available, but incomplete, information on the impact of agriculture, urban development, transportation and electricity infrastructrual development, recreational development, and mining and petroleum exploration. Overall the estimates are of low confidence and based on a range covering possible low and high values for deforested areas.

The estimates assume that deforested areas are completely forested and that above-ground biomass carbon on a deforested area is equal to the average for the province in which it occurred. Based on the published information from previous national carbon budget modeling work it was assumed that below-ground biomass is 26% of average above-ground biomass (7 to 21 t C / ha depending on the province) (Kurz et al. 1996). It was also assumed that carbon in litter, coarse woody debris and 10% of the humus pool would be emitted as a result of deforestation - we assumed these carbon pools hold 48 t C / ha, based on the previous work for national carbon budget modeling. We assumed all carbon to be emitted immediately upon deforestation. With the information collected and these assumptions we derived an approximate estimate of annual deforestation rates and the associated carbon stock change for the early to mid 1990s. We assume the annual estimates apply to each year in the 1990-2012 period.

5. Treatment of Non-CO_2 greenhouse gases

Article 3.3 specifies measurement using verifiable changes in carbon stocks so that accounting for non-CO_2 greenhouse gases is not required, and estimates are not provided here.

6. Methods and Key Assumptions for the First Commitment Period

We note that trends in ARD activities are difficult to predict as they will depend in part on decisions on Articles 3.3 and 3.4, and perhaps other Articles, as well as on other economic and social factors.

Afforestation (and Reforestation with the IPCC Definition)

The annual rates of afforestatation in the early to mid 1990s, which were quite low, are assumed to apply in the 1990-2012 period. Carbon sequestration increases over time as a result of this afforestation but due to slow tree growth the carbon stock change is expected to be less than 0.5 Mt C in the first commitment period. We expect that private and public interest and investment in

afforestation may increase once the Protocol is ratified, but it would be many years before substantive sequestration from afforestation would occur due to the relatively slow growth rates. The increase would depend on economics and policy decisions. Work undertaken as part of Canada's analysis of how to meet its Kyoto target showed that the carbon stock change from a very ambitious afforestation program (up to about 70,000 ha per year for 15 years) would amount to a carbon stock change of less than 3 Mt C in the first commitment period (NCCP 1999a, 1999b).

Reforestation (FAO-Type Definition)

For the late 1990s through to the first commitment period the area subject to harvest and regeneration is based on a projection of moderate harvest growth. The mix of tree species and of planting and natural regeneration that occurred in the early to mid 1990s is assumed to continue, based on continuation of provincial forest agency regulatory requirements for regeneration activity.

Deforestation

We assumed that estimated annual deforestation rates and carbon stock changes for the early to mid 1990 apply in the 1990-2012 period. Insufficient data exists at present to determine deforestation trends in Canada. As well, insufficient data exists at present to determine the fate of biomass or soil on deforested areas, or the release of carbon over time resulting from deforestation in a given year. We assumed all carbon is emitted immediately upon deforestation in the 1990-2012 period. The potential to reduce the rate or impact of deforestation in the future is unknown at present.

II. TABLE II EXPLANATORY NOTES

1. Description, Methodologies and Data

Estimates were derived from several sources and obtained using various methods. The area of forested lands of 418 10^6 ha is drawn from the 1991 National Forest Inventory (Lowe et al. 1996). The total ecosystem carbon stock reported in the Table for forests is that corresponding to the 404 10^6 ha of forests for which biomass data are available (Kurz and Apps, 1999); it includes above-ground and below-ground biomass and total soil carbon.

The area of Canada's agricultural land base (Statistics Canada, 1997) is assumed to have remained constant over the last 10 years and is therefore used for 1990. The amount of organic carbon in this pool has been estimated to a soil depth of one meter by matching the attributes of corresponding polygons in the Canadian Soil Organic Carbon Database and the Canadian Land Potential Database (Dumanski et al., 1998; Tarnocai, 1994).

Wetlands in Canada are defined as lands saturated with water long enough to allow the physical processes or biological activities characteristic of aquatic environments. They are divided into peatlands (bogs and fens) and non-peat accumulating wetlands (marsh, swamps and shallow water), which together occupy approximately 148 10^6 ha (Rubec 2000). Ninety four percent (94%) of wetlands are peatlands. There is no estimate of the magnitude of the 1990 wetlands carbon reservoir. A conservative estimate of 150 Gt C is used, corresponding to the amount of carbon stored in all organic soils of Canada in the Canadian Soil Organic Carbon Database (SOCD, Tarnocai, 1998). With 50% of all carbon stocks reported in Table II, wetlands represent the largest carbon reservoir in Canada.

There is no reliable data on the area of tundra. However, the frozen soils typical of the tundra landscape (Cryosols in the Canadian Soil Classification System) cover 210 10^6 ha and represent a significant carbon pool of 55 Gt of carbon (Tarnocai 1998). This value excludes Organic Cryosols that were incorporated in the carbon estimate for organic soils.

2. Sources of Uncertainty

A major source of uncertainty results from the use of information from the Canadian Soil Organic Carbon Database to infer 1990 carbon stocks. The Database was created from actual soil survey data collected mostly in the 1970s and 1980s, complemented by information interpreted from 1:1 million Landsat imagery for remote regions (Lacelle, 1998). It is not structured to monitor changes in land-uses and soil conditions. The total soil carbon reservoir reported here is much larger and assumed to be more stable than the carbon reservoir in the surface soil, which is more susceptible to alterations due to natural and anthropogenic events. Thus the estimates of total soil carbon stocks are more reliable than those of surface carbon stocks.

There is also an unquantified overlap between the total carbon stocks contained in the forest and agricultural ecosystems, and that of organic soils, as some organic soils may occur in either one of these categories.

Work is underway to improve Canada's national capacity to assess land-use practices, monitor land-use changes and estimate their effects on carbon stock changes, as required by the Kyoto Protocol. The estimates provided in Table II largely reflect the current state of knowledge and we emphasize that caution must be exercised in their use and interpretation.

III. TABLE III EXPLANATORY NOTES

A. FOREST MANAGEMENT

1. Activities and Accounting

Sections 5 and 6 of the submission discuss our approach to additional activities under Article 3.4. We consider the preliminary estimates given in Table III to be indicative of the impact in Canada of the additional activities we propose for inclusion. We have used a variety of assumptions and currently available data to derive the estimates shown in Table III, but we emphasize that these approaches do not reflect the systems that Canada proposes to use to measure and monitor additional activities. These proposed systems currently are being assessed and will be implemented as required once decisions have been made on what is acceptable.

Our proposal for the inclusion of forest management would be accounted for using a land-based accounting approach in terms of the managed forest area. The managed forest is only a portion of the total forest area of 418 million hectares, the largest share of which is not accessible through ground transportation routes. For the purposes of Article 3.4, forest management is the broad set of management activities in the forest related to multiple use values including timber, which is the forest use of greatest significance for carbon stock changes.

2. Carbon Pools Included

The preliminary estimates in Table III do not include all carbon pools affected by forest management. We have included all biomass pools such as above and below-ground living biomass, harvested material and harvest slash. We have not included soil carbon. This pool is not included as it is beyond the scope of the methodology, which relies on the methods used in the *Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories*. We emphasize that, in terms of actual accounting for the purposes of the Protocol, Canada proposes that all carbon pools be included, subject to the proposed rule that Parties must report all sources but may choose to not report a pool if they can verifiably demonstrate that the pool is not a source.

3. Methodologies and Data

Our estimates are based on the methodology of the *Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories* and the data underlying Canada's latest report on LUCF, published in 1999 as part of our greenhouse gas inventory (Sellers and Wellisch 1998, Neitzert et al. 1999). In order to produce estimates for Table III we made some additional assumptions but our estimates are consistent with those reported in our greenhouse gas inventory.

We note first that the area of land subject to forest management – the managed forest – has not been legally or administratively defined in Canada. For the purposes of the accounting for Article 3.4, discussions within Canada will be needed to determine what areas would be classified as subject to forest management, especially as much of the forest is owned by provinces and under provincial jurisdiction. As a preliminary estimate (given currently available information) we use the accessible stocked timber productive forest, 134 million ha, as the managed forest. We assume that this area currently is most closely related to the area subject to forest management.

To derive carbon stock estimates for this land area we made assumptions related to harvesting and forest products production, forest growth rates and areas subject to natural disturbances. Because these influences are uncertain, we also explored the impact of some alterations in our major assumptions. Other influences, such as those related to woodlots and the small-scale use of the managed forest for firewood, were also included but do not have a major impact on the results.

We assumed moderate growth in forest products production and the consequent emissions associated with harvesting. We assumed that emissions from harvested material taken off-site for products occur in the same year as harvest, as do emissions from biomass left on site. This assumption is consistent with the *Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories* but we note that we strongly support the development of a more accurate accounting approach for emissions from forest products.

Forest growth rates used in our estimates are derived from national forest inventory data. These rates are average growth rates net of the impact of non-stand destroying natural disturbances which affect growth over the landscape. There is some uncertainty about these growth rates so we explored the possibility that the growth rates may be up to 10% higher than the rates used in our reporting for the LUCF inventory.

The estimates reflect the full effect of stand-replacing fires on biomass carbon pools in the managed forest estate. These fires averaged 350 10^3 ha per year in 1980-90, and we assumed that this rate would continue. We note that this is the rate of area burned after significant fire suppression efforts, and that we are concerned that climate change may increase the incidence of fire. The estimates also include the full harvest-regeneration cycle, and therefore include reforestation as Canada proposes it should be defined. The estimate should also include afforestation. While we have not explicitly included afforestation in the estimate, the very limited extent of the activity in Canada means that its inclusion would not significantly affect the result.

4. Treatment of Non-CO_2 greenhouse gases

The major sources of non-CO_2 greenhouse gases from the managed forest are expected to be those associated with prescribed, accidental and natural fires. The estimates shown in Table III are for emissions associated with these fires, and are based on an assumption that the recent fire disturbance pattern and the current level of prescribed burning activity continue. The methodology of the *Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories* for LUCF was used to derive these estimates.

5. Methods and Key Assumptions for the First Commitment Period

Over time the area subject to forest management will change due to deforestation, afforestation and possible slow expansion of management activities. However, this expansion is slow so, for the purposes of Table III, we assume that the area remains constant at 134 million ha in the 1990-2012 period. We also made a number of key assumptions about future forest products production and areas subject to fire, as noted above.

B. CROPLAND, GRAZING LAND AND SHELTERBELT MANAGEMENT

Canada adopted a broad land based approach for estimation of agricultural emissions and removals. The extent of cropland and grazing land was based on 1991 and 1996 agricultural census statistics. The statistics also provided information on the extent and level of crop and grazing land activities that were incorporated into the Canadian Economic and Emissions Model for Agriculture (CEEMA). The CEEMA links the Canadian Regional Agriculture Model (CRAM), which predicts agricultural activities between census years and into the future, to a greenhouse gas module that systematically links the CRAM output to the IPCC guidelines and coefficients. We have in some instances deviated from the IPCC methodology. Those deviations are noted in Annex 3.

The CENTURY model was used to derive coefficients for estimation of the change in carbon stocks associated with most crop and grazing land activities. The change in soil carbon in the Prairie region for adoption of zero tillage and elimination of summerfallow were based on coefficients derived from empirical data, because there were sufficient representative and long-term measures representing those cropping practices.

Peterson et al. (1999) estimated carbon sequestration in farm shelterbelts (above and below ground biomass carbon) was based on information on land productivity, tree species and growth rates. Their work was not based on the CEEMA, and did not account for all of the greenhouse gas implications of increased planting of shelterbelts.

Inclusion of agricultural cropland management, grazing land and livestock management, and shelterbelts in Article 3.4 will help Canada encourage soil conservation practices that will restore some of the 1 billion tonnes of carbon that we have lost since our lands were first broken some 100 years ago. Depending on international and domestic policies, our preliminary estimates in Table III show Canadian farmers could sequester on cropland, grazing land and shelterbelts a total of between 20 Mt and 100 Mt CO_2 over the course of the first commitment period, or between 4 and 25 Mt CO_2 per year. The lower range of these estimates reflects low adoption rates of sink-enhancing practices. The higher estimates reflect ambitious adoption rates, for which our estimates are more uncertain.

These estimates are for gross removals and do not include the impact of the other greenhouse gases from agricultural activity, nitrous oxide and methane. As shown in Table III, we estimate inclusion of agricultural land management in Article 3.4 will cause an increase in our methane and nitrous oxide emissions of between 0 and 14 Mt CO_2-equivalent over the first commitment period, depending on the adoption rates of the activities. This will partially offset the removals of CO_2 in soil carbon.

The methane and nitrous oxide emissions reported in Table III are incremental and related to the specific sink-enhancing practices and their rate of adoption. The accounting framework (CEEMA) is systematic such that adoption of carbon sequestering practices causes the level of other land uses to change, which has implications for emissions of the non-CO_2 gases. For example, the incremental changes in emissions associated with an increase in permanent cover reflect the greenhouse gas implications of the corresponding increase in the livestock herd and decrease in crop production and crop inputs.

More detailed information about Canada's methodology for calculating agricultural greenhouse gas emissions and sequestration can be found in Annex 3.

PROPOSALS RELATED TO KYOTO PROTOCOL ARTICLES 3.3 AND 3.4
CANADIAN SUBMISSION TO THE UNFCCC

ANNEX 2

CONSOLIDATED CANADIAN TEXTUAL PROPOSAL

1 AUGUST 2000

Draft Decision X/CP 6

The Conference of the Parties:

recalling Article 3.3 of the United Nations Framework Convention on Climate Change and Article 2.1 (a) (ii) and (iii) of the Kyoto Protocol,

pursuant to decisions 9/CP.4 and 16/CP.5 of the Conference of the Parties,

agree to recommend that the following text be adopted by the CoP/moP, at its first session, as decision X/MP.1:

1. Parties may define **forest** in accordance with their own circumstances and must take into account published definitions. Parties may choose to use different definitions of forest to account for different forest types in their country. The definition or definitions must be used consistently in the accounting in the first and subsequent commitment period. Parties shall provide information on the source and suitability of their definitions under Article 7. Their definitions shall be reviewed in accordance with Article 8 of the Protocol.

2. For the purposes of Article 3.3, the following definitions shall apply:

(a) **Afforestation** is a change in land-use that, through the establishment of a stand of trees, forms a forest.

(b) **Reforestation** is a land-use practice that, through the establishment of a stand of trees, forms a forest.

(c) **Deforestation** is a land-use change that removes a forest.

3. For the purposes of Article 3.3, the following accounting rules shall apply:

(a) Subject to paragraph 4 (b), in accounting for afforestation, reforestation and deforestation since 1990, Parties shall include verifiable changes in all carbon stocks in the first and all subsequent commitment periods. Once land enters the accounting it shall be included in the first and all subsequent commitment periods.

(b) Parties shall account for all carbon pools that are sources as a result of afforestation, reforestation and deforestation since 1990, but may choose not to account for a given pool in a commitment period if they provide transparent and verifiable information demonstrating that it is not a source.

(c) Verifiable changes in carbon stocks which Parties include in their accounting and which result from afforestation, reforestation and deforestation since 1990 shall be measured as the change in carbon stocks between the beginning and end of a commitment period.

4. The human-induced activities of forest management, cropland management, grazing land management and shelterbelts (‘agricultural land management’) shall be used to meet the commitments under Article 3 of each Party included in Annex I in accordance with Article 3.4.

5. For the purposes of Article 3.4, the following accounting rules shall apply:

(a) Accounting for changes in greenhouse gas emissions by sources and removals by sinks shall be based on the land area subject to forest management and agricultural land management at the end of each commitment period.

(b) Verifiable changes in carbon stocks that Parties include in their accounting shall be measured as the change in carbon stocks between the beginning and end of a commitment period. The carbon dioxide equivalent emissions and removals of the other greenhouse gases included in Annex A of the Protocol shall be measured between the beginning and end of a commitment period .

(c) Subject to paragraph 5 (d), the net greenhouse gas emissions by sources and removals by sinks of carbon dioxide resulting from forest management and agricultural land management shall be measured as the verifiable changes in all carbon stocks in the first and all subsequent commitment periods on land subject to these activities. The carbon dioxide equivalent emissions and removals of the other greenhouse gases included in Annex A of the Protocol and directly resulting from land subject to forest management and agricultural management shall also be measured and included in the accounting for the first and all subsequent commitment periods

(d) Parties shall account for all carbon pools that are sources as a result of forest management and agricultural land management, but may choose not to account for a given pool in a commitment period if they provide transparent and verifiable information demonstrating that it is not a source. Parties shall account for all emissions of greenhouse gases included in Annex A other than carbon dioxide as a result of forest management, but may choose not to account for a potential source in a commitment period if they provide transparent and verifiable information demonstrating that it is not a source.

6. For the purposes of accounting under Articles 3.3 and 3.4, the following rules shall apply.

(a) If an area of land is subject to afforestation, reforestation or deforestation since 1990 under Article 3.3 and qualifies as land subject to forest management or agricultural land management under Article 3.4, it shall be accounted for under Article 3.4 and shall not be accounted for under the provisions for accounting related to Article 3.3.

(b) Carbon stocks in forest products or agricultural products derived from land subject to afforestation, reforestation and deforestation since 1990, or from forest management or agricultural land management shall be included in the accounting based on rules agreed at the first session of the Conference of the Parties serving as the meeting of the Parties to the Protocol.

(c) Accounting approaches used by Parties for accounting under Articles 3.3 and 3.4 shall conform to additional rules for the accounting as agreed at the first session of the Conference of the Parties serving as the meeting of the Parties to the Protocol.

(d) Supplementary information on the accounting by a Party under Articles 3.3 and Article 3.4 shall be submitted in accordance with Article 7 of the Protocol and shall be sufficient to ensure transparency and verifiability during the expert review process established by Article 8. It shall also be sufficient to demonstrate consistent application of definitions and land areas subject to accounting within and between commitment periods, and to demonstrate compliance with the accounting rules agreed by Parties.

PROPOSALS RELATED TO KYOTO PROTOCOL ARTICLES 3.3 AND 3.4
CANADIAN SUBMISSION TO THE UNFCCC

ANNEX 3

SUPPLEMENTAL INFORMATION ON AGRICULTURAL ACTIVITIES PROPOSED FOR INCLUSION UNDER ARTICLE 3.4

1 AUGUST 2000

PLEASE NOTE THAT EMISSIONS/REMOVALS HAVE BEEN ENTERED IN MEGATONNES RATHER THAN TONNES, AND THAT AREAS ARE IN MILLIONS O

Table A - Detailed preliminary estimates for Canada related to the inclusion of agricultural land management under Article 3.4

Article 3.4 Country specific data	Accounting framework	a_I (ha) 1996 (x 10^6)	$CO_{2,I}$ (t CO_2)* (x 10^6)	$CH_{4,I}$ (t CO_2 equiv.)* § (x 10^6)	$N_2O_{,I}$ (t CO_2 equiv.)* § (x 10^6)	a_{II} (ha)1999 (x 10^6)	$CO_{2,II}$ (t CO_2)* (x 10^6)	$CH_{4,II}$ (t CO_2 equiv.)* § (x 10^6)	$N_2O_{,II}$ (t CO_2 equiv.)* § (x 10^6)	a_{cp} (ha) (x 10^6)	$\triangle C_{cp}$ (t C) (x 10^6)
The following rows show the historical and projected emissions of CH_4 and N_2O that are already included in the Kyoto accounting.											
Cropland Management (low adoption rates)	*Land based*	34.7		-2.2	-110.3	34.4		-3.1	-164.7	34.2	
	Activity based										
Grazing Land Management & Livestock (low adoption rates)	*Land based*	26.2		-149.7	-101.4	26.8		-216.2	-147.8	26.5	
	Activity based										
Shelterbelts (low adoption rates)	*Land based*	0.02		0.0	0.0	0.03		0.0	0.0	0.07	
	Activity based										
Low Adoption: The following rows represent low adoption rates for mitigation strategies to reduce GHG emissions.											
Cropland Management (low adoption rates)	*Land based*	34.7	-22.1	See note	See note	34.4	-22.2	See note	See note	34.2	3.1
	Activity based										
Grazing Land Management & Livestock (low adoption rates)	*Land based*	26.2	3.6	See note	See note	26.8	8.7	See note	See note	26.5	2.1
	Activity based										
Shelterbelts (low adoption rates)	*Land based*	0.02	0.3	See note	See note	0.03	0.6	See note	See note	0.07	0.4
	Activity based										
Medium Adoption: The following rows represent the results of medium adoption rates for mitigation scenarios targeted at reducing greenhouse gas emissions in the first commitment period.											
Changes from low adoption due to: (1) Increase No-till on Prairies from 17% to 30%	*Cropland*									0.0	4.3
	Grazing & Livestock									0.0	0.0
	Shelterbelts										
Changes from low adoption due to: (2) Decrease summerfallow from 5 m ha to 3 m ha	*Cropland*									0.1	5.9
	Grazing & Livestock									-0.1	-0.3
	Shelterbelts										
Changes from low adoption due to: (3) Improve grazing management practices	*Cropland*									0.1	0.0
	Grazing & Livestock									-0.1	3.5
	Shelterbelts										
Changes from low adoption due to: (4) Increase Permanent Cover Program by 1 m ha	*Cropland*									-1.0	-0.2
	Grazing & Livestock									1.0	1.8
	Shelterbelts										
Total of medium adoption scenarios [(1)+(2)+(3)+(4)]	*Cropland*	34.7	-22.1	See note	See note	34.4	-22.2	See note	See note	33.4	13.1
	Grazing & Livestock	26.2	3.6	See note	See note	26.8	8.7	See note	See note	27.3	7.1
	Shelterbelts										
High Adoption: The following rows represent the results of high adoption rates for mitigation scenarios targeted at reducing greenhouse gas emissions in the first commitment period.											
Changes from low adoption due to: (5) Increase No-till on Prairies from 17% to 50%	*Cropland*									0.0	11.7
	Grazing & Livestock									0.0	0.0
	Shelterbelts										
Changes from low adoption due to: (6) Convert cropland to shelterbelts	*Cropland*									-0.05	0.00
	Grazing & Livestock									0.00	0.01
	Shelterbelts									0.05	0.23
Total of high adoption scenarios [(2)+(3)+(4)+(5)+(6)]	*Cropland*	34.7	-22.1	See note	See note	34.4	-22.2	See note	See note	33.3	20.5
	Grazing & Livestock	26.2	3.6	See note	See note	26.8	8.7	See note	See note	27.3	7.1

This annex provides further discussion of the agricultural land management activities shown in Table III of Annex 1, and shown in greater detail in Table A.

1. Activities and accounting

a) Definitions and descriptions of all activities proposed

Agricultural GHG emissions were estimated within a comprehensive land-based accounting framework for three land management systems: cropland, grazing land and shelterbelts. Emission estimates of total N_2O, CH_4, and net CO_2 were made using the Canadian Economic and Emissions Model for Agriculture (CEEMA).

Cropland refers to land that produces annual field crops (grains, oilseeds, pulses, and potatoes) for harvest or green manure, as well as summerfallow land. Net CO_2 estimates for cropland were based on two major activities that influence carbon gain or loss from cropped soils:

- The frequency of summerfallow in crop rotations; and
- The degree of soil disturbance resulting from crop production (proportion of conventional versus zero tillage practices).

Sources of non-CO_2 GHG emissions from cropland are:

- Direct N_2O emissions from the decomposition of crop residues, N fertilizer, N-fixing crops, and histosols;
- Indirect emissions from atmospheric deposition of N_2O from N fertilizers, and N_2O released to the atmosphere from leached N fertilizer; and
- CH_4 from waterlogged lands.

Summerfallow, 'idle land' in the agricultural census, is cropland that is not seeded to a crop for one growing season, and on which chemical or tillage weed control practices are used. The practice of summerfallow is used in the most arid regions of the prairies to store soil moisture for the succeeding crop. Statistics Canada defines zero tillage as a practice with "no tillage prior to seeding" that includes direct seeding into stubble or sod, and ridge tilling. Minimum tillage is defined as "tillage prior to seeding that retains most of the crop residue on the surface" (Statistics Canada). Conventional cropping systems are any other systems in which tillage incorporates most of the crop residue into the soil (Statistics Canada).

Grazing land management applies to land used for livestock production (hayland, improved and natural pasture) and includes estimates of direct and indirect emissions from the associated animals. Hayland is alfalfa and alfalfa mixtures or other tame hay cut for hay or silage. Improved pasture includes land that has been cultivated and seeded, or drained, irrigated, fertilized, or controlled for weeds or brush. Natural pasture includes native pasture, native hay, and rangelands (Statistics Canada).

Activities associated with changes in the carbon stock on lands managed for grazing are:

- the conversion of cropland to permanent cover (improved pasture, grazing lands, or hayland);
- changes in the intensity of pasture and grazing land management; and
- conversion of natural rangelands to either improved pasture, hayland or cropland.

Sources of non-CO_2 emissions from grazing land management are:

- direct emissions of CH_4 from ruminant animals and manure;
- direct emissions of N_2O from synthetic fertilizer, nitrogen-fixing crops, the manure of grazing animals, manure in storage, and manure applied to fields;
- indirect emissions from the atmospheric deposition and leaching of N_2O from manure; and
- N_2O from human sewage applied to agricultural land.

Nitrous oxide emissions from histosols were allocated to cropland management because it was assumed that most cultivation of histosols was done for the production of annual crops. Human sewage emissions of N_2O were allocated to the grazing management systems because it was assumed that Canadians obtain the majority of their protein intake from animal sources.

Portions of the agricultural landscape not used directly for crop, hay, or pasture production, such as lakes, wetlands or treed land, were not included in the accounting framework. Greenhouse gas sources or sinks associated with these lands are not yet well understood, and research projects are currently underway or are being initiated within Canada to estimate the magnitude of human-induced emissions associated with these areas.

Carbon sequestration from the planting of trees and shrubs on agricultural land in the form of shelterbelts on the Prairies was also assessed. The estimated changes in carbon stock are related to both above ground and below ground biomass.

b) Scope of activities and how they fit into broader managed land categories

Cropland management encompasses the range of cropping systems and activities involved in annual crop production in Canada. Activities were defined by the following parameters (Kulshreshtha et al., 1999):

- crop type: grains, oilseeds, pulses, potatoes
- tillage system: conventional, minimum or zero tillage
- inclusion of summerfallow in the rotation.

CEEMA accounts for GHG emissions from 106 cropland management activities (crop-tillage-summerfallow combinations). The 106 activities are estimated for 22 census districts in the prairies and the seven non-prairie provinces (29 regions for Canada).

Grazing land management accounts for emissions from hayland, improved pasture and natural pasture and four types of livestock production: beef, dairy, hog, and poultry. Thirty activities related to livestock production, listed in Kulshreshtha et al. (1999), and the three land uses were assessed. Emissions associated with the management of hayland, improved and natural pastures were estimated for the 22 prairie census districts and the seven non-prairie provinces. Emissions from the livestock production activities were estimated at the provincial level.

Because production activity levels and extent, as well as rates of soil C gain or loss, differ among the various ecological regions of Canada, the 29 regions were allocated proportionally to one or more ecoregion. Ecoregions correspond to soils zones (Brown, Dark Brown, Black and Gray) which are distinguished on the basis of soil colour and soil organic carbon content (Ecological Stratification Working Group, 1996). Some coefficients, such as the C sequestration coefficients in Table B, were developed by soil zone, and linked to the regions based on the proportion of each soil zone within a region.

c) Accounting approaches

Canada has developed a comprehensive land-based GHG accounting system for agriculture. A land-based approach was adopted because accounting based on narrowly defined activities could result in double counting of either sinks or sources if changes in more than one activity was associated with an individual land unit. Land-based accounting also provides a systematic basis for estimation of all human-induced sources and sinks within the agricultural landscape.

Canada uses models to calculate the greenhouse gas emissions from agriculture and to calculate future emissions from various economic or production scenarios. The model Canada has developed is the Canadian Economic and Emissions Model for Agriculture (CEEMA). CEEMA links the Canadian Regional Agriculture Model (CRAM), an economic optimization model and a Greenhouse Gas

Emissions Model. It estimates agricultural emissions of CO_2, N_2O and CH_4 as well as the CO_2 equivalent (CO_2-Eq) emissions of the combined gases. The conversion to CO_2-Eq is based on 100-year warming potentials, which are one for CO_2, 21 for CH_4, and 310 for N_2O.The modeling systems are described below. More information can also be found at the following web site: http://www.agr.ca/policy/epad/english/pubs/wp-tp/ggh/ggindx.htm.

CRAM is an equilibrium model for Canadian agriculture that is disaggregated by commodity and region and is calibrated with Statistics Canada agriculture census data. When a change is introduced to the model, it solves for a new equilibrium position based on non-linear optimization that maximizes producer plus consumer surplus less transportation costs. The modeled commodities include grains and oilseeds, forages, beef, hogs, dairy, and poultry, which can be traded in primary or processed form both inter-provincially and internationally. Livestock and crop production are simulated for the 22 crop districts in the prairies and for provinces in the rest of the country. Government policies are introduced through direct payments or indirectly through policies such as supply management or subsidized input costs.

Grain, oilseeds, and forage responses are determined by changes in the relative profitability of alternative crops. A calibration process duplicates the observed allocation of land by positioning an unobserved marginal cost curve such that conditions for constrained profit maximization are obtained. The marginal value product less the marginal cost for each output must equal the return to the fixed factor, which is land. At the margin, the return to land for each commodity is equal. The only constraint on crop production is the amount of land within each region (crop district or province), whereas beef and hog production react to changes in prices as well as input costs, such as the price of feed grains.

The model has been constructed so that demand cannot exceed available supply. As a result, CRAM can reach optimal solutions at less than full employment of resources if the returns are not expected to cover the variable costs of production.

CRAM determines optimal agricultural land use and levels of crop and livestock production for a given set of economic and market conditions. The GHG emissions component links the production levels to GHG emission coefficients, and calculates emissions based on a measure and multiply approach. The emission coefficients are based on the current scientific knowledge and obtained from a variety of sources within Canada and the 1996 revised guidelines for GHG inventory.

CEEMA can be used to estimate all of the emissions associated with agricultural crop production, including energy related emissions associated with the production of farm inputs, and the transportation and processing of agricultural commodities. However, for this submission, only the direct and indirect emissions associated with crop production, as specified in the IPCC inventory guidelines (IPCC, 1996) are reported.

Because CEEMA is a system model, changes in any one part of the system cause adjustments throughout the whole system, which influence the relative emission levels of the three GHG. As a result, the GHG implications of the adoption of a mitigation practice can be assessed on the basis of changes in sources and sinks of all the GHG. For example, the elimination of summerfallow from cropping rotations has been promoted as a good soil conservation practice because it is associated with an increase in soil carbon. As a GHG mitigation practice, reduced summerfallow must be also be assessed in terms of the effects on non-CO_2 GHG. As summerfallow use declines, the amount of seeded land and the emissions associated with crop production, such as N fertilizer use, and therefore N_2O emissions, tend to increase. The mitigative potential of reduced summerfallow is thus the relative difference between the CO_2 removal and the N_2O emissions. As this example demonstrates, to assess a change in agricultural activity without an understanding of the whole system effects on all GHG could lead to overestimation of mitigation potential or the promotion of practices that cause a net increase in emissions.

The CEEMA output provides regional, provincial and national estimates of total N_2O, CH_4 emissions and net CO_2 emissions associated with major cropland and grazing land management activities. Emission coefficients were based primarily on the IPCC default values (IPCC, 1997), except where noted in the subsequent sections of the explanatory text.

Emissions from croplands are the weighted sum of emissions for each crop activity times the scale of operation. If different crops are denoted p:

$$\text{Crop GHG}_{rg} = \sum_{p=1}^{P} E_{prg} * S_{pr}$$

where

Crop GHG_{rg} = emissions of the g^{th} gas from cropland activities in the r^{th} region

P = number of crop activities

E_{prg} = emissions for p^{th} crop per unit of land base for the g^{th} gas in the r^{th} region, and

S_{pr} = scale of operations (i.e., hectares of land or Mg of fertilizer input) of the p^{th} crop in the r^{th} region.

The emissions of the p^{th} crop activity, E_{prg}, is the sum of emissions for the various GHG emission sources and sinks associated with the production activities (a) of that crop:

$$E_{prg} = \sum E_{parg}$$

where

$\sum E_{parg}$ = GHG emissions for the p^{th} crop, a^{th} production activity for the g^{th} gas in the r^{th} region.

Emissions from grazing land management associated with land use activities (hayland and pasture) were estimated using the same methodology as for emissions from cropland.

$$\text{Land GHG} = E_{Hrg} + E_{Irg} + E_{Nrg}$$

where

Land GHG = total land emissions of the g^{th} GHG in the r^{th} region;

E_{Hrg} = emissions of the g^{th} GHG from haylands in the r^{th} region;

E_{Irg} = emissions of the g^{th} GHG from improved pastures in the r^{th} region;

E_{Nrg} = emissions of the g^{th} GHG from natural pastures in the r^{th} region.

Total direct and indirect emissions from each type of livestock were estimated as:

$$\text{Lvsk GHG} = DLS_{rlg} + WLS_{rlg}$$

where

Lvsk GHG = emissions of the g^{th} GHG from the l^{th} type of livestock in the r^{th} region;

DLS_{rlg} = direct emissions of g^{th} GHG from the l^{th} type of livestock in r^{th} region;

WLS_{rlg} = indirect emissions of g^{th} GHG from the l^{th} type of livestock in the r^{th} region;

Direct and indirect emissions were estimated for each type of livestock produced in a region as the product of the size of the animal herd or population in a region and the emission coefficients (IPCC default values) attributed to that livestock type. Total grazing land GHG emissions are land management emissions plus the sum of animal emissions for each type of livestock.

Estimates of carbon sequestration through the use of shelterbelts were based on the methodology of Peterson et al. (1999). They used information on land productivity, the appropriate mix of tree and shrub species that might be planted, and the corresponding growth rates to determine both the above ground and below ground carbon sequestration potential of Prairie shelterbelts planted since 1990. Their estimates are consistent (but not identical) with work being done by the Shelterbelt Centre of the Prairie Farm Rehabilitation Administration of Agriculture and Agri-food Canada.

Peterson et al. did not take into account all of the GHG implications of shelterbelts. For example, by occupying a part of the cropland base, they reduce the area available for conventional crop agriculture, and consequently the need for inputs such as supplemental nitrogen. These types of changes in GHG emissions were estimated using CEEMA. It should also be noted that shelterbelts have a positive impact on the sustainability of the remaining cropland due to reductions in soil erosion.

d) Proposals for key accounting features, e.g. assumptions on baselines, basis for the area estimates covered by activity

Estimates of the extent of cropland and grazing land activities at the regional level were based on data from the Census of Agriculture in census years (Statistics Canada). Data that are available only at the provincial level, such as fertilizer input use, were allocated proportionally to regional crop-tillage system combinations based on available agronomic information for the census districts.

Area estimates of activities were assumed to follow trends evident in the census data in most cases. For example, summerfallow trends were assumed to decline from 1990 to 2012 on the trend line established from 1986 to 1996. For newer cropping activities, there is less certainty in the census data trends. For example, census data on zero tillage, which has been recorded only since 1991, shows that its adoption between 1991 and 1996 was very rapid. However, zero tillage was promoted actively by various regional and national soil conservation programs in the prairie provinces during those years. Specifically, the Green Plan (1991 to 1996), designed to reduced the uncertainties about GHG and to identify potential mitigation practices, demonstrated to producers that land practices that were good for soil and water conservation were also consistent with carbon sequestration, reducing GHG emissions, and improving water and nutrient use efficiency. Future rates of adoption may depend on whether or not there continue to be programs that make the industry aware of GHG issues and sustainable mitigation strategies. Because of the uncertainty about future rates of zero tillage adoption, it was held constant at the 1996 level. The estimate will be revised when data are available from the 2001 census of agriculture.

Cumulative estimates of emissions were based on linear interpolation of data between years that were analyzed using CEEMA. Cumulative values in Table III represent linear interpolations from 1990 to 1996, from 1990 to 1999 and from 2008 to 2012.

2. Carbon pools included (e.g. above ground biomass, litter and woody debris, below-ground biomass, soil carbon, and harvested materials)

The change in organic carbon stocks in agricultural soils was based on the soil organic carbon pool. Crop biomass (with the exception of shelterbelt above and below ground biomass C), crop residues, and harvested material were not included in the soil carbon stock.

3. Methodologies and data

a) Data sources

Census of Agriculture data from Statistics Canada is the major source of data on the extent of land use activities, crop types and tillage practices in census years (1986, 1991, 1996). The Medium Term Baseline data (Policy Branch) were the basis of the projections to the first commitment period.

The major source of information on the rates of GHG emissions from cropland and grazing land management activities was the IPCC guidelines (IPCC, 1997) since IPCC default values were used to develop most of the emission coefficients in CEEMA. Data sources associated with the development of emission coefficients from non-IPCC empirical or modelled data are provided in Section 3c – Models and key parameters.

Data sources for carbon sequestration estimates associated with shelterbelts are given in Peterson et al. (1999).

b) Sampling techniques

Sampling techniques for estimates based on empirical data are as described within each of the cited sources.

c) Models and key parameters

Changes in soil organic carbon stocks associated with crop production activities were estimated using the CENTURY model. The methodology is described in Smith et al. (2000) and summarized in this explanatory text. The CENTURY model was run for three soil textures (sandy loam, loam and clay loam) and seven soils (Brown Chernozem, Dark Brown Chernmozem, Black Chernozem, Dark Gray Chernozem or Luvisol, Gray Brown Luvisol, Gray Luvisol, and Gleysolic) of the Canadian System of Soil Classification (Soil Classification Working Group, 1998) for a 20 cm soil depth. The soil group-texture combinations represent 80% of cultivated lands in Canada. Baseline simulations were carried out for the two most commonly used cropping systems in each soil group. Subsequent runs involved changes in land management that were introduced in the year 2000. The introduced management systems included:

- addition of forage or pasture in a rotation;
- conversion of cropland to permanent cover;
- changes in the extent of summerfallow; and
- change from conventional tillage to minimum and zero tillage practices.

The change in soil carbon stocks was compared to the control run 10 years after the introduction of the management changes. The carbon coefficients, averaged over the 10-year period, were determined by weighting the fraction of crop rotation, soil texture, and soil group:

$$C = \sum^{g} F_g \left(\sum^{t} F_t \left(\sum^{r} F_r R_r\right)\right)$$

where

C	= carbon coefficient
g	= number of soil groups
F_g	= proportion of area covered by soil group
t	= number of soil textures
F_t	= proportion of area covered by soil texture
r	= number of crop rotations
F_r	= proportion of areas covered by crop rotation
R_r	= carbon coefficient for a crop within a soil texture and soil group

The land management activities for which the CENTURY-derived CO_2 coefficients were negative, indicating a sink of CO_2, are shown in Table B along with the predicted rates of carbon sequestration.

On the prairies, where there has been a long history of soil organic carbon research based on well established scientific sampling and measurement protocols (Ellert et al., 2000), the CENTURY-derived rates of carbon sequestration associated with the adoption of zero tillage and elimination of summerfallow were replaced with empirically derived coefficients (McConkey et al., 1999). The empirical coefficients (Table B) were based on research findings from Campbell et al. (1995, 1996a, 1996b) and Liang et al. (1999) for long-term tillage experiments in the Brown, Dark Brown and Black soil zones of Saskatchewan. Additional, but less long-term data, were obtained from Bremer et al. (1994) and McConkey et al. (unpublished data). In the Gray and Dark Gray soil zones, carbon sequestration data were derived from Nyborg et al. (1995) and Janzen et al. (1998). Researchers are continuing to validate the CENTURY model and to verify predictions of soil organic carbon for adoption of the reduced tillage systems of the prairies.

The CO_2 emission data were aggregated from the regional to the national level as follows:

- for each region, net CO_2 (total CO_2 emissions minus total CO_2 sinks) was calculated and reported as a total net source or a total net sink;
- regional results were aggregated by summing and reporting as a soil organic matter source, all of the positive net CO_2 values per region, and by summing and reporting as a sink, all of the negative net CO_2 values per region.
- total net CO_2 values reported in Table III are the sum of all net sources plus all net sinks for the 29 regions of Canada.

Table B. Carbon sequestration coefficients (Mg CO_2 ha^{-1} yr^{-1}).

ACTIVITY	PRAIRIE REGION SOIL ZONES			NON-PRAIRIE
	Brown	Dark Brown	Black	
Adoption of Zero tillage	**-0.73**	**-0.73**	**-1.34**	-0.54
Reduce summerfallow	**-0.15**	**-0.16**	**-0.08**	--
Increase forages in crop rotation		-0.94	-2.44	-2.44
Permanent cover	-0.88	-1.15	-3.3	-3.3

Notes:

1 The coefficients shown in bold are from empirical data (McConkey et al., 1999).

2 Other coefficients were derived with the CENTURY model (Smith et al., 2000).

3 The coefficients for reduced summerfallow were based on the change in cropping frequency from the start to the end of the run period. They are re-calculated for each scenario and time period. The values shown the table were for the period from 1990 to the first commitment period.

d) Uncertainties

There is uncertainty associated with all estimates of GHG sources and sinks from agricultural activities. Agriculture is a biologically based activity in which factors such as weather or insect and disease damage will influence crop productivity and the potential for changes in soil carbon. Variations in management practices among individual producers, spatial variability in soil quality, and trend changes in soil quality itself all further contribute to the uncertainty inherent in measures of soil carbon. As the area represented by the measure increases from the pedon to the landscape to the census district and the nation, the uncertainty of the measure increases, not only for soil carbon, but also for all of the GHG estimates. For N_2O specifically, the processes that govern its loss from agricultural soils are much more variable, both spatially and temporally, than for carbon. As a result, the uncertainty associated with prediction of N_2O emissions is greater than for carbon.

In recognition of the uncertainty, we have estimated changes in the soil carbon stock on the basis of relatively conservative values, based on the available empirical data (Campbell et al, 1995, 1996a, 1996b; Liang, 1999; Nyborg et al., 1995; Janzen et al., 1998). The IPCC Special Report on Land Use, Land Use Change and Forestry (IPCC, 2000 Table 5-3) lists ranges of C gain from reduced frequency of summerfallow and adoption of conservation tillage practices in Canada as 0.17 to 0.76 t C ha^{-1} yr^{-1} (0.62 to 2.79 t CO_2 ha^{-1} yr^{-1}). Results of the Prairie Carbon Balance Study (IPCC, 2000, Table 5-2) will provide additional information on the rate of change in carbon stocks in response to adoption of conservation tillage practices. Research on the soil carbon dynamics of agricultural systems in Canada will continue, along with development of protocols for the scaling-up of research data and verification of model output. It is anticipated that over the long-term, estimates of the rate of carbon sequestration in response to adoption of soil conserving practices will tend to increase.

In contrast to the conservative approach used to estimate the change in soil carbon, we have used the IPCC default values (IPCC, 1997) to estimate emissions of the other GHG, despite mounting evidence that for some activities those emission rates are higher than measured values for Canadian conditions.

By adopting this approach, we are confident that the current protocols and models do not overestimate of the sink potential of Canadian agriculture relative to emissions of the other GHG.

The estimates of sources and sinks of GHG from Canadian agriculture in Table III are based on a broad land-based approach. Accounting in this way ensures that the GHG implications of all major land uses and changes in land use are captured in the monitoring framework, which is an important consideration with regard to the issue of permanence. Land use changes will occur, and accounting frameworks must be able to report the debits and credits associated with the changes. For example, excessive spring precipitation in the southeastern prairies in 1999 prevented the seeding of a significant portion of the cropland in that region. The resulting increase in summerfallow caused an increase in soil emissions in 1999. Land use data for 2000, however, indicate that as a result of the increase in 1999, summerfallow acreage is below average in 2000 and will probably return to the long-term trend line for 2001. Thus, on average over a five-year commitment period, that large-scale and weather-induced land use change will not result in a large deviation from the expected emission trends. These findings indicate that although individual producers may change land use practices, it is unlikely that significant numbers of producers would simultaneously change their farming practices from successful best management practices. If weather or other conditions force a change in land use activities, it is highly likely to be temporary and producers will return to best management practices. If producers are encouraged to adopt best management practices that are economically viable, soil conserving, and sink enhancing, the issue of permanence is manageable.

4. Treatment of non-CO_2 greenhouse gases.

Nitrous Oxide

Estimates of N_2O emissions for both direct and indirect sources were based on the IPCC default coefficient of 1.25% N_2O-N $kg^{-1}N$ (IPCC, 1997). Emissions were calculated using the same methodology as for reporting of Canada's emission inventory, except where noted in the subsequent paragraphs of this section. Because of the large variability in the emission rates and estimation methodologies, more research is needed in Canada before the IPCC default value can be replaced by coefficients more representative of Canadian conditions. It is generally agreed within the Canadian scientific community that the IPCC coefficients and methodology tend to overestimate emissions from Canadian agriculture.

Nitrous oxide emissions from synthetic fertilizers were based on the IPCC default loss rate for all fertilizer types. The amount of applied N was reduced by the IPCC default value of 10% to account for volatilization losses. The amount of applied N fertilizer was based on yearly fertilizer sales data (Policy Branch). Total N fertilizer was allocated proportionally among the crop-tillage systems at the census district (prairies) and provincial (non-prairie) levels.

The IPCC default methodology and emission factor were used to determine N_2O emissions from animal wastes applied to cropland as fertilizer. The excretion rates for animal types are given in Neitzert et al. (1999) and animal populations were based on CEEMA output. The amount of manure nitrogen excreted was reduced by 20% to account for volatilization (IPCC default).

Emissions from the manure of grazing animals were based on the IPCC emission coefficient and volatilization loss rate. Excretion rates for each livestock type are given in Neitzert et al. (1999). Herd sizes were predicted by CEEMA.

Emissions of N_2O from animal waste management systems were based on IPCC methodology and default coefficients, as described in Neitzert et al. (1999).

Nitrous oxide emissions from biologically-fixed nitrogen were based on the IPCC default coefficient (0.0125 kg N_2O-N $kg^{-1}N$). Crop mass was assumed to be 40% for annual crops and 80% for perennial crops, and the nitrogen concentration of dry mass was assumed to be 5% for nitrogen-fixing crops.

Nitrous oxide emissions from biologically fixed nitrogen was assumed to be negligible except for pulse crops (Janzen et al., 2000).

Emissions of N_2O from crop residue decomposition were based on the IPCC emission coefficient and conditions that are representative for Canada (Janzen et al., 2000). It was assumed that crops have 0.01 kgN kg^{-1}dry mass and nitrogen-fixing crops have 0.02 kgN kg^{-1}dry mass. It was also assumed that the harvest index was 0.4 for all crops, and that 90% of the residues were returned to the soil after harvest.

Estimates of the emissions from the cultivation of histosols were calculated as in Neitzert et al. (1999). Nitrous oxide from human sewage was calculated for sewage sludge applied to agricultural land, based on the IPCC methodology (Janzen et al., 2000).

Volatilization and subsequent redeposition were estimated using the IPCC default values. Volatilization was set to 10% of nitrogen fertilizer use and 20% of manure nitrogen. The amount of volatilized nitrogen was multiplied by 0.01 kg N_2O (IPCC default). Estimates of emissions from runoff and leaching assumed that 15% of the nitrogen applied as fertilizer or manure was lost by leaching (Janzen et al., 2000), and emission occurred at the rate of 0.0125 kg N_2O kg^{-1} N leached (IPCC default).

Methane

Methane emissions from enteric fermentation were estimated by multiplying numbers of domestic animals of each type by the IPCC default emissions factors for cool climate conditions (Neitzert et al., 1999). Domestic animal numbers were derived from CEEMA. Emissions associated with the handling of livestock manure were based on the IPCC Tier I methodology, and are described in Neitzert et al. (1999).

5. Methods and key assumptions in projections for the first commitment period (2008–2012) and discussion, if possible, of trends beyond the first commitment period.

Predictions of the rate of adoption of sink-enhancing practices for the first commitment period are uncertain**.** Emissions data tabulated in this annex and Table III were therefore estimated for low to high rates of adoption and represent low uncertainty (low adoption rate) to higher uncertainty (high adoption rate) outcomes. The assumptions associated with each of the adoption scenarios are discussed in Junkins et al. (2000).

Cropland management

Sink-based mitigation in the cropland management system was estimated for two major activities: adoption of zero tillage and elimination of summerfallow. Estimates were made for three combined levels of adoption of these practices: low, medium and high.

The low adoption rate estimates were based on the current level of adoption for zero tillage and a continuation of the long-term decline in summerfallow through the first commitment period. The level of uncertainty associated with those estimates is very low.
The medium adoption rate scenario was based on further increases in zero tillage and decreases in summerfallow. It was assumed that zero tillage adoption would continue at the same rate from 1996 to the first commitment period as from 1991 to 1996 and summerfallow would decrease to 3 million hectares. The uncertainty associated with this scenario is higher, but is possible to achieve without incentives or programs if adoption rates remain constant into the future. The high adoption rate scenario is based on aggressive adoption of zero tillage and has the highest level of uncertainty.

The major assumptions associated with each of the adoption rates are given in the following sections.

Low adoption rate

- The land base for agricultural production was held constant at the 1996 levels with regional distributions by crop based on the Medium Term Baseline (MTB) (Policy Branch, 1999).
- Yields of grains, and oilseeds were increased based on historical trends.
- Livestock production levels were based on the MTB, with a larger proportion of the increase occurring in western Canada. From 1996 to ~2010, beef numbers increased by 10% in the west and 2% in the east; hogs increased by 31% in the west and 8% in the east.
- Costs of production were increased based on projections of Farm Input Price Indexes (Policy Branch, 1999).
- Nitrogen fertilizer use in the prairies increased by 25% over 1996 levels, whereas fertilizer use in Eastern Canada was held constant at 1999 levels.
- The amount of cropland under summerfallow was reduced from 7.8 million hectares in 1990 and 6.2 million hectares in 1999 to an average of 5 million hectares between 2008 and 2012.
- The amount of land under zero tillage on the prairies was held at the 1996 level of ~5.1 million hectares (17% of cropland).

Medium adoption rate

- Zero tillage adoption increased linearly, based on 1991 and 1996 census of agriculture data, in the Prairies and the Peace River region of British Columbia (where the highest rates of adoption of zero and minimum tillage have occurred since 1990). Zero tillage adoption was 30% in the first commitment period, compared to 17% in the low adoption scenario. As a result of the increase in zero tillage, conventional tillage declined from 51% in the low impact scenario to 43 %, and minimum tillage remained constant.
- Summerfallow was reduced to 3 million hectares, compared to ~ 5 million hectares in the low adoption scenario. The reduction in summerfallow was assumed to occur to a greater extent in the more humid regions of the prairies (for example, a 50% reduction in the Black and Gray soil zones compared to a 30% reduction in the Brown soil zone).
- Reduced summerfallow frequency caused an increase in seeded area. As a result the total amount of fertilizer, other inputs, and total crop production increased. In addition, nitrogen fertilizer use was increased by 10% on additional no-till land over the low adoption projection to ensure that crop biomass production and carbon sequestration under zero tillage were not constrained by a nitrogen limitation.
- The increase in zero tillage did not significantly alter the mix of crops produced on the Prairies or change livestock production relative to those activities in the low adoption scenario, although prairie hay production increased slightly as some summerfallow land was converted to forage production.

High adoption rate

- Zero tillage in the Prairies and the Peace River region of British Columbia increased to 50% by the first commitment period. As a result of the increase in zero tillage, conventional and minimum tillage declined.
- Summerfallow was projected to be 3 million hectares, compared to ~5 million hectares in the low adoption scenario. The reduction in summerfallow was assumed to occur to a greater extent in the more humid regions of the prairies (for example, a 50% reduction in the Black and Gray soil zones compared to a 30% reduction in the Brown soil zone).
- Nitrogen fertilizer use was increased by 10% on additional no-till land over the low adoption projection.
- The increase in zero tillage did not significantly alter the mix of crops produced on the Prairies or change livestock production relative to those activities in the low adoption scenario, although

prairie hay production increased slightly as some summerfallow land was converted to forage production.

Grazing Land Management

Carbon sequestration in grazing land management systems was based on improvement in grazing land management and conversion of marginal croplands to permanent cover. Two emission estimates for low and medium adoption rates of those activities were made using CEEMA. The uncertainty associated with the low adoption scenario is low because the change in practice relative to present conditions was assumed to be small. The uncertainty associated with the medium adoption rates is higher.

Low adoption rate

- The land base for agricultural production was held constant at the 1996 levels with regional distributions by crop based on the Medium Term Baseline (MTB) (Policy Branch, 1999).
- Yields of grains and forage were increased based on historical trends.
- Livestock production levels were based on the MTB, with a larger proportion of the increase occurring in western Canada. From 1996 to ~2010, beef numbers increased by 10% in the west and 2% in the east; hogs increased by 31% in the west and 8% in the east.
- The adoption of reduced stocking rates and complimentary grazing was 25%, but no rotational grazing was assumed.
- Costs of production were increased based on projections of Farm Input Price Indexes (Policy Branch, 1999).

Medium adoption rates

- Permanent cover land was assumed to increase by 1 million hectares in the prairie provinces (167,092 ha in Manitoba, 415,637 ha in Saskatchewan, and 417,271 ha in Alberta) over the low adoption rate scenario. The distribution of the converted land within each province varied by region, soil type, amount of cultivated marginal land and the distribution of grazing and hayland to support beef production.
- In response to the increase in permanent cover land, the beef herd was increased by 4.2% so that utilization of natural pasture was to the same extent as in the low adoption rate scenario. Corresponding changes in other parts of the agricultural system were small, for example, summerfallow declined by 3.4% and wheat production declined by 3.6%.
- Improved grazing practices (described in Junkins et al., 2000) were adopted as follows:
  - Reduced stocking occurred on 35% of native rangeland in British Columbia, western Manitoba, the northern grain-belt of Saskatchewan and Alberta.
  - Complimentary grazing occurred on 35% of native rangeland in British Columbia, western Manitoba, the northern grain-belt of Saskatchewan and Alberta.
  - Rotational grazing increased from 0% (low adoption rate scenario) to:
    - 10% in Western Canada on improved pasture,
    - 5% in Eastern Canada on improved pasture, and
    - 10% in Eastern Canada on natural pasture.
- To achieve the lower stocking rates, cattle were removed from native rangelands to alternative feeding situations, such as feedlots. Compensation for the loss of feed from rangeland was achieved by increasing hayland and hay production from the conversion of marginal cropland to meet the demand for livestock feed. In addition, the net demand for grain and forage feed was reduced to reflect the higher quality of the feed resulting from this grazing strategy. The overall effects were an increase in the rate of conversion of marginal cropland to hayland and greater cattle production per unit of feed.
- Complimentary grazing optimized grazing when the pasture and rangelands were in prime quality, and thereby increased forage yields and nutritional quality. As a result, weaning weights

were higher, grain and forage feed demand declined and the rate of calving was increased by four calves per 84 cows.

Shelterbelts

Carbon sequestration in shelterbelts is based on the conversion of cropland to shelterbelts in the three Prairie provinces (Alberta, Saskatchewan and Manitoba). Two emission estimates for low and high adoption rates of those activities were made. The uncertainty associated with the low adoption scenario is low because the change in practice relative to present conditions was assumed to be small. The uncertainty associated with the high adoption rate is higher.

Low adoption rate

- The land base for Prairie shelterbelts was increased by 2,880 ha per year from 2000 to the first commitment period.

High adoption rate

- The land base for Prairie shelterbelts was increased by 7,000 ha per year from 2000 to the first commitment period.

References

Bremer, E., H.H. Janzen and A.M. Johnston. 1994. Sensitivity of total, light fraction and mineralizable organic matter to management practices in a Lethbridge soil. Can. J. Soil Sci. 74:131-138.

Campbell, C.A., B.G. McConkey, R.P. Zentner, F. Selles, and D. Curtin. 1996a. Long-term effects of tillage and crop rotations on soil organic C and total N in a clay soil in southwestern Saskatchewan. Can. J. Soil Sci. 76:395-401.

Campbell, C.A., B.G. McConkey, R.P. Zentner, F. Selles, and D. Curtin. 1996b. Tillage and crop rotation effects on soil organic C and N in a coarse-textured Typic Haploboroll in southwestern Saskatchewan. Soil & Tillage Research 37:3-14.

Campbell, C.A., B.G. McConkey, R.P. Zentner, F.B. Dyck, F. Selles, and D. Curtin. 1995. Carbon sequestration in a Brown Chernozem as affected by tillage and rotation. Can. J. Soil Sci. 75:449-458.

Ecological Stratification Working Group, 1996. A national ecological framework for Canada. Centre for Land and Biological Resources Research, Research Branch, Agriculture and Agri-Food Canada, and State of the Environment Directorate, Environment Canada.

Ellert, B.H., H.H. Janzen and B.G. McConkey. 2000. Measuring and comparing soil carbon storage. in R. Lal et al. (eds.). Assessment Methods for Soil Carbon Pools. Advances in Soil Science. Ann Arbor Press, Chelsea, MI. (in press)

IPCC. 1997. Revised 1996 IPCC guidelines for National Greenhouse Gas Inventories, Volume 3: Greenhouse Gas Inventory Reference Manual. IPCC/OECD/IEA.UK.

IPCC. 2000. Land Use, Land Use Change, and Forestry. Special Report of the Intergovernmental Panel on Climate Change. Robert T. Watson, Ian R. Noble, Bert Bolin, N. H. Ravindranath, David J. Verardo and David J. Dokken (Eds.), Cambridge University Press, UK. pp 375.

Janzen, H.H., C.A. Campbell, R.C. Izaurralde, B.H. Ellert, N. Juma, W.B. McGill, and R.P. Zentner. 1998. Management effects on soil C storage on the Canadian prairies. Soil & Tillage Research 47:181-195.

Janzen, H.H., R.L. Lemke and R.L. Desjardins. 2000. Estimating N2O emissions from Canadian agroecosystems. (in preparation)

Junkins, B., S.N. Kulshreshtha, R. MacGregor, R. Gill, C. Dauncey, R. Desjardins, M. Boehm, P. Thomassin, A. Weersink, K Parton, and J. Cleary. 2000. Analyses of strategies for reducing greenhouse has emissions from Canadian agriculture: Technical report to the Agriculture and Agri-Food Table. Policy Branch, AAFC, Ottawa (forthcoming).

Kulshreshtha, S., M. Bonneau, M. Boehm, and J. Giraldez. 1999. *Canadian Economic and Emissions Model for Agriculture (CEEMA Version 1.0). Report 1. Model Description.* Economic and Policy Analysis Directorate, Policy Branch, Ottawa: Agriculture and Agri-Food Canada.

Liang, B.C., B.G. McConkey, C.A. Campbell, and D. Curtin, A. Moulin, S.A. Brandt, and G.P. Lafond. 1999. Crop rotation and tillage impact on carbon sequestration in Saskatchewan soils. Proceedings of Saskatoon Soils & Crops '99, February 25-26, 1999, Saskatoon, Saskatchewan.

McConkey, B.G., B.C. Liang, and C.A. Campbell. 1999. Estimating gains of soil carbon over a 15-year period due to changes in fallow frequency, tillage system, and fertilization practices for the Canadian Prairies (An Expert Opinion). Misc. Publication #379M0209, Swift Current Semiarid Prairie Agricultural Research Centre, Agriculture and Agri-Food Canada. 9 pp.

Neitzert, F., K. Olsen and P. Collas. 1999. Canada's Greenhouse Gas Inventory, 1997 Emissions and Removals with Trends. Environment Canada, April.

Nyborg, M., E.D. Solberg, S.S. Malhi and R.C. Izaurralde. 1995. Fertilizer N, crop residue, and tillage alter soil C and N content in a decade. In R. Lal, J.M. Kimble, R.F. Follett and B.A. Stewart (eds.) Soil Processes and the Carbon Cycle. CRC Press, Boca Raton, FL.

Peterson, E.B., G.C. Robinson, and N.M. Peterson. 1999. Prairie Provinces and British Columbia Forestry Options. Prepared for the Agriculture and Agri-Food Issues Table on Climate Change.

Policy Branch, Agriculture and Agri-Food Canada, 1999. Canadian fertilizer consumption, shipments and trade. Annual publications of Policy Branch, Agriculture and Agri-Food Canada. http://www.agr.ca/policy/cdnfert/text.html

Policy Branch, Agriculture and Agri-Food Canada. 1999. Medium Term Policy Baseline. Ottawa, Canada. http://www.agr.ca/policy/epad/english/pubs/mtb

Soil Classification Working Group. 1998. The Canadian System of Soil Classification. Third Edition. Research Branch, Agriculture and Agri-Food Canada, Publication 1646, NRC Research Press, Ottawa, Canada.

Smith, W.N., R.L. Desjardins and B. Grant. 2000. Estimated changes in soil carbon associated with agricultural practices in Canada. Can. J. Soil Sci. (submitted)

PAPER NO. 4: CHILE

ARTICLE 3.3 OF THE KYOTO PROTOCOL

As requested by document FCCC/SBSTA/2000/CRP.2, para. 5 and 6, the Government of Chile submits the following definitions and comments.

1. *AFFORESTATION, REFORESTATION AND DEFORESTATION (ARD)*

Forest: A definition of forest is required before defining ARD. Since the IPCC Special Report on LULUCF recognizes that "there are many possible definitions of a forest", it is suggested to adopt a single threshold of canopy cover for each relevant biome-specific, such as tropical moist forest, tropical dry forest, boreal forest, temperate forest, planted forest and agroforestry, among others, in order to reduce bias in defining lands under Article 3.3.

Afforestation: A direct human-induced activity that establishes forests in lands where there were no forests in 1990. When accounting for National GHG inventories, a land-based accounting system will be used according to the IPCC guidelines. Afforestation will be eligible under articles 6 and 12, and a project level activity-based accounting system will be used according to the above mentioned guidelines. The verifiable complete accounting of carbon stock changes will be made in all carbon pools related to a given set of landscape units in a given time period.

Deforestation: The natural or direct human-induced land use change resulting in the conversion of forests to other land use, in a given set of landscape units in a given time period, resulting in a verifiable change in carbon stocks. Deforestation by verifiable natural causes can be attributed to non direct human-induced activities, such as land slides, avalanches, volcano eruptions, floods, tsunamis, and also caused by the change in site ecological conditions such as salinization, desertification and adverse climate change, which are uncontrollable by immediate direct human-induced activities.

Reforestation: The reestablishment of forests by direct human-induced activities or natural regeneration in landscape units deforested after 1990. The changes in carbon stocks resulting from natural or direct human-induced reforestation will be included in the national GHG inventories within a land-based accounting system, according to the IPCC Guidelines. Carbon stock changes resulting from direct human-induced reforestation of landscape units deforested by verifiable natural causes will be eligible for project activities under articles 6 and 12 of the Kyoto Protocol. On the other hand, carbon stock changes resulting from direct human-induced reforestation of landscapes units deforested by direct human-induced causes will not be eligible for project activities under articles 6 and 12.

2. RATIONALE

The rationale of the above textual definitions is based on the IPCC Special Report on Land Use, Land Use Change and Forestry and includes the following analysis about their implications in the national inventories and in the Kyoto mechanisms.

Art. 3.3 establishes that the verifiable changes in carbon stocks resulting from direct human-induced land-use change and forestry activities, limited to afforestation, reforestation and deforestation since 1990, shall be used to meet the commitments under this Article of each Party included in Annex I.
In practical terms, Art. 3.3 allows Annex I Parties to include the changes in carbon stocks resulting from direct human-induce land use change and forestry limited to ARD activities in their national GHG inventories during the first commitment period, which will be made by measuring the net changes in GHG emissions by sources and removals by sinks, the latter measured as verifiable changes in carbon stocks.

Afforestation, reforestation and deforestation terms are defined separately as there are important differences among them, for the Kyoto Protocol purposes. The cornerstone is the expression “since 1990”. The essence is that the quantified emissions limitation or reduction commitments must be accomplished in relation to the 1990 gross emission levels as mentioned in Annex B of the protocol.

Considering that 1990 is the base year for most of the Annex I Parties GHG emissions inventories by sources and removals by sinks, the land use existing in 1990 should also be the basis to calculate the increase or decrease of the GHG emissions during the first commitment period, from 2008 to 2012.

As Art. 3.3 states that only direct human-induced land-use change and forestry activities —the latter limited to afforestation, reforestation and deforestation— resulting in changes in carbon stocks can be reported, the base year 1990 is a sort of “thin red line” that separates the existing carbon stocks in 1990 and the actual carbon stocks in the first commitment period.

Since afforestation, reforestation and deforestation are activities that cause land use change, the carbon stocks contained in the forests existing in 1990 at a national level is the carbon stock baseline to calculate the changes that could occur after that year.

It also means that if a forest existing in 1990 is clear-cut later, there will be an immediate net emission with a carbon stock loss. If that particular forest is replaced again in the same patch of land after clear-cutting, the consequence will be restoring the same carbon stock, by recapturing that emission in a period of time, depending on the species and site conditions. In this case, replacing a forest existing in 1990 and clear-cut later would be considered “reforestation” for the Kyoto Protocol purposes.

Reforestation of lands deforested by direct human-induced causes should not be eligible for project activities under Articles 6 and 12. On the other hand, reforestation of lands deforested by natural causes should be eligible under those Articles. Recognizing that forest fires can be caused by natural forces, but given the facts that slash-and-burn practices are the main causes of land use change worldwide, and the difficulties involved in determining a fire origin, it is proposed that reforestation that follows in a land that has been cleared by a previous fire, should not be eligible for project activities under articles 6 and 12 of the Kyoto Protocol.

Likewise, a patch of land without forest existing in 1990 that is converted into forest after that year and remains in that condition, it turns into a new carbon stock as it grows. This situation should be considered as “afforestation” to the Kyoto Protocol purposes.

An approach in this sense was introduced by the Chilean Forest Incentive Law, which establishes that October 28th 1974 is the line to separate afforestation from reforestation. To apply for the incentives, a new plantation must be established in bare soils with forest potential. When forest is harvested, reforestation is mandatory and high cash fines are applied in case of no compliance. In addition, in all lands with forests in 1974, any action of cut or harvest requires mandatory reforestation.

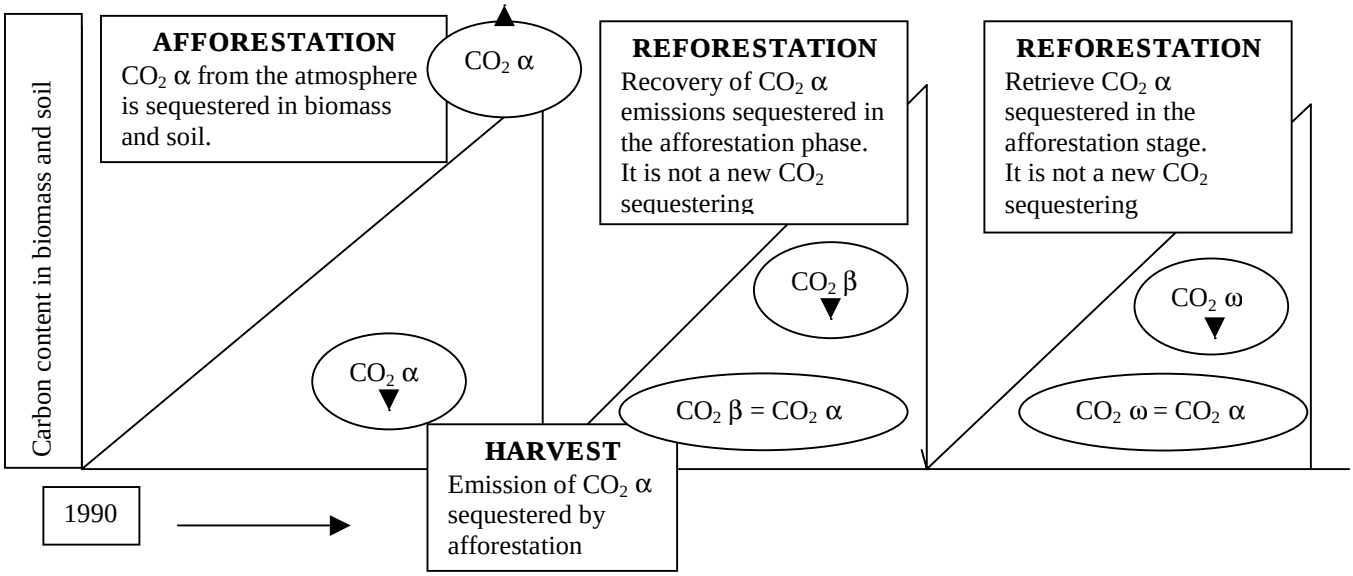
In general, almost all afforestation is a direct human-induced activity, because any land patch without forest cover before 1990 has little possibilities to get a forest cover without human-induced intervention, such as site preparation, direct sowing or planting with seedlings and protection against both domestic and wild animals. On the other hand, natural regeneration generally requires the tree felling of a pre-established natural or planted forest in the same patch of land to prosper, and should be defined as reforestation if occurs from 1990 henceforth.

Since Art. 3.3 establish that only direct human-induced activities shall be used to meet the commitments of each Party Annex I, verified afforestation activities should apply to carbon credits under the Kyoto mechanisms.

Finally, from an atmospheric point of view regarding ~~in~~ the afforestation, harvest and reforestation cycle, only afforestation of lands without forest since 1990 should be considered as carbon

sequestration under Articles 6 and 12, since reforestation after successive harvesting in the same patch of land does not constitute a new carbon sequestration. Only the recovery of the capture made during the first stage of afforestation should be considered as real carbon sequestration.

On the other hand, the changes in carbon stocks are reflected in the GHG national inventories every time that they occur, as emissions by sources at harvest phase, and removals by sinks in each reforestation stage. The figure below shows the CO_2 behavior as sequestered by afforestation, released by harvest and recovered by reforestation.



PAPER NO. 5: COSTA RICA[1]

PROPUESTA PARCIAL:

USO DEL SUELO, CAMBIO DE USO DEL SUELO Y SILVICULTURA

Artículos 3.3, 3.4 , 3.7 y 12 del Protocolo de Kioto:
Definiciones, modalidades, contabilidad y aspectos metodológicos.

Preámbulo

En el documento FCCC/SBSTA/2000/CRP.2, se insta a todas las Partes a someter propuestas de texto sobre los Artículos 3.3, 3.4 y 3.7 del Protocolo de Kioto (PK), referidos al tema de uso del suelo, cambio de uso del suelo y silvicultura, que contribuyan a la preparación de un texto consolidado de negociación sobre la materia.

En aras de contribuir a las definiciones y reglamentación de las actividades de uso del suelo, cambio de uso y silvicultura dentro del PK, Costa Rica somete a la Secretaría de la Convención Marco de las Naciones Unidas sobre Cambio Climático (CMCC) algunas posturas iniciales en algunos de los temas solicitados.

Costa Rica considera que las actividades humanas directamente relacionadas con el uso de la tierra, cambio de uso de la tierra y la silvicultura limitadas a la forestación, reforestación y deforestación, indicadas en el Artículo 3.3, y aquellas que se definan para el Artículo 3.4, son elegibles para el Mecanismo de Desarrollo Limpio (MDL) del Artículo 12, de acuerdo a los términos y fundamentos del documento FCCC/SB/2000/MISC.1/Add.2, el cual forma parte integral de esta propuesta y se incluye como Anexo.

(1) Definiciones y Propuesta Contable

(a) Definiciones sobre Forestación, Reforestación y Deforestación:

Para los efectos de cumplir con los compromisos de cada Parte incluida en el anexo I dimanantes del Artículo 3.1 del Protocolo de Kioto, se deberá incluir las variaciones netas de las emisiones por las fuentes y la absorción por los sumideros de gases de efecto invernadero que se deban a la actividad humana directamente relacionada con el cambio de uso de la tierra y la silvicultura, limitada a la forestación, reforestación y la deforestación, de acuerdo al Artículo 3.3, según las siguientes definiciones:

Forestación: Establecimiento de la condición de bosque[2] en tierras donde no había bosque durante al menos los últimos veinte años previos al establecimiento de la condición de bosque, siempre que estas actividades se hayan realizado a partir de 1990.

Reforestación: Restablecimiento de la condición de bosque[2] en tierras que han sido deforestadas, según la definición de deforestación que sigue, siempre que estas actividades se hayan realizado a partir de 1990.

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[1] Propuesta remetida a la secretaría de la Convención Marco de las Naciones Unidas sobre Cambio Climático el 1 de Agosto, 2000.

[2] Bosque y no-bosque, se definen respectivamente como todo aquel ecosistema terrestre natural o plantación forestal, cuya biomasa vegetal viva por encima del suelo es superior o inferior al umbral prefijado del 10% de su biomasa potencial, la cual varía de acuerdo al bioma.

Deforestación: Conversión de bosque a no-bosque con propósitos económicos por una actividad humana, siempre que estas actividades se hayan realizado a partir de 1990.

Tomando nota que los Artículos 3.1, 3.3 y 3.4 constituyen la base contable de las Partes Anexo I, reconociendo que los Artículos 3.10, 3.11 y 3.12 definen los ajustes contables a través de los Mecanismos, y recordando además, las relaciones dimanantes con el Artículo 12, Costa Rica considera que para garantizar la consistencia del marco contable del PK, se debe establecer un paralelismo entre la base contable dispuesta en los Artículos 3.1, 3.3, 3.4, 3.10, 3.11 y 3.12, con la reglamentación del Artículo 6 y el Artículo 12.

Por lo anterior, la elegibilidad de las actividades de cambio de uso del suelo y silvicultura en el Mecanismo de Desarrollo Limpio debe estar circunscrita a la forestación, reforestación y deforestación, según las siguientes definiciones:

Forestación: Establecimiento de la condición de bosque[2] en tierras donde no había bosque durante los últimos veinte años previos al inicio del proyecto MDL.

Reforestación: Restablecimiento de la condición de bosque[2] en tierras que han sido deforestadas previo al inicio del proyecto MDL.

Deforestación: Conversión de bosque a no-bosque con propósitos económicos por una actividad humana.

(b) Propuesta contable

Para contribuir al cumplimiento de una parte de sus compromisos cuantificados de limitación y reducción de las emisiones, contraídos en virtud del Artículo 3, las Partes incluidas en el anexo I podrán utilizar las unidades de reducción certificada de emisiones que adquieran de una Parte con arreglo a lo dispuesto en el Artículo 12, producto de las variaciones netas de las emisiones por las fuentes y la absorción por los sumideros de gases de efecto invernadero que se deban a la actividad humana directamente relacionada con el cambio de uso de la tierra y la silvicultura, limitada a la forestación, reforestación y deforestación desde el inicio del proyecto, calculadas como variaciones verificables del carbono almacenado desde el inicio del proyecto hasta el año 2012.

Por lo anterior, en el caso de ajustes contables de los inventarios de emisiones en virtud del Artículo 3.3, medidas como las variaciones netas de las emisiones por las fuentes y la absorción por los sumideros de gases de efecto invernadero que se deban a la actividad humana directamente relacionada con el cambio de uso de la tierra y la silvicultura, limitada a la forestación, reforestación y deforestación, se contabilizarán únicamente aquellos reservorios de carbono relevantes que se puedan medir y monitorear, limitado a los cambios en biomasa viva vegetal por encima del suelo.

Esta propuesta permitirá cuantificar las variaciones netas en los depósitos de carbono, la verificación independiente de los beneficios netos de carbono de las actividades de proyecto MDL, la contabilidad conexa entre las Partes y la transferencia de unidades de reducción de emisiones certificadas entre Partes anexo I y Partes no Anexo, de una manera paralela y consistente.

(2) Actividades humanas elegibles bajo Artículo 12 en la modalidad de uso del suelo, cambio de uso del suelo y silvicultura.

Costa Rica considera que las actividades humanas elegibles para proyectos de MDL[3], serán, en la categoría de cambio de uso de la tierra y silvicultura, aquellas actividades limitadas a la forestación, reforestación y deforestación definidas en virtud del artículo 3.3, y, en la categoría de uso de la tierra

[3] Bajo las disposiciones del Artículo 12,

y suelos agrícolas, aquellas actividades que sean de aplicación común a todas las Partes del anexo I que propongan para el primer período de cumplimiento, en virtud del Artículo 3.4.

Tomando nota de las modalidades dispuestas en el Artículo 3.3, se consideran como opciones elegibles para el Artículo 12, las actividades de proyectos de reducción de emisiones antropogénicas de gases de efecto invernadero y de absorción por sumideros de carbono. En la primera opción, se incluyen aquellas actividades de proyecto que efectivamente reduzcan las emisiones causadas por la deforestación a través de la protección de los depósitos de carbono bajo amenaza de deforestación. En la segunda opción, se incluyen aquellas actividades de proyecto que incrementen los depósitos de carbono por medio de la forestación y la reforestación.

(3) Otros aspectos metodológicos

Línea de Base y Adicionalidad

Conscientes que, según las disposiciones del Artículo 12.5, las actividades de proyecto del MDL deben ser "reales, medibles y de largo plazo" y que "las reducciones de emisiones sólo podrán ser certificadas si son adicionales a las que se producirían en ausencia de las actividades del proyecto", se deberá establecer al nivel de proyecto, una línea de base que refleje el escenario sin proyecto. La diferencia entre la línea de base y el escenario de emisión o fijación del proyecto, determinará el beneficio ambiental neto de las actividades del proyecto y su adicionalidad.

Costa Rica considera que una vez certificada la línea base, debe permanecer estática durante la vida útil del proyecto MDL. Sin embargo, para nuevos proyectos se debe considerar líneas base más actualizadas en virtud de una mayor experiencia y el adelanto en el conocimiento.

Adicionalidad y Antropogeneidad

Uno de los requisitos indispensables en cuanto a las actividades elegibles en la modalidad de uso de la tierra, cambio de uso de la tierra y silvicultura es demonstrar su condición de antropogéneidad.

Reconociendo que, según lo dispuesto en el Artículo 12.5, la adicionalidad[4] es uno de los criterios de elegibilidad para actividades de proyectos del MDL, y, recordando que las actividades de proyectos de uso del suelo, cambio de uso del suelo y silvicultura satisfacen fácilmente la condición de adicionalidad financiera[5], Costa Rica considera que la inclusión de estas categorías de actividades de proyecto en el MDL, refuerza, a través de la prueba de adicionalidad, la condición de antropogeneidad de las actividades "per se" y fortalece así, su contribución en el logro del objetivo último de la CMCC.

Monitoreo y Verificación

Reconociendo lo dispuesto en el Artículo 12.7, "La Conferencia de las Partes… deberá establecer modalidades y procedimientos que permitan asegurar transparencia, eficiencia y la rendición de cuentas por medio de una auditoría y la verificación independiente de las actividades de proyecto".

Costa Rica considera esencial la obligatoriedad de un sistema de monitoreo al nivel de proyecto MDL, para cuantificar y controlar los beneficios netos de carbono durante el horizonte del proyecto. El monitoreo debe complementarse con un auditoraje externo que valide sus resultados y verifique el cumplimiento de las metas del proyecto en términos de sus beneficios netos de carbono.

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[4] Las reducciones de emisiones sólo podrán ser certificadas si son "adicionales a las que se producirían en la ausencia de las actividades del proyecto".

[5] La adicionalidad financiera es una derivación del concepto de adicionalidad ambiental, y se refiere a que si la actividad de proyecto hubiera existido en la ausencia de la valoración económica de las unidades de reducciones de emisiones certificadas en la estructura financiera del proyecto.

El monitoreo, la certificación, la verificación y sus interacciones son, bajo los propósitos de seguimiento y fiscalización, los elementos básicos para garantizar la efectividad ambiental de las actividades del proyecto, así como también la integridad y credibilidad del MDL.

Fugas

El potencial de fugas[6] en actividades de proyectos del MDL no es un problema exclusivo a la modalidad de cambio de uso del suelo y silvicultura, sino más bien es un problema común a todas las demás opciones de mitigación elegibles para actividades de proyectos MDL. Inclusive, algunos proyectos de cambio de uso del suelo y silvicultura, por su naturaleza, tienen poco o ningún riesgo de fuga.

Reconociendo que la orientación explícita del MDL es hacia actividades de proyectos, Costa Rica considera que diversas medidas pueden ser adoptadas para reducir el riesgo de las fugas. Sin embargo, la medida más efectiva es a través de un diseño adecuado de las actividades y límites o fronteras del proyecto.

Además, se considera que, en muchos casos, las fugas se pueden controlar ampliando las fronteras del proyecto. Inclusive, las fugas se pueden atenuar a través del diseño de proyectos de cobertura nacional, donde las debilidades de un proyecto se atenúan con las bondades del otro[7]. Además, dependiendo de su localización, se deben considerar, para efectos de diseño del proyecto, el potencial de fugas transfronterizas.

Las fugas pueden ser, eventualmente, cuantificadas y descontadas del total de reducciones de emisiones reclamadas por el proyecto, o en su defecto, establecerse, al nivel de proyecto, una reserva permanente o temporal, dependiendo de su naturaleza, que compense este riesgo potencial.

En virtud de lo anterior, se recomienda que el análisis de riesgos debe ser parte de los requerimientos mínimos de la certificación.

Riesgos

Reconociendo la variedad de los riesgos implícitos y las incertidumbres inherentes a las actividades de uso del suelo, cambio de uso del suelo y silvicultura, Costa Rica considera que en aras de garantizar la efectividad ambiental, todo proyecto MDL debe incluir como parte integral de su diseño, un análisis de riesgos e incertidumbres, que permita establecer, a nivel de proyecto, una reserva temporal y/o permanente de reducciones de emisiones certificadas que compense los riesgos potenciales por factores naturales y antropogénicos, políticos, económicos y financieros.

[6] Fuga se refiere al fenómeno por el cual un proyecto MDL, aunque reduce emisiones o aumenta la fijación de carbono en el sitio del proyecto, desplaza o las incrementa en otro lado, reduciendo el beneficio neto del proyecto.

[7] Costa Rica tiene, en la categoría de cambio de uso del suelo, dos proyectos de cobertura nacional que se complementan para evitar fugas. El "Proyecto de Áreas Protegidas" (PAP) y el "Proyecto Forestal Privado"(PFP). El PAP tiene como objetivo la consolidación territorial del Sistema Nacional de Áreas de Conservación, a través de la comercialización de reducciones de emisiones certificadas que resulten con evitar la deforestación, y el PFP, es un compromiso entre el Gobierno y pequeños propietarios fuera del área del PAP, que proporciona "Pago por Servicios Ambientales", entre ellos el de fijación de carbono, por dedicar sus tierras a usos compatibles con su potencialidad, desencentivando usos marginales no compatibles.

Enfoque Portafolio y Permanencia

Un aspecto que solamente afecta a las actividades en la categoría de cambio de uso del suelo y silvicultura, es el problema de la permanencia[8]. Los bosques, plantaciones y otras formas de fijación de carbono son vulnerables a los desastres naturales, como inundaciones, sequías y huracanes, así como a incendios, plagas e intervenciones humanas imprevistas, que pueden afectar la cobertura vegetal y no verse reflejado en la contabilidad del PK.

Costa Rica considera que el problema de la permanencia para las actividades de las Partes que constituyen el Anexo I, debe resolverse a través de periodos continuos de cumplimiento. Sin embargo, para garantizar la permanencia de los beneficios netos de largo plazo de actividades de proyectos MDL y poder, en los casos que corresponda, reflejar su reversibilidad en el marco contable del PK, se requiere aplicar un enfoque de portafolio y contabilizar en el agregado y en forma conexa, los beneficios netos de carbono de las actividades de proyectos domésticos en esta modalidad.

Será responsabilidad de la autoridad oficialmente designada ante la Secretaria de la CMCC, reconciliar anualmente la cuenta nacional de los proyectos del MDL en las categorías de uso del suelo, cambio de uso del suelo y silvicultura, de forma que se refleje la reversibilidad.

ANEXO

COSTA RICA, ON BEHALF ALSO OF ARGENTINA, BOLIVIA, CHILE, COLOMBIA, THE DOMINICAN REPUBLIC, ECUADOR, GUATEMALA, HONDURAS, MEXICO, NICARAGUA, PANAMA, PARAGUAY AND URUGUAY

LAND USE, LAND USE CHANGE AND FORESTRY PROJECTS UNDER THE CLEAN DEVELOPMENT MECHANISM

The countries listed above submit to the UNFCCC Secretariat the following document and request its publication as a miscellaneous non-paper during the XII Sessions of the Subsidiary Bodies to the UNFCCC (12-16 June 2000). The aim of this non-paper is to address comments made by some observers suggesting that Land Use, Land Use Change and Forestry (LULUCF) projects are ineligible under Article 12 of the Protocol, which defines the Clean Development Mechanism (CDM of the Kyoto Protocol). In our view, these comments do not have any valid legal or scientific basis, and have become an unwelcome distraction from efforts to develop the rules necessary to ensure that the CDM fulfills its purposes of assisting non-Annex I Parties in achieving sustainable development, and assisting Annex I Parties in achieving compliance with their quantified emission limitation and reduction commitments, with a contribution to the ultimate objective of the Convention.

The above-listed countries emphasize that questions of interpretation of the Kyoto Protocol must be resolved in accordance with Article 2 of the Convention which states: “The ultimate objective of this Convention and any related legal instruments that the Conference of the Parties may adopt is to achieve, in accordance with the relevant provisions of the Convention, stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system.” Consistent with this objective, the above-listed countries state the following:

[8] Artículo 12.5: “las reducciones de emisiones deben ser certificadas sobre la base de” … “beneficios ambientales …*de largo plazo en relación con la mitigación del cambio climático.*

I. LULUCF projects are eligible under the Article 12 CDM. Article 12 does not explicitly or implicitly exclude LULUCF projects from eligibility.

A number of observers have interpreted Article 12 as excluding from eligibility under the CDM projects from the LULUCF sector. The plain language of Article 12 does not contain any explicit exclusion of any category of projects. Nevertheless, these observers argue that an implicit exclusion must be read into Article 12. This exclusionary interpretation of Article 12 is invalid for the following reasons:

A) The exclusionary interpretation is inconsistent with the guiding principles of the Protocol. The Preamble to the Protocol states that the Parties to the Protocol will be "guided by Article 3 of the Convention," which sets forth the Convention's principles. One of the Article 3 principles is that the policies and measures undertaken by the Parties "should take into account different socio-economic contexts, be comprehensive, cover all relevant sources, sinks and reservoirs of greenhouse gases and adaptation, and comprise all economic sectors." Reading into Article 12 an implicit exclusion of LULUCF projects is inconsistent with this guiding principle of the Protocol. Obviously, the drafters intended to preserve this principle of comprehensiveness established in the text of the Convention.

B) The exclusionary interpretation is inconsistent with Article 2 of the Protocol. Article 2 of the Kyoto Protocol sets forth how each Annex I Party is to achieve its quantified emission limitation and reduction commitments (QELRCs) under Article 3 while promoting sustainable development. Article 2 states that each Annex I Party "shall [i]mplement and/or further elaborate policies and measures in accordance with its national circumstances, such as: …(ii) [p]rotection and enhancement of sinks and reservoirs of greenhouse gases; …and (iii) promotion of sustainable forms of agriculture in light of climate change considerations." Given that Article 12's stated purposes are to provide a means for Annex I Parties to achieve their QELRC's and to contribute to sustainable development, Article 2 dictates the scope of activities eligible under Article 12.

C) The term "emission reductions" as it is used in Article 12 does not imply that only projects that reduce emissions, and not projects that remove emissions, may be considered under Article 12 of the CDM. The term "emission reductions" is not explicitly defined in either the Convention or the Protocol. Throughout the Protocol, it is used as a term of art to refer to particular kinds of units of account rather than particular types of activities.

The term "emission reductions" appears for the first time in Articles 3.10, 3.11 and 3.12. Articles 3.10 and 3.11 use the term "emission reductions units" as the Article 6 unit of account to adjust the assigned amounts of the Parties involved. Similarly, Article 3.12 uses the term "certified emission reductions" as the unit of account to adjust the assigned amount of the acquiring Party in a CDM transaction. The text uses the word "certified" to distinguish the emissions reduction units of account obtained under Article 12 from those obtained under Article 6.

The next appearance of the term "emission reductions" is in Article 6. The plain language of Article 6 states that "emission reduction units" may "result[] from projects aimed at *reducing anthropogenic emissions by sources or enhancing anthropogenic removals by sinks in any sector of the economy*" (emphasis added).

Accordingly, the Protocol uses the term "emission reductions" in connection with the project-based mechanisms to describe the impact of projects on Parties' accounts, not the type or category of project. Moreover, Article 6 makes clear that the drafters contemplated that "emission reduction units" could result from projects that enhance removals by sinks. Where the drafters intended to distinguish among categories of eligible activities and projects, they did so explicitly, e.g., Article 6's reference to "projects aimed at reducing anthropogenic emissions by sources or

enhancing anthropogenic removals by sinks"; and Article 3.3's reference to "afforestation, reforestation, and deforestation."

However, even if one infers from the use of term "emission reduction" in Article 12 an implicit exclusion of projects that enhance removals by sinks, it is important to note that not all LULUCF projects are sinks projects. As the IPCC has recognized, forests can be sources, sinks, or reservoirs. Many LULUCF projects slow, reduce, or avoid deforestation. Such projects reduce anthropogenic emissions by sources.

D) The exclusionary interpretation is inconsistent with the mandatory accounting framework for Annex I Parties established under Article 3.3. Article 3.3 states that "net changes in greenhouse gas emissions by sources and removals by sinks, resulting from direct human-induced land-use change and forestry activities, limited to afforestation, reforestation and deforestation since 1990, measured as verifiable changes in carbon stocks in each commitment period, *shall* be used to meet the commitments under this Article of each Party included in Annex I" (emphasis added). Accordingly, Article 3.3 establishes explicitly that Annex I Parties must take into account certain LULUCF activities in meeting their commitments under Article 3. Since Article 3.3 refers explicitly to "net changes" –a phrase which automatically includes emissions by sources and removals by sinks– and since one of the purposes of Article 12 is to assist those Parties in meeting their commitments under Article 3, it would be inconsistent with the mandatory Article 3.3 accounting framework to exclude LULUCF projects from Article 12. Accordingly, the scope of projects eligible under Article 12 should correspond to the activities eligible under Articles 3.3 and 3.4.

To the extent that arguments against the eligibility of LULUCF projects under Article 12 represent a "back-door" effort to renegotiate Article 3 or any other provisions of the Protocol, the above-listed countries condemn such an effort. As Article 26 of the Protocol makes clear, the text of the Protocol is final and whole. It is not subject to renegotiation.

E) The exclusionary interpretation is inconsistent with the CDM's purpose of assisting Non-Annex I countries in achieving sustainable development and meeting the costs of adaptation measures. The sustainable management of natural resources, including land use, land-use change and forestry activities, is deemed critical for the achievement of sustainable development as well as for addressing vulnerability to climate change. The exclusionary interpretation fundamentally conflicts with the ultimate objective of the Convention expressed in Article 2 and conflicts with the principles expressed in Article 3.1 ("The Parties should protect the climate system for the benefit of present and future generations of humankind, on the basis of equity and in accordance with their common but differentiated responsibilities and respective capabilities.")

F) In the past, proponents of the exclusionary interpretation of Article 12 have asserted that a lack of full scientific certainty about the validity of LULUCF projects justifies making such projects ineligible under Article 12. This argument is inconsistent with the guiding principles of the Protocol as expressed in Article 3 of the Convention. Article 3.3 of the Convention states that: "The Parties should take precautionary measures to anticipate, prevent or minimize the causes of climate change and mitigate its adverse effects. Where there are threats of serious or irreversible damage, *lack of full scientific certainty should not be used as a reason for postponing such measures*, taking into account the policies and measures to deal with climate change should be cost-effective so as to ensure global benefits at the lowest possible cost" (emphasis added).

Moreover, even if there was at one time a lack of full scientific certainty about the merits of projects from the LULUCF sector, particularly compared to projects from the energy sector, this uncertainty has been resolved by the authoritative IPCC Special Report on Land Use, Land Use Change, and Forestry. This report cites with approval a review and comparison of projects from both sectors. The IPCC states:

> "This assessment found that LULUCF and energy projects face parallel, comparable issues in measurement and in ensuring social and environmental benefits. *In general, it is not possible to assert that energy projects are superior as a class to LULUCF projects on these grounds.*" (Emphasis added).

The IPCC report identified only one significant difference between projects in the two sectors. This issue, duration, is associated with only certain types of LULUCF projects and can be addressed through project design. All in all, the IPCC Special Report does not provide any scientific basis for excluding the entire category of LULUCF projects from eligibility under the CDM.

II. Conclusions

According to the letter of the Protocol, the spirit of the negotiations, and the purpose of the Clean Development Mechanism, LULUCF projects are eligible to receive certified emissions reductions. The scope of eligible LULUCF projects should correspond to the activities established under the Article 3.3 and those to be established under Article 3.4. Projects that effectively and credibly avoid, slow, or reduce deforestation are covered under Article 3.3, whether the project includes total protection or forest management.

Excluding LULUCF projects and other related activities from the CDM will go against the spirit, objectives and principles of the Convention and the Kyoto Protocol.

The time has ended for spurious legal interpretations and invalid scientific claims regarding LULUCF projects. These arguments have distracted from the real task at hand, which is developing the rules that will ensure that all CDM projects have real, measurable, and long-term benefits related to the mitigation of climate change and that those benefits are additional to those that would occur in the absence of those projects. The above-listed countries offer this paper in the hope that we all can move forward in designing a CDM that is characterized by environmental integrity and assists in our achievement of sustainable development.

PAPER NO. 5: FRANCE
(ON BEHALF OF THE EUROPEAN COMMUNITY AND ITS MEMBER STATES)

TEXTUAL PROPOSALS ON ARTICLES 3.3, 3.4, 3.7 AND EXPLANATORY MATERIAL IN ACCORDANCE WITH THE CONCLUSIONS OF THE 12th SESSION OF SBSTA

1 DEFINITIONS AND ACCOUNTING APPROACHES RELATED TO AFFORESTATION, REFORESTATION AND DEFORESTATION UNDER ART 3.3[1]

The Conference of Parties,

Recalling its decision 9/CP4, in particular paragraph 1 on the interpretation of Article 3.3, and paragraph 3 on the need for a draft decision on definitions for activities under this Article, to be adopted by the Conference of the Parties serving as the meeting of the Parties to the Kyoto Protocol at its first session,

Further recalling its decision 16/CP5,

Noting the scientific advice provided in the Special Report on Land Use, Land Use Change and Forestry prepared by the Intergovernmental Panel on Climate Change,

Wishing to design a balanced, scientifically and environmentally sound definitional and accounting system,

Further wishing to conserve biological diversity and to encourage sustainable management of forests and other natural resources

Decides on the following definitions, procedures and accounting approaches for use in the implementation of Art 3.3 of the Kyoto Protocol[2]:

i. Forest is land with tree crown cover (or equivalent stocking level) of more than 10% and area of more than 0.5 ha. The trees should be able to reach a minimum height of 5m at maturity *in situ.* Forest may consist either of closed forest formations where trees of various storeys and undergrowth cover a high proportion of the ground; or of open forest formations with a continuous vegetation cover in which tree crown cover exceeds 10 percent. Young natural stands and all plantations established for forestry purposes which have yet to reach a crown density of 10 percent or tree height of 5m are included under forest, as are areas which are temporarily unstocked as a result of human intervention or natural causes, but which are expected to revert to forest[3].

ii. A Party may use other numerical values for the minimum height and minimum area provisions in the definition of forest traditionally used by that Party, to reflect national circumstances relevant to specified biomes.

iii. Afforestation is conversion to forest of land that has not supported forest for a period of at least 50 years[4]

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[1] The EU is of the view that decisions for Articles 3.3, 3.4 and 3.7 are intrinsically linked, and should be viewed in their entirety

[2] This *Decides* deals with para 6(a) in the SBSTA12 decision

[3] The definition of *forest* is taken from the UN-ECE/FAO *Temporal and Boreal Forest Resources Assessment 2000.* The original reads 'May consist…' in the third sentence this has been replaced by 'Forest may consist...'.

[4] According to the IPCC Special Report 'Afforestation is usually defined as the establishment of land that has been without forest for a period of time (eg 20 to 50 years) and was previously under a different land use' (SPM para 24).

iv. Reforestation is conversion to forest of land that has supported forest within the past 50 years, but has been converted to other land uses for a period of at least twenty years prior to the start of a commitment period

v. Deforestation is conversion of forest land to non-forest land

vi. Spatial assessment related to forests shall be conducted with a resolution no larger than 10 ha.

vii. To review the definition of forest for the second and subsequent commitment period in order to reflect better biome specific circumstances,

viii. The area counted as deforestation during the first commitment period may be reduced by areas of afforestation and reforestation with the same or greater potential carbon content, provided that

a) areas of afforestation or reforestation used in this way are not otherwise used to help meet commitments under the provisions of Art 3.3

b) the total deforested area during the first commitment period is less than 1% of the total forest area in a country at the beginning of the commitment period

c) the total human induced forest carbon stock change during the commitment period, due to activities including ARD since 1990, is not negative

d) national forest policies and measures are established, are consistent with the ecosystem approach under the Convention on Biological Diversity and ensure sustainable forest development and management

ix. A Party shall not use carbon stock changes corresponding to Art 3.3 activities to help meet commitments through additions to its assigned amount if its total forest carbon stock is falling as shown by its greenhouse gas inventory estimated in accordance with the Revised 1996 IPCC Guidelines and any good practices adopted by the COP. For determination of this total forest carbon stock, a Party may choose to exclude carbon stock changes due to damage by natural disturbances from its inventory estimates[5].

x. The requirement for direct human induced activities signifies intent to establish forest by planting, seeding, or natural regeneration, or the intent to deforest, traceable to decisions affecting the land areas concerned. This requirement applies in all cases where forest land is converted to another land use.

xi. Accounting of carbon stock changes during the commitment period shall begin with the onset of the activity and shall include above ground biomass, roots, litter and forest soil organic matter.

xii. Carbon stock changes in litter and forest soil organic matter resulting from afforestation and reforestation activities need not be accounted for in detail provided these pools are increasing as estimated in accordance with methodologies adopted by the COP[6]. In this case the increase shall not be used to help meet commitments under Art 3 of the Kyoto Protocol.

[5] This provision is inserted to ensure that the forest as a whole cannot be degraded whilst gaining credits under Art 3.3 from post 1990 establishment.

[6] These methodologies would take account of the Revised 1996 IPCC Inventory Guidelines, possibly to be revised, and any associated work on Good Practices.

xiii. Emissions of non-CO_2 greenhouse gases covered by the Kyoto Protocol and resulting from Art 3.3 activities shall be estimated and reported as information items in Parties' greenhouse gas inventories in accordance with methodologies agreed by the COP.

xiv. Implementation of the activities included under the provisions of Art 3.3 shall be consistent with the Convention on Biological Diversity, the Rio Forest Principles, and Agenda 21, and take into account the ongoing intergovernmental forest policy dialogue.

A*lso decides* on the following methodologies for measuring and reporting[7]:

xv. The requirement for verifiability requires, *inter alia*, that areas of land subject to afforestation, reforestation and deforestation activities under the provisions of Art 3.3 be identifiable via the national inventory system

xvi. Verifiable carbon stock changes shall be measured, estimated, monitored and reported with associated uncertainties in a manner consistent with the inventory guidelines adopted by the COP[8], any good practices adopted by the COP, and the requirements for supplementary information agreed by the COP/MOP under the provisions of Art 7.1 of the Kyoto Protocol, and these guidelines and good practices shall also take account of the need to ensure transparency.

xvii. That the IPCC be asked to develop its work in Good Practices and Uncertainty Management to cover the requirements of verification, measurement, estimation, assessment of uncertainties, monitoring and reporting carbon stock changes and emissions of other greenhouse gases associated with Art 3.3 activities, taking account of accounting issues associated with reversibility.

xviii. That a COP decision be made at a future session on how the accounting system for Art 3.3 will use the Good Practice guidance provided by the IPCC.

xix. Parties shall report to the relevant international organisations on how implementation of the activities included under the provisions of Art 3.3 are consistent with the Convention on Biological Diversity, the Rio Forest Principles, and Agenda 21 and are taking into account the ongoing intergovernmental forest policy dialogue.

2 HOW AND WHICH ADDITIONAL ACTIVITIES MIGHT BE INCLUDED UNDER ART 3.4[9]

The Conference of Parties,

Recalling its decision 9/CP4, in particular the draft decision referred to in paragraph 4, and its subsequent decision 16/CP5,

Noting the commitments of the UNFCCC, in particular Article 4, paragraph 1(d), to promote sustainable management and to promote and cooperate in the conservation and enhancement of sinks and reservoirs,

[7] This *Also decides* deals with para 6c of the SBSTA12 decision in the context of Art 3.3
[8] Currently the Revised 1996 IPCC Guidelines , possibly to be revised
[9] The EU is of the view that decisions for Articles 3.3, 3.4 and 3.7 are intrinsically linked, and should be viewed in their entirety

Noting the scientific advice provided in the Special Report on Land Use, Land Use Change and Forestry prepared by the Intergovernmental Panel on Climate Change, including advice relevant to scale, uncertainties and risks,

Taking into account the country specific data and information available prior to COP6[10],

Aware of the estimated magnitude and uncertainties related to the residual terrestrial uptake[11],

Reaffirming the need to maintain incentives to reduce fossil fuel and other emissions and to promote sustainable management of forests and other ecosystems and to conserve biological diversity,

Further wishing to design a balanced, scientifically and environmentally sound accounting system, taking the feasibility into account,

Decides on the following methodologies, rules, guidelines and accounting approaches to decide how and which additional activities might be included under the provisions of Art 3.4[12]:

i. no additional activities shall be used under the provisions of Art 3.4 during the first commitment period, except if the COP decides that the issues of scale, uncertainty and risk related to the sinks are resolved[13]

ii. to establish, prior to the fixing of quantified objectives for the second commitment period, a list of agreed additional activities for use in the second and subsequent commitment periods together with the rules, modalities and guidelines for their accounting.

iii. to clarify the meaning of the final sentence of Art 3.4 to be that a Party may choose to apply during the first commitment period either the whole set of any agreed activities if occurring, or to apply certain of them, or to apply none of them provided that these activities have taken place since 1 January 1990. A Party may account for additional activities leading to an increase in carbon stocks only if it also accounts for all activities which lead to a decrease in carbon stocks in accordance with methods to be agreed by the COP.

iv. both increases and the decreases in carbon stocks and emissions of greenhouse gases other than CO2 associated with any agreed activities shall be reported and accounted under the provisions of Art 3.4. During the first commitment period emissions of greenhouse gases other than CO2 need not to be accounted so long as they are shown to be decreasing according to methodologies to be agreed by COP.

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[10] This text will need elaboration in the light of the data to become available with the 1 August submissions.
[11] The residual terrestrial uptake is qualified in Table 2 of the SPM of the IPCC Special Report on LULUCF
[12] This *Decides* deals with para 6b of the SBSTA12 decision
[13] *"The Council reaffirms its willingness to continue to work with other Parties to clarify the treatment of sinks in the Kyoto Protocol. The Council notes that the IPCC Special Report on Land Use, Land Use Change and Forestry provides information relevant to decision-making. Furthermore, country specific data and information need to be available so that Parties can make well-informed decisions on Articles 3.3 and 3.4 and 3.7 of the Kyoto Protocol. The Council reaffirms that the inclusion of sinks activities should not undermine incentives for emissions reductions nor the conservation of biological diversity. The Council has serious concerns about the scale and the scientific and other uncertainties and risks associated with sinks. The Council therefore takes the position that a decision on the inclusion of defined and limited activities associated with further sources and sinks (Article 3.4) shall not apply in the first commitment period, except if these concerns are met. Criteria will be needed to develop modalities, rules and guidelines for the application of Art. 3.4 of the Kyoto Protocol before quantified objectives are fixed for the second commitment period. (…) The Council also emphasises that any decision on definitions, methodologies and accounting rules should be consistent with sustainable forest management, including the conservation of biological diversity* (Community Strategy on Climate Change – Council Conclusions, Brussels, 23 June 2000 (9707/00))

v. a combination of the following approaches shall be used for the accounting rules for activities under Art 3.4:

Approach A:

(Ai) Only additional agreed activities which can be shown to have a detectable intentional human induced effect on carbon stocks shall be accounted under the provisions of Art 3.4. This requirement shall be tested using verifiable statistical data to show that the hypothesis[14], that the activity has no detectable intentional human induced effect, can be rejected with 10% significance

(Aii) Accepted statistical tests and deterministic modeling techniques shall be used singly or in combination to test the statistical hypothesis referred to in previous paragraph and to separate the intentional human induced effects from other effects. Such tests and techniques shall be based on data and information from:

a) control plots used for comparison between land subject to the activity and those not subject to it
b) data from research plots
c) existing forest survey and planting data

(Aiii) Deterministic model projections shall be used to factor out the dynamic effects of age structure in forest ecosystems and data from control and research plots shall be used to exclude carbon stock changes in all ecosystems caused by climate change, elevated carbon dioxide concentration and the effects of fertilisation due to nitrogen fallout.

(Aiv) Where such models, tests and techniques are not used changes in carbon stocks associated with agreed activities shall only be counted in excess of a threshold level of 0.5 tC/ha-yr

(Av) Crediting of carbon stock increases due to human activities shall not exceed the net increase in carbon on lands affected by the actions.

Approach B:

(Bi) Estimated carbon stock changes under Art 3.4 shall be adjusted for uncertainty in a conservative way[15]

Approach C:

(Ci) Changes in carbon stocks associated with agreed activities shall only be counted in excess of a threshold level of X tC/ha-yr

Approach D:

(Di) Only 5% of the verifiable changes in carbon stocks associated with agreed activities shall be accountable under the provisions of Art 3.4 during the first commitment period.

Approach E:

(Ei) Verifiable increases in carbon stocks associated with any agreed activities shall only be accountable under the provisions of Art 3.4 up to 1% of the assigned amount during the first commitment period

[Approach E ends here]

[14] This would be referred to as the *null hypothesis* in statistical usage

[15] This means, eg that carbon stock changes shall be debited or credited at the lower bound of the absolute value of the 95% confidence interval.

vi. Accounting of carbon stock changes and changes in emissions and/or removals of greenhouse gases related to the agreed additional activity during each commitment period shall begin with the onset of the activity. Such accounting for any agreed activities which began prior to the first commitment period shall be from January 1 2008.

vii. Implementation of the activities included under the provisions of Art 3.4 shall be consistent with the Convention on Biological Diversity, the Rio Forest Principles, and Agenda 21, and take into account the ongoing intergovernmental forest policy dialogue .

Also decides on the following methodologies for measuring and reporting[16]:

viii. that the requirement for verifiability requires *inter alia* that the areas of land subject to any agreed additional activities be identifiable via the national inventory system

ix. Verifiable carbon stock changes and greenhouse gas emissions shall be measured, monitored, estimated and reported with associated uncertainties in a manner consistent with the inventory guidelines adopted by the COP[17], any good practices adopted by the COP, and the requirements for supplementary information agreed by the COP/MOP under the provisions of Art 7.1 of the Kyoto Protocol and these guidelines and good practices shall also be used to ensure transparency.

x. that the IPCC be asked to develop its work in Good Practices and Uncertainty Management to cover the requirements of verification, measurement, estimation, assessment of uncertainties, monitoring and reporting carbon stock changes and emissions of other greenhouse gas associated with Art 3.4 activities, taking account of accounting issues associated with reversibility

xi. that a COP decision be made at a future session on how the accounting system for Art 3.4 will use the Good Practice guidance provided by the IPCC.

xii. Parties shall report to the relevant international organisations on how implementation of the activities included under the provisions of Art 3.4 are consistent with the Convention on Biological Diversity, the Rio Forest Principles, and Agenda 21 and take into account the ongoing intergovernmental forest policy dialogue.

3 OVERALL ACCOUNTING APPROACHES IN RELATION TO THE REQUIREMENTS OF ARTS 3.3, 3.4 AND 3.7 REGARDING INTER ALIA REVERSIBILITY, NATURAL EFFECTS, AND ACCOUNTING INTERLINKAGES[18]

The Conference of Parties,

Noting the scientific advice provided in the Special Report on Land Use, Land Use Change and Forestry prepared by the Intergovernmental Panel on Climate Change

Mindful of the potential for sink reversal,

Aware of the residual terrestrial uptake,

[16] This *Decides* deals with para 6c of the SBSTA12 decision in the context of Art 3.4
[17] Currently the Revised 1996 IPCC Inventory Guidelines, possibly to be revised
[18] The EU is of the view that decisions for Articles 3.3, 3.4 and 3.7 are intrinsically linked, and should be viewed in their entirety

Cognisant of the need to clarify the relationship between Articles 3.3, 3.4 and 3.7 of the Kyoto Protocol,

So as not to double count emissions minus removals or carbon stock changes,

Recalling the need for time series consistency,

Further wishing to conserve biological diversity and to encourage sustainable management or forests and other natural resources

Decides:

i. that all changes in carbon stocks which, under the provisions of Art 3.3 and 3.4 of the Kyoto Protocol have been added to Parties' assigned amounts shall be monitored so long as they remain so added, shall be subtracted from the assigned amount if the monitoring cease, and shall be subtracted from the assigned amount in proportion to their decrease should the monitoring indicate that they are declining[19]

ii. to clarify the meaning of the final sentence of Art 3.7 of the Kyoto Protocol to be that Parties for whom land use change and forestry constituted a net source of greenhouse gas emissions in 1990 shall include their aggregate anthropogenic emissions minus removals from land use change[20] in their greenhouse gas inventory for the base year and subsequent years.

iii. since Parties for whom the final sentence of Art 3.7 applies will already have counted the effects of activities related to land use change agreed under the provisions of Art 3.3 and Art 3.4 as part of their base year and subsequent inventories, further accounting of these activities under the provisions of Art 3.3 and 3.4 would not apply to these Parties[21]

iv. to consider further the accounting rules that shall be used if Art 3.3 and Art 3.4 activities were to be applied to the same piece of land.

v. that further accounting rules would be required if commitment periods are not contiguous[22]

vi. Parties' accounting of sinks credits under Art 3 shall be contingent on the requirements that:

a) national policies on the management, conservation and sustainable development of all types of forests be in place and are consistent with the Forest Principles as agreed on at the 1992 Rio Conference and are consistent with the recommendations of the Intergovernmental Panel on Forests and the Intergovernmental Forum on Forests[23],

b) national policies provide criteria and indicators for the sustainable development and management of forests as well as of other ecosystems in accordance with the Convention on Biological Diversity.

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[19] This *Decides* deals with sink reversal

[20] Recognising that afforestation, reforestation and deforestation are all examples of land use change

[21] This *Also* d*ecides* deals with avoiding double counting between the second sentence of Art 3.7 and Art 3.3 and 3.4.

[22] The EU is strongly in favour of contiguous commitment periods

[23] Bearing in mind that national policies and accompanying criteria and indicators will be revised in line with developments of international policies.

ANNEXES COUNTRY SPECIFIC DATA AND INFORMATION

Country specific data provided by Member States for different definitions, accounting frameworks and activities are for information only. This should not be interpreted as if the EU or its Member States were advocating any of the definitional and accounting scenarios or activities for which data are presented in the Tables and explanatory material which follow.

AUSTRIA
BELGIUM
DENMARK
FINLAND
FRANCE
GERMANY
GREECE
IRELAND
ITALY
LUXEMBURG
NETHERLANDS
PORTUGAL
SPAIN
SWEDEN
UNITED KINGDOM

AUSTRIA

Table 1: Preliminary data and information provided by Austria on carbon stock changes and areas related to Article 3.3 activities in Austria – Revision of data, July 2000

Article 3.3 Country specific data	Definitions	Accounting framework	a_I [5] (1000 ha)	ΔC_I [5] (kt C) + uptake - release	a_{II} [6] (1000 ha)	ΔC_{II} [6] (kt C) + uptake - release	a_{cp} [6] (1000 ha)	ΔC_{cp} [6] (kt C) + uptake - release	Methods and approaches	Data sources, data quality, and uncertainty	Other information relevant to decision-making
Afforestation Reforestation	IPCC	Activity based	88	483	103	936	238	1877	see below	see below	
		Land based	88	[3]	103	[3]	238	[3]			
Afforestation	FAO	Activity based	88	483	103	936	238	1877			
		Land based	88	[3]	103	[3]	238	[3]			
Reforestation	FAO	Activity based	66	295	110	771	253	1635			[2]
		Land based I	66	-7543	110	-12644	253	-6337			[2]
		Land based II	66	-77	110	-201	253	-115			[2]
Afforestation Reforestation	IPCC net[1]	Activity based	46	252	48	438	111	878			
		Land based	46	[3]	48	[3]	111	[3]			
Deforestation	IPPC/FAO	Activity based	42	-3957	55	-5227	127	-2900			
		Land based	42	[4]	55	[4]	127	[4]			
	IPCC net[1]	Activity based	0	0	0	0	0	0			
		Land based	0	0	0	0	0	0			
Sum of Afforestation Reforestation Deforestation	**IPCC**	**Activity based Land based**		**-3474**		**-4291**		**-1023**			
	FAO	**Activity based**		**-3179**		**-3520**		**612**			
		Land based I		**-11017**		**-16935**		**-7360**			
		Land based II		**-3551**		**-4492**		**-1138**			
	IPCC net[1]	**Activity based Land based**		**252**		**438**		**878**			

[1] IPCC definitions for ARD are used. However, af-, reforestation area is reduced by the deforestation area

[2] A comparison between the figures for reforestation according to the three FAO accounting scenarios clearly outlines the huge amount of released C due to harvest prior to reforestation, which is not accounted in the „FAO, activity based" and in the „FAO, land based II" scenarios.

[3] Figures would be approximately the same as the corresponding af-, reforestation figures for „IPCC, activity based" and „IPCC net, activity based", respectively

[4] Absolute amount of ΔC_{cp} would be approximately 3 % lower than the corresponding deforestation figure at „IPCC/FAO, activity based". The figures for forest increment prior to deforestation are highly dependent on the length of the period which is taken into consideration. Therefore estimates for the „land based" deforestation were only estimated for the first commitment period ($\Delta C_{cp.}$) but not for ΔC_I and ΔC_{II}

[5] estimates are based on the results of the forest inventory period 1992-96 (*1*)

[6] estimates are based on the mean of the results of the forest inventory periods 1986-90 and 1992-96 (*1,2*)

a_I Area (1000 ha) afforested and reforested, or deforested since 1990 up to 1995.

ΔC_I Carbon stock change (kt C) since 1990 up to the same year as used in a_I on land afforested, reforested and deforested.

a_{II} Area (1000 ha) afforested and reforested, or deforested since 1990 up to 1999.

ΔC_{II} Carbon stock change (kt C) since 1990 up to the same year as used in a_{II} on land afforested, reforested and deforested.

a_{cp} Projected area (1000 ha) afforested and reforested, or deforested since 1990 up to 2012.

ΔC_{cp} Projected carbon stock change (kt C) over the first commitment period on land afforested, reforested and deforested since 1990 up to 2012.

EXPLANATORY TEXT (table 1)

1.1 Definitions and accounting

a) Forest

"Forest land" according to the Austrian Forestry Act (*3*) is an area stocked by trees (a list of tree species in this context is given in an annex to the Austrian Forestry Act), if the stocking of trees represents an area of at least 1000 m^2 and is of an average width of at least 10 m. Forest areas, which are unstocked due to forest management practices (for instance harvesting areas or areas used for timber storage, skidding tracks or forest roads), are still referred to as "forest land" according to the Austrian Forestry Act.

Non-forest land and other wooded land according to the Austrian Forestry Act are

- areas which are not under forest management and which have a crown cover of less than 30%
- areas stocked by shrubs (except coppice stands and areas which have been identified as protective forests)
- rows of trees (except wind belts)
- short rotation plantations, for instance for fuelwood production (with a rotation period of less than 30 years)
- Christmas tree cultures, forest nurseries, plantations for seeds of forest trees or fruits.

The Austrian Forest Inventory (*1,2*) always used the same definitions as the forest act except the minimum area for forest with 500 m^2 instead of 1000 m^2. Therefore the data provided refer to the minimum area of 500 m^2.

b) Afforestation, reforestation and deforestation

The used definitions for ARD are rather similar to the ones of the „IPCC Scenario“ and „FAO Scenario“ given in the IPCC special report „Land Use, Land Use Change and Forestry“ (4) (Table 3-4, p. 142 ff.). However, the following slight differences or remarks need to be taken into consideration for a better understanding of the provided data:

- Afforestation and reforestation areas (according to IPCC definitions) and afforestion areas (according to FAO definitions) used for the calculation of the provided data include areas of artificial planting and natural afforestation/reforestation (e.g. due to abandonment of agricultural lands).
- Af-, reforestation according to IPCC definitions cannot be separated by the Austrian Forest Inventory. Both include land use change from other uses to forests. We therefore used the figures for af-, reforestation according to IPCC as figures for afforestation according to FAO definitions.
- The Austrian Forest Inventory uses a minimum area of 500 m^2 for accounting an area as forest. In addition, a minimum crown coverage of 30 % is necessary that the Austrian Forest Inventory accounts an area as afforested (according to FAO) or af-, reforested (according to IPCC). Less than 30 % crown coverage are necessary to account an area as deforested. However, deforestation according to the accounting rules of the Austrian Forest Inventory needs a land use change (or unsustainable forest management, eg no regeneration during a long period after harvesting or other losses of the stands). Although young stands may have a lower crown coverage they have been counted as af-, reforested area (IPCC, FAO) as long as the given number and distribution of trees of these stands is sufficient to reach 30 % crown coverage in a mature state.
- The used area for reforestation according to FAO corresponds to the areas of clear-fellings with a size of more than 500 m^2. Clear-felling according to the Austrian Forest Inventory means harvest of the whole forest stock (stemwood).

d) Accounting frameworks

- The used accounting frameworks for „activity based“, „land based I“ „land based II“ correspond to the options given in the IPCC special report „Land Use, Land Use Change and Forestry“ (*4*) (p 76ff., p. 147).
- „since 1990“ was understood as starting with 1.1.1990

- soil C increase at af-, reforested areas (IPCC) was assumed to be 2/3 in the first 20 years and 1/3 in the following 80 years; soil C decrease at deforested areas was assumed to be 2/3 in the first 20 years and 1/3 in 4000 years (*5,6*)
- only stemwood over bark was accounted as harvested biomass according to FAO reforestation (land based I); the remaining biomass (slash, woody debris, stumps and roots) were assumed to decompose within the first 20 years (2/3) and 4000 years (1/3), respectively (*5,6*)
- the C pools of the harvested biomass according to FAO reforestation (land based I) and the C pools of the deforested biomass were assumed to be released to the atmosphere in the year of harvest and deforestation, respectively (*6*)

1.2 Carbon pools included

Above- and below-ground biomass, litter and woody debris, soil carbon, harvested materials

1.3 Stratification (detailed description will be given in *7*)

The estimates are based on the following stratifications or biome values:

- consideration of the altitudinal shares within the increase of the Austrian forest area (*8*)
- consideration of the shares of management types (e.g. forest within yield, protective forest within yield, protective forest without yield) within the increase of the Austrian forest area (*8*)
- differentiation of C uptake per year and ha according to type, altitude and age of forest (af-, reforestation)
- use of age specific increments and conversion factors
- use of the mean C harvest/ha (only stemwood over bark - see 1.1.c) of the Austrian forest areas with clear-fellings of a size of more than 500 m^2 (*1,2*) as C harvest/ha in reforested areas according to FAO (land based I)
- use of the mean biomass C stock/ha of the Austrian forests (*1,2*) as „deforested" biomass C stock/ha
- use of stratified conversion factors according to the species composition of the recent 1st age class of the Austrian forests within yield and protective forests without yield (af-, reforestation), according to the species composition of the harvested biomass of the Austrian forests (reforestation FAO, land based I) and according to the species composition of the mean biomass C stock/ha of the Austrian forests (deforestation), (*1,2*)
- use of biome specific soil C stocks/ha for forests, grassland and arable land (*7*)

1.4 Methodologies and data (detailed description will be given in *7*)

a) Data bases of the estimates

Biomass (increment, harvest, deforested biomass):

- a_I, ΔC_I: Austrian Forest Inventory 1992-96 (*1*); the calculations of the conversion factors are based on a comprehensive literature survey (*7*)
- a_{II}, ΔC_{II}, a_{cp}, ΔC_{cp}: means of Austrian Forest Inventories 1986-90 and 1992-96 (*1,2*); the calculations of the conversion factors are based on a comprehensive literature survey (*7*)

Soil:

- Austrian soil inventories (*9-17*)

c) Sampling techniques

Austrian Forest Inventory (*1,2*):

- Field assessment
- Distance of cluster samples: 4 x 4 km grid
- One cluster unit contains four sample plots, each with a size of 300 m^2

Soil inventories:

- Austrian Forest Soil Inventory: 8.7 x 8.7 km grid (*9*)
- Agricultural Soil Inventories by the Federal Provinces of Austria: various grid sizes (*10-16*)

d) Models and key parameters

No models other than typical Forest Inventory Models (e.g. height models, models for volume) were used

Key parameters were derived and stratified according to 1.3):

- Af-, reforestation (IPCC)
  Mean annual increment (m^3 stemwood o.b./ha) according to inventory periods 86/90, 92/96:
  - 1^{st} age class (0-20): 2.6
  - 2^{nd} age class (21-40): 9.4
  - 3^{rd} age class (41-60): 12.3
- Reforestation (FAO):
  Mean annual increment (m^3 stemwood o.b./ha) according to inventory periods 86/90, 92/96:
  - 1^{st} age class (0-20): 3.2
  - 2^{nd} age class (21-40): 11.7
  - 3^{rd} age class (41-60): 15.4
- Mean conversion factors for increment „stemwood m^3 o.b. → whole tree t C“
  - 1^{st} age class (0-20): 0.39
  - 2^{nd} age class (21-40): 0.32
  - 3^{rd} age class (41-60): 0.30
- Mean annual harvest at FAO (land based I) reforestation areas according to inventory periods 86/90, 92/96
  549 m^3 stemwood o.b./ha
- Mean conversion factor for harvest „stemwood m^3 o.b. → whole tree t C“
  0.29
- Deforestation:
  Mean annual deforested biomass according to inventory periods 86/90, 92/96
  294 m^3 stemwood o.b./ha
- Mean conversion factor for deforested biomass „stemwood m^3 o.b. → whole tree t C“
  0.31
- Used projected equilibrium soil C pools (up to 50 cm depth) for ARD areas:

forest	121 t C/ha
grassland int.	87 t C/ha
grassland ext.	120 t C/ha
arable land	71 t C/ha
alpine land	90 t C/ha
other uses	80 t C/ha
sealed land	0 t C/ha

e) Uncertainties

- ARD areas according to IPCC definitions for the period 1990 up to 1995 (a_I) are based on the Austrian Forest Inventory 1992-96 (*1,8*) and therefore rather certain
- However, areas of ARD according to IPCC definitions varied considerably in the periods 1986-90 and 1992-96 (86/90: AR = 6000 ha/a, D = 4000 ha/a; 92/96: AR = 14667 ha/a, D = 7000 ha/a) (*2,8*). It is therefore rather uncertain that the increase in areas of ARD in 2008-2012 (and in the period from 1990 to 2008) will look like the same as the annual mean of the periods 1986-1990 and 1992-1996 which was used for the estimates of a_{II}, ΔC_{II}, a_{cp} and ΔC_{cp}. Therefore the projections beyond 1995 are highly uncertain.
- Values for increment, harvest and deforested biomass and derived conversion factors are not based on measured data from the ARD areas but estimated from Austrian biome specific values or further stratified estimates according to the results of the Austrian Forest Inventory (see 1.3).
- The same is true for the used soil C pools. In addition, the present Austrian soil inventories measured only concentrations of the soil organic C, which means that these values need to be converted to soil C pools by using conversion factors where the amount of coarse material (> 2 mm) and the soil densities are taken into consideration. These parameters were not measured but estimated (*9,18*). The former land uses of the AR areas as well as the land uses past deforestation

were roughly estimated according to probabilities derived from the locations of the ARD areas and other statistics (*7,8,21*). For these reasons the used data on the soil C pools and their changes over time at the ARD areas are highly uncertain.

- Trees with a diameter at breast height smaller than 5 cm are not included in the measurements of the Austrian forest inventory. Therefore, the increment of the 1st age class (0-20) is underestimated by the Austrian Forest Inventory.

1.5 Treatment of non-CO2 greenhouse gases

- not treated

1.6 Methods and key assumptions in projections for the first commitment period (2008-2012) and discussion, if possible, of trends beyond the first commitment period

Key assumptions:
It has been assumed that the mean annual increase in ARD areas from 1990 up to 2008 and beyond will be the same as the mean annual increase in ARD areas according to the results of the Austrian Forest Inventory in the periods 1986-90 and 1992-96. The same assumption was taken for increment, harvest and deforested biomass.

Table 2: Preliminary data and information provided by Austria on carbon stocks and area estimates (First sentence of Article 3.4), (7,19)

	Area (1000 ha)	Carbon stock in 1990 (Mt C)	
		living biomass (above and below ground, annual means)	soil (50 cm depth)
Forest lands	3893	323 ± 42	459 ± 184 [a]
Agriculture lands	1502	5	87 ± 38 [a]
Rangelands/grasslands	1993	4	194 ± 85 [a]
Wetland/tundra	0	0	0
Other	998	2	52
Total (as listed above)	8386	334 ± 42 [b]	792 ± 209 [c]

[a] Preliminary estimates of the uncertainty
[b] The uncertainty of the total was calculated by assuming a relative uncertainty of 20 % for the land categories „Agriculture lands“ and „Grasslands“ and of 70 % for the category „Other“
[c] The uncertainty of the total was calculated by assuming a relative uncertainty of 70 % for the land category „Other“

EXPLANATORY TEXT (table 2)

2.1 Description of land categories, including any land categories not covered

All Austrian land categories are covered by the figures in table 2
„Forest lands“ corresponds to the definition given in 1.1.a) above, which is rather similar to the FAO definition.
„Agriculture lands“ include lands which are used for crop and cereal production and gardenland (e.g. wineyards, orchards etc.)
„Grasslands“ includes agricultural used grasslands, agricultural used alpine pastures and no more used agricultural grasslands, which have not been converted to other uses
„Other“ includes alpine unused areas with undisturbed vegetation which do not belong to the category „Forest lands“, sealed land for buildings, land for traffic infrastructure, glaciers and rocks, surface waters etc.

2.2 Carbon pools – distinctions and assumptions

The biomass figures for all land use categories represent annual means. For instance, for annual agricultural plants 50 % of the peak biomass at harvest time was taken for the calculations.
The C pools of „sealed land“ and „glaciers and rocks“ were estimated to be 0.
5 % of the land for traffic infrastructure were assumed to be inhabited by vegetation and therefore assumed to have C-pools in biomass and soil.
C pools in the sediments of surface waters were not estimated and are not included in the figures of the land category „Other“.

2.3 Data sources

„Forest lands“: Austrian Forest Inventories 1986/90, 1992/96 (1,2); Austrian Forest Soil Inventory (9); various literature data for the conversion factors for measured biomass to C-pools and the conversion of the measured concentrations of soil organic C to C-pools (7)
„Agricultural lands“: National statistics on the land use in Austria and biomass of agricultural lands (20,21); Agricultural Soil Inventories of several Austrian Federal Provinces (10-17) were the basis for the estimation of the soil C pools in the total agricultural lands of Austria (18); various literature data for the conversion factors for biomass to C-pools and for the conversion of the measured concentrations of soil organic C to C-pools (18,19)
„Grasslands“: National statistics on the land use in Austria and biomass of agricultural lands (20,21); Agricultural Soil Inventories of several Austrian Federal Provinces (10-17) were the basis for the estimation of the soil C pools in the total grasslands of Austria (18); various literature data for the conversion factors for biomass to C-pools and for the conversion of the measured concentrations of soil organic C to C-pools (18,19)
„Other“: National statistics on the land use in Austria (20,21); various literature data for the estimates of the C-pools in biomass and soil (18,19)

2.4 Methods (detailed descriptions will be given in 7,19)

Aboveground biomass (m^3 stemwood over bark, t dry matter of harvested agricultural biomass etc.) was converted to t C of total above- and below-ground biomass by using expansion and conversion factors. The biomass figures for annual plants correspond to annual means (see 2.2).
Measured concentrations of soil organic C were converted to C-pools by using soil specific conversion factors, where estimated amounts of coarse material (> 2 mm) and soil densities were taken into consideration. For more details see 2.6.

2.5 Possible changes in carbon stocks

„Forest lands“ represent the most important biomass C-stock in Austria. This C-stock increased steadily in the period 1960 to 1996 (7). In addition, the area of „Forest lands“ increased considerably from 1960 to 1996 (1,2). In the period 1990 to 1996 the biomass of the Austrian „forest lands“ (sector 5.A, „Changes in forests and other woody biomass stocks“) was each year a net annual C-sink between 1.47 ±1.01 Mio. t C and 3.68 ±1.05 Mio. t C (mean: 2.37 Mio. t C) (7).
Repetitions of the soil inventories were not undertaken so far. Therefore, the trends of the Austrian soil C-stocks are unknown.

2.6 Uncertainties

The biomass C stocks of the categories „Forest Lands“, „Agriculture lands“ and „Grasslands“ are based on statistical data. Therefore, the methodological uncertainties of these C-pools are quite low (below 20 %, table 2). For instance, most of the uncertainty of the biomass C stock of „Forest lands“ is attributable to the uncertainties of the conversion factors (7).
The soil C stocks are based on data from Austrian soil inventories. The whole Austrian forest area is covered by the Austrian Forest Soil Inventory (8.7 x 8.7 km grid) (9). The figures for the C-pools in „Agricultural lands“ and „Grasslands“ are based on the data of the Agricultural Soil Inventories, which are available for most of the Austrian Federal Provinces (various grid sizes below 4 x 4 km) (10-17). For Federal Provinces, where data from Agricultural Soil Inventories were not available, estimates had to be done. In addition, all soil inventories measured the concentrations of soil organic C. These values had to be converted to C-pools by using estimates for the fractions of coarse material

(> 2 mm) and estimates for the soil densities (7,18). Most of the soil inventories do not correspond to the year 1990, but to years immediately before or after 1990. For these reasons the estimates of the soil C-pools have a comparable higher uncertainty (see table 2).
Data availability for the category „Other“ is less comprehensive. Therefore, the uncertainty of the figures of this category is considerable higher.

References

1 FBVA 1997: Waldinventur 1992/96. CD-Rom, Federal Forest Research Institute, Wien.

2 SCHIELER K., BÜCHSENMEISTER R. and SCHADAUER K. 1995: Österreichische Forstinventur – Ergebnisse 1986/90. Bericht 92, Federal Forest Research Institute, Wien.

3 Federal Legal Gazette no. 440/1975, as amended Federal Legal Gazette 231/1977, 142/1978 and 576/1987

4 IPCC 2000: Land use, land use change and forestry. Cambridge University Press, Cambridge.

5 PERRUCHOUD D., JOOS F., FISCHLIN A., HAJDAS I. and BONANI G. 1999: Evaluating timescales of carbon turnover in temperate forest soils with radiocarbon data. Global Biogeochem. Cycles 13 (2), 555-573.

6 IPCC 1997: Revised 1996 IPCC guidelines for national greenhouse gas inventories. Vol. 1: Reporting Instructions, Vol. 2: Workbook, Vol. 3: Reference Manual. Intergovernmental Panel on Climate Change, Geneva.

7 WEISS P., SCHIELER K., SCHADAUER K., RADUNSKY K. and ENGLISCH M. 2000: Die Kohlenstoffbilanz des österreichischen Waldes und Betrachtungen zu Artikel 3.3 des Kyoto-Protokolls. Federal Environment Agency and Federal Forest Research Institute, Report of the Federal Environment Agency, Wien, in press.

8 RUSS W. 1997: Waldfläche wächst weiter – Tendenz zu mehr Laubholz. In: Waldinventur 1992/96. Supplement to Österreichische Forstzeitung 12/1997, 4-6.

9 FBVA 1992: Österreichische Waldbodenzustandsinventur. Mitteilungen der Forstlichen Bundesversuchsanstalt, Bd. 168/I, Bd. 168/II, Federal Forest Research Institute, Wien.

10 AMT DER BURGENLÄNDISCHEN LANDESREGIERUNG 1996: Bodenzustandsinventur Burgenland. Amt der Burgenländischen Landesregierung, Eisenstadt.

11 AMT DER KÄRNTNER LANDESREGIERUNG 1999: Kärntner Bodenzustandsinventur. Amt der Kärntner Landesregierung, Klagenfurt.

12 AMT DER NIEDERÖSTERREICHISCHEN LANDESREGIERUNG 1994. Bodenzustandsinventur Niederösterreich. Amt der Niederösterreichischen Landesregierung, St. Pölten.

13 AMT DER OBERÖSTERREICHISCHEN LANDESREGIERUNG 1993: Oberösterreichischer Bodenkataster – Bodenzustandsinventur 1993. Amt der Oberösterreichischen Landesregierung, Linz.

14 AMT DER SALZBURGER LANDESREGIERUNG 1993: Salzburger Bodenzustandsinventur. Amt der Salzburger Landesregierung, Salzburg.

15 AMT DER STEIERMÄRKISCHEN LANDESREGIERUNG XXXX. Steiermärkische Bodenschutzberichte 1988-1996. Amt der Steiermärkischen Landesregierung, Graz.

16 AMT DER TIROLER LANDESREGIERUNG 1988: Bericht über den Zustand der Tiroler Böden. Amt der Tiroler Landesregierung, Innsbruck.

17 SCHWARZ S., SCHREIER I., HUBER S., TULIPAN M., GAMPER G., NAGY W. und ACKERL W. 2000: BORIS – Boden-Rechnergestütztes Informationssystem. Homepage: www.ubavie.gv.at, Federal Environment Agency, Wien.

18 STREBL F. and GERZABEK M.H. 2000: pers. Comm. to the figures of the C-pools in the agricultural soils of Austria which were calculated within the project „Austrian Carbon Balance Model„. Austrian Research Centre Seibersdorf.

19 ORTHOFER R. 2000: pers. Comm. to the figures of the C-pools in all Austrian land-use sectors other than forests, which were calculated within the project „Austrian Carbon Balance Model„. Austrian Research Centre Seibersdorf.

20 ÖSTAT, UMWELTBUNDESAMT 1994: Umwelt in Österreich – Daten und Trends 1994. Österreichisches Statistisches Zentralamt Wien und Umweltbundesamt Wien.

21 BMLF XXXX: Grüner Bericht. Annually published by the Federal Ministry of Agriculture, Forestry, Environment and Water Management, Wien.

DENMARK

Table I Preliminary data and information provided by Denmark on carbon stock changes and areas related to article 3.3 activities

Article 3.3 Country specific data	Definitions	Accounting framework	a_I(ha) (1995)	ΔC_I (1000 tC)	A_{II}(ha) (1999)	ΔC_{II} (1000 tC)	a_{cp}(ha) (2012)	ΔC_{cp} (1000 tC)	Methods and approaches	Data sources, data quality, and uncertainty (e.g. ranges)	Other information relevant to decision-making
Afforestation/ Reforestation[1)]	**IPCC**	**Activity based**	**10007**	**12**	**21346**	**58**	**52678**	**474**			
		Land based	**10007**	**12**	**21346**	**58**	**52678**	**474**			
Afforestation	**FAO**	**Activity based**	**10007**	**12**	**21346**	**58**	**52678**	**474**	**See below**	**See below**	**See below**
		Land based	**10007**	**12**	**21346**	**58**	**52678**	**474**			
Reforestation	**FAO**	**Activity based**	**8200**	**8**	**13800**	**44**	**31700**	**301**			
		Land based I	**8200**	**-368**	**13800**	**-838**	**31700**	**-669**			
		Land based II	**8200**	**-93**	**13800**	**-254**	**31700**	**-185**			
Deforestation[2)]	**IPCC/FAO**	**Activity based**	**0**	**0**	**0**	**0**	**0**	**0**			
		Land based	**0**	**0**	**0**	**0**	**0**	**0**			
Sum of	IPCC	**Activity based**		**12**		**58**		**474**			
Afforestation		**Land based**		**12**		**58**		**474**			
Reforestation and Deforestation	**FAO**	**Activity based**		**20**		**102**		**775**			
		Land based I		**-356**		**-780**		**-195**			
		Land based II		**-81**		**-196**		**289**			

[1)] It is not possible to separate the Danish afforestation area according to IPCC's definitions on afforestation and reforestation. Most of the afforestation area fulfil the requirements for IPCC's definition of afforestation (see explanatory text). Forest products were included in the estimate of C sequestration. There is made no distinction between activity based and land based accounting for afforestation

[2)] Deforestation is not considered to occur at a significant scale (see explanatory text).

a_I : Area (ha) afforested and reforested, or deforested since 1990 up to 1995 or possibly an earlier specific year.
ΔC_I : Carbon stock change (1000 t C) since 1990 up to the same year as used in a_I on land afforested, reforested, and deforested.
a_{II} : Area (ha) afforested and reforested, or deforested since 1990 up to 1999 or an earlier specific year.
ΔC_{II} : Carbon stock change (1000 t C) since 1990 up to the same year as used in a_{II} on land afforested, reforested, and deforested.
a_{cp}: Projected area (ha) afforested and reforested, or deforested since 1990 up to 2012.
ΔC_{cp}: Projected carbon stock change (1000 t C) over the first commitment period (2008-2012) on land afforested, reforested, and deforested since 1990 up to 2012.

EXPLANATORY TEXT (Table I):

1a) Forest definition:
The definition of forest in Denmark is as follows (Statistics Denmark 1994): 1) areas supporting a stand that now or later may produce wood or other forest products, and 2) fields planted to Christmas trees and greenery (max. 10% of the area of each forest district). Orchards, parkland, willow scrub, windbreaks etc. are not included in the forest area.

1b) Definitions and accounting of afforestation, reforestation and deforestation

Afforestation/Reforestation IPCC: It is not possible to separate the Danish afforestation area according to IPCC's definitions on afforestation and reforestation. Most of the afforestation land fulfil the requirements for IPCC's definition of afforestation, as they were cleared of forest 800-1240 A.D. and used continuously for agriculture since then (Nature of Denmark, 1980). Practically no forest clearings have taken place in Denmark during the last 200 years, in fact there has been a significant increase in forest area from about 2% in 1805 to the present 11%.

In 1989 the Danish Government decided on a plan to double the forested area within a tree generation (approximately 80-90 years) (the National Forest and Nature Agency 2000). In order to achieve this target, an afforestation rate of ca. 5000 ha/yr is needed. Afforestation is carried out on soils formerly used for agriculture (cropland). Except for 1999, the afforestation rate has been lower than required (about 2000 ha/yr), and the sum of governmental and private afforestation (National Forest and Nature Agency 2000) was used in calculations (see below). During the period 2000-2003 private afforestation is subsidised, and an afforestation rate of 3300 ha/yr is expected. At present there is no knowledge of specific incentives for private afforestation beyond 2003. Consequently, a decrease in afforestation rate to 2000 ha/yr is assumed for the period 2004-2012. This was the afforestation rate prior to subsidisation of private afforestation and may result in underestimation of C sequestration resulting from afforestation if afforestation rates prove to remain high.

Afforestation FAO: Artificial establishment of forest on lands that did not carry forest within living memory. This definition applies to the total Danish afforestation area.

Reforestation FAO: Artificial establishment of forest on lands that carried forest before, i.e. planting following clearcutting.

Activity based, Land based I, and Land based II have been used according to definitions in the IPCC Special reports p. 131.

Deforestation IPCC/FAO: Conversion of forest to non-forest. Deforestation is not considered to occur in Denmark to any significant extent. As the forest cover area is quite limited at present, activities like road construction very seldom result in significant deforestation of forest areas.

1c) Accounting approach:
Full carbon accounting is used for all three approaches (Activity based, Land based I, and Land based II) in a manner by which C-stock changes are based on area multiplied by uptake. Uptake is based on a simple carbon storage model based on the Danish yield tables for Norway spruce (representing conifers) and oak (representing broadleaves) (Møller 1933). Wood volumes are converted into carbon stores by a general expansion factor (2) and conversion factors of 0.19 t C/m^3 for conifers and 0.29 t C/m^3 for broadleaves. Decomposition rates for the various slash components and turnover rates for various wood products are included in the model (for more information see Danish Energy Agency (2000)).
Period 1990-1995: 6 years
Period 1990-1999: 10 years
Period 1990-2012: 23 years, but the reported carbon stock changes are only for the first commitment period i.e. 2008-2012: 5 years.

2) Carbon pools included
The following carbon pools were included for re- and afforestation: whole tree biomass (including roots), slash, and wood products. Based on chronosequence studies of soils in afforested stands (Vesterdal et al., in prep.), no significant changes in soil organic matter was expected to take place over the short time spans reported here.

3) Stratification
The yield tables behind calculation of carbon stores are for yield class 2 (on a scale decreasing from 1 to 4). For afforestation areas, a ratio between conifers and broadleaves of 1:3 was assumed, while all calculations for regeneration were done using Norway spruce as the model tree species. For the future periods simple assumptions were made regarding the re-growth rates times area per age class. We did not distinguish between forest growth rates (and soil carbon losses) on former cropland and former forest land or between different soil types.

4) Methodologies and data:
Afforestation land: The areas for 1990-1999 were obtained from the National Forest and Nature Agency (2000). For 2000-2003 an afforestation rate of 3300 ha/yr was applied, and for 2004-2012 a rate of 2000 ha/yr was applied based on the current and future incentives for private afforestation.

Reforestation land: It was only possible to obtain values for reforestation areas (clearcutting and replanting) from the Danish state forests. The current practice of final felling and replanting or seeding was carried out on 460 ha per year in average during the period 1990-1999 in the state forests (data from the National Forest and Nature Agency). The state-owned forest area makes up 1/3 of the Danish forest area, and when assuming the same frequency of regeneration for the total forest area the annual regeneration area was 1380 ha. For the period 1990-1995, this gives a total area of 1380*6 = 8260 ha. This estimate was rounded off to 8300 ha. It was assumed that the same rate could be applied to the period 1999 to 2012. This gives a total area of reforestation for the period 1990-2012 of approximately 31700 ha.

Models and key parameters

Afforestation IPCC and FAO
No distinction was made between activity based and land based accounting, as we have no reason to believe that the cropland soils will decrease significantly in total C storage following afforestation (Vesterdal et al., in prep.). The annual CO_2 fluxes of the model trees oak and spruce is shown over 140 years in Fig. 1.

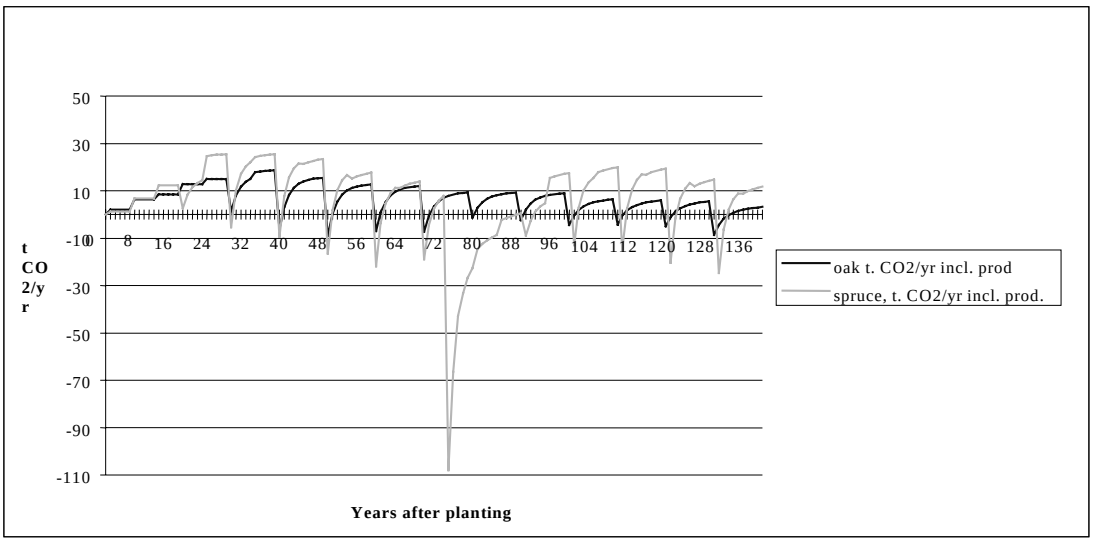

Figure 1. Annual CO_2 flux over two spruce rotations and one oak rotation in Denmark.

These models were the basis for the carbon storage model used for calculating the C storage in afforested stands during the three periods 1990-1995, 1990-1999 and 2008-2012. The carbon storage in successive generations of afforestation areas are summed up to give the cumulated carbon storage over a certain period.

Reforestation FAO Activity based: The carbon storage model for afforestation (Danish Energy Agency 2000) was used to calculate carbon sequestration in trees planted on harvested forest areas. The carbon storage in successive generations of reforestation areas are summed up to give the cumulated carbon storage over a certain period.

Reforestation FAO Land based I: The full forest harvest and decomposing slash is included in the calculation of C storage following reforestation.

Reforestation FAO land based II: Accounting from the start of activity, but from then on decaying slash is taken into account. The carbon storage model is run from the beginning of a new planting, i.e. without including the C stock in wood of the former stand but including the release of carbon from decaying slash.

5) Uncertainties
Main uncertainties are in assumptions for area estimates (e.g. for afforestation areas), and averaging of growth rates for the whole of Denmark. Use of the same growth rates for former arable land and for harvested forest sites may have introduced an overestimation of C storage by reforestation (FAO). The use of spruce as a model tree species for calculation of reforestation is a simplification as many clearcuts are also planted with deciduous species.

Table II – Preliminary data and information provided by Annex I Party on carbon stocks and area estimates
(First sentence of Article 3.4)

Land system	**Area (ha) 1990**	**Carbon stock in 1990 (t C)**
Forest lands	417.000	77.700.000
Agriculture lands	2.788.000	
Rangelands/grasslands		
Wetland/tundra		
Other		
Total (as listed above)		

EXPLANATORY TEXT (Table II)

1) Description of land categories, including any land categories not covered.

Table A

Land system	Definition	Source	Anticipated change 1999 and 2012	C-stock
Forest lands	1) Areas supporting a stand that now or later may produce wood or other forest products. 2) Fields planted to Christmas trees and greenery (max. 10% of the area of each forest district).4 3) Orchards, parkland, willow scrub, windbreaks etc. are not included in the forest area.	Forests 1990, Statistics Denmark 1994.	Area will increase by appr. 3000 ha per year because of afforestation. Average growing stock per ha in existing forest may increase as well, partly because of more use of natural regeneration	On average 25 t C/ha of total biomass (including clearcuts and aggrading stands) + 125 t C/ha in SOM (including forest floors, Vejre et al., in prep.)
Agriculture lands				

2) Carbon pools - distinctions and assumptions.

O-hor 25 tC/ha
Total 125 tC/ha

The estimates of carbon stocks in forest vegetation (whole tree biomass) are based on conversions of forest inventory (stemwood volume) data (Statistics Denmark 1994) to whole tree carbon. For the conversions, Danish conversion factors (see Danish Energy Agency 2000) and IPCC reporting guidelines are used. For forest soil carbon, a selection of Danish forest soils (n= 106) were analysed. Profile descriptions were used to assess organic carbon content to 1 m depth (Vejre et al., in prep.).

3) Data sources. Inventories published by Statistics Denmark (1994) for standing volume in 1990. The soil carbon estimate to 1 m depth is based on a synthesis of C stores in Danish forest soils (Vejre et al., in prep.).

4) Methods.
The estimates for the size of the carbon stocks in forest vegetation are based on conversion factors used to convert stemwood volume into whole-tree carbon stores for conifers and broadleaves (Danish Energy Agency 2000).

5) Possible changes in carbon stocks.
Possible changes in carbon stocks would be largely based on changes in areas due to afforestation of arable land and less based on changes in carbon content from changes in land use. At present it is not possible to give management-specific estimates on carbon stores in forest (e.g. resulting from different tree species, silvicultural systems and soil drainage classes). It is possible that less maintenance of ditches and more use of silvicultural systems with continuous forest cover (increased use of natural regeneration) will increase carbon contents in forest ecosystems.

6) Uncertainties.

The forest area in the existing forest inventory is most probably underestimated. The forest inventories in Denmark has been based on questionnaires to forest owners, and small forest estates are often not included in the inventory. It is currently planned that the next forest inventories be sample-based.

The soil carbon estimates may be slightly biased toward sandy soils resulting in a slight overestimation of soil carbon stores.

References

Danish Energy Agency 2000. Projections of Emissions of Greenhouse Gases, Ozone Precursors and Sulphur Dioxide from Danish Sources until 2012. Ministry of Environment and Energy, Danish Energy Agency. May be obtained from: http://www.ens.dk/uk/publica.htm

Danmarks Natur. Bind 6. Skovene. Politikens Forlag, 1969. [The Nature of Denmark. Vol. 6, The Forests. Politiken, Denmark, 1980.

Møller, C.M. 1933. Bonitetsvise tilvækstoversigter for Bøg, Eg og Rødgran i Danmark. [Yield tables for different site classes of beech, oak and Norway spruce in Denmark]. Dansk Skovforenings Tidsskrift 18.

National Forest and Nature Agency 2000. Evaluering af den gennemførte skovrejsning 1989-1998. Miljø- og Energiministeriet, Skov- og Naturstyrelsen, 2000. [Evaluation of afforestation areas 1989-1998. Ministry of Environment and Energy, National Forest and Nature Agency, 2000.] ISBN: 87-7279-241-8

Statistics Denmark, 1994. Forests 1990. ISBN 87-501-0887-5

Vejre, H., Callesen, I., Vesterdal, L., Raulund-Rasmussen, K. (in prep.). Organic carbon and nitrogen in Danish forest soils – contents and distribution as influenced by soil type. Manuscript for Geoderma

Vesterdal , L., Ritter, E., Gundersen, P. (in prep.). Change in soil organic carbon following afforestation of former arable land. Manuscript for Forest Ecology and Management.

FINLAND

PRELIMINARY COUNTRY-SPECIFIC DATA AND INFORMATION PROVIDED BY FINLAND

Table I - Preliminary data and information provided by Finland on carbon stock changes and areas related to Article 3.3 activities.

Article 3.3 Country specific data	Definitions	Accounting framework	a_I (ha) 1990-1995	ΔC_I (Gg C) 1990-1995	a_{II} (ha) 1990-1998	ΔC_{II} (Gg C) 1990-1998	a_{cp} (ha) 1990-2012	ΔC_{cp} (Gg C) 2008-2012	Methods and approaches	Data sources, data quality, and uncertainty (e.g. ranges)	Other information relevant to decision-making
Afforestation	IPCC	Activity based	66 700	165	92 200	380	142 700	610	See explanatory text below	See explanatory text below	
Reforestation		Land based									
Afforestation	FAO	Activity based	66 700	165	92 200	380	142 700	610			
		Land based									
Reforestation	FAO	Activity based	951 000	1640	1 485 000	4220	4 285 000	14 000			
		Land based									
Deforestation	IPCC/FAO	Activity based Option 1. [1] Option 2.	72 900 90 000	- 2330 - 2880	93 300 135 000	- 2990 - 4320	233 000 345 000	- 1600 - 2400			
		Land based									
	Other	Activity based									
		Land based									

a_I Area (ha) afforested and reforested, or deforested since 1990 up to 1995.
$_\Delta C_I$ Carbon stock change (t C) since 1990 up to 1995 on land afforested, reforested, and deforested.
a_{II} Area (ha) afforested and reforested, or deforested since 1990 up to 1998.
$_\Delta C_{II}$ Carbon stock change (t C) since 1990 up to 1998 on land afforested, reforested, and deforested.
a_{cp} Projected area (ha) afforested and reforested, or deforested since 1990 up to 2012.
$_\Delta C_{cp}$ Projected carbon stock change (t C) over the first commitment period on land afforested, reforested, and deforested since 1990 up to 2012 (i.e. changes in carbon stocks 1 Jan. 2008 - 31 Dec. 2012).

EXPLANATORY TEXT (table I)

1. Definitions and accounting:

a) Forest:

See explanatory text of Table II, point 1. In this assessment (afforestation, reforestation and deforestation) the Finnish classification for forest is used and it is assumed that it corresponds also with FAO definition of forest (10% canopy cover).

[1] Option 1 for deforestation: Area information 1990-1998 is registered by Statistics Finland, since 2000 onwards, projected deforestation is 10 000 ha/a.
Option 2 for deforestation: Estimates are based on the previous Finnish National Forest Inventory, provided that previous deforestation rate 15 000 ha/a would continue.

b) Afforestation, reforestation, and deforestation:

Definitions of FAO and IPCC on afforestation , reforestation and deforestation are used in this assessment. It is assumed that IPCC's afforestation and reforestation equals to afforestation of FAO. For deforestation, it is assumed that deforestation is same for both IPCC and FAO definition.

In case that afforestation/reforestation of abandoned lands (subject to decision of a landowner) is included, an expert judgement is that approximately 3000 ha/a will be converted into forests annually. During 1990-2012 approximately 69 000 ha would be converted, provided that carbon uptake is 0,3 MgC/ha/a, it would result approximately 90 Gg C during 2008-2012.

c) Accounting approaches:

Estimations are done on the activity-based approach.

2. Carbon pools included (e.g. above ground biomass, litter and woody debris, below- ground biomass, soil carbon, and harvested materials):

Carbon pools include the whole biomass of trees including stem, branches, leaves and roots. Whole biomass carbon pools could be divided into above and below ground. Soil carbon is not included in this assessment. In particular, changes in soil carbon stocks due to deforestation are impossible to trace with present methodologies.

3. Stratification (e.g. biomes and regions);

This submission covers the total forest area of Finland including different types of forests.

4. Methodologies and data:

a) Data sources:

For the purposes of the Art. 3.3 of Kyoto Protocol, there is not yet an operational inventory and reporting system in Finland. For this assessment, data has been collected from various sources with the assistance of a number of experts. Specific calculations for projections of FAO/reforestation were carried out on the basis of Finnish National Forest Programme.

b) Sampling techniques:

Description of forest related sampling techniques, on models and key parameters is available e.g. in http://www.metla.fi/ and in the Finnish Statistical Yearbook of Forestry (Finnish Forest Research Institute, 1999).

c) Models and key parameters:

Key assumptions[2] for area, carbon uptake and release:

- Afforestation: Data on area 1990-1999 registered, from 2000-2012 projected. Average carbon uptake during the first 20 year assumed to be 0,925 MgC/ha/a (2,4 m^{3}/ha)

[2] Mäkipää & Tomppo 1998. Ilmastosopimuksen Kioton pöytäkirjan nielukysymysten taustaselvitys. Finnish Forest Research Institute. See also Ministry of Agriculture and Forestry, 2000. Forests in the UN Framework Convention on Climate Change and Kioto Protocol as well as Granholm 1998. Estimated implications of the Kyoto Protocol Art. 3.3 to Finland. Presentation at the UNFCCC/SBSTA Workshop on land-use, land-use change and forestry, Rome 24-25 September 1998.

- Afforestation/reforestation of abandoned land: Data on area is based on expert judgement. Average carbon uptake is assumed to be 0,30 MgC/ha/a

- Reforestation/regeneration (FAO/reforestation): Data on area 1990-1998 is registered, from 1999 onwards projected according to the Finnish National Forest Programme. Average carbon uptake during the first 20 years assumed to be 0,76 MgC/ha/a

- Deforestation: Area estimates vary between data sources available. Option 1 for deforestation provides slightly smaller area estimates for deforestation (since 2000 onwards 10 000 ha/a) than option 2 (15 000 ha/a). Estimates on higher area estimates are based on the previous Finnish National Forest Inventory, on an assumption that previous deforestation rate 15 000 ha/a would continue during the commitment period. An average biomass (stem, branches, leaves and roots in the Finnish forest land is 32 MgC/ha/a (92 $m^{3/}$ha. For the particular estimation purposes emissions caused by deforestation are assumed to take place in a particular year.

d) Uncertainties:

- Afforestation: An expert estimation is that the error margin on land area estimate is ± 5% at the national level. In practice it cannot be improved much more without a substantial increase in resources and costs. There is not yet a system for monitoring changes in carbon stocks in afforested areas.

- Reforestation/regeneration: An expert estimation is that error margin at the national level on land area estimate is also approximately ± 5% and for each reforestation/regeneration project approximately ±10%. There is not yet a system for monitoring changes in carbon stocks in these areas.

- Deforestation: Data on forest and forestry land area are very precise (error ±0.5%) but the estimate for the rate of deforestation is less precise (about ±7%). %. There is not yet a system for monitoring changes in carbon stocks in areas deforested.

5. Treatment of non- CO 2 greenhouse gases.

Article 3.3 defines the carbon stocks to be measured. Other greenhouse gases are not included in this assessment.

6. Methods and key assumptions in projections for the first commitment period (2008– 2012) and discussion, if possible, of trends beyond the first commitment period.

See point 4(c) above.

Table II - Preliminary data and information provided by Finland on carbon stocks and area estimates (First sentence of Article 3.4).

Land system	**Area (mill. ha) in 1990**	**Carbon stock in 1990 (Tg C)**
Forestry land: - Forest land - Scrub land - Waste land - Other forestry lands; roads, depots etc.	**26,3** 20,0 3,0 3,1 0,2	**6530** (different estimates vary between 6200 - 7700) * in trees 660 Tg C * in surface vegetation 30 Tg C * in forest soil 1040 Tg C * in peatland layers[3] 4800 Tg C
Agriculture lands	**3,0**	not available (n.a.)
Rangelands/grasslands	-	-
Wetland/tundra	included in above	included in above
Other - Built-up land - Unclassified - Other spatially not specified * wood products[4] * wood products in landfills	**1,2** 0,94 0,29	n.a. n.a. n.a. 10,7 n.e.
Total (as listed above)	**30,5**	**6540** (Different estimates vary between 6200-7700**)**

EXPLANATORY TEXT (table II)

1. Description of land categories, including any land categories not covered.

The total area of Finland is 33.8 mill ha of which inland watercourses represent 3.3 mill. ha. Total land area of 30.5 mill. ha fall into categories as presented in the table II. According to the Finnish system, forestry land is grouped into three classes according to site productivity: (i) Forest land, where the potential annual increment is at least 1 m^3/ha/a; (ii) Scrub land (unproductive forest land), where the potential annual increment is between 0.1 - 1.0 m^3/ha/a; Waste land, unless naturally treeless, products less then 0.1 m^3/ha/a, and (iv) other forestry lands, mainly roads, depots, etc.

The international definition of forest land, as applied in the UN/ECE-FAO Temperate and Boreal Forest Resource Assessment 2000, sets a 10% canopy cover as the threshold between forest land and other lands. The estimation of the Finnish forest area based on the Forest Resource Assessment 2000 (FRA 2000) definition can be done by using measured basal areas for the plots stands and partly by interpretation of aerial photographs. Thus, the respective Finnish forest area equals 21.7 mill. ha, to the FRA definition.

Data on carbon stocks in agriculture lands, rangelands/grasslands is not available. Data on carbon stocks in wetland/tundra is included in above mentioned carbon stocks.

[3] Where the layer of peat is at least 30 cm thick (Kauppi et al. 1997).
[4] Includes wooden products in Finnish building stock. Annual increment in 1990-1995 was 0,15 Tg C a^{-1} (Pingoud & Perälä 2000). There are also other estimations ranging from 0,20 to 0,25 Tg C a^{-1}.

2. Carbon pools - distinctions and assumptions.

Carbon pools presented in table II (in trees, in surface vegetation, in forest soil and in peatland layers >30 cm thick) are covering all the forestry land area.

3. Data sources.

The National Forestry Inventory is the source of carbon stocks in trees. Preliminary estimates are based on a number of individual studies and research findings. Key references here include the following publications: Kauppi. P. 1997. Metsien hiilitalous ja kestävyyden periaate. Ministry of Agriculture and Forestry (10/1997), Kauppi et al. 1997 Carbon Reservoirs in Peatlands and Forests in the Boreal Regions of Finland and Marttila, V. et al. 2000, Forests in the UN Framework Convention on Climate Change and Kyoto Protocol (in Finnish only). Ministry of Agriculture and Forestry (1/2000).

4. Methods.

See above.

The National Forest Inventories (NFI) which have been carried out since 1921 are the basis for the monitoring of the forest related data. The Eight National Forest Inventory was carried out in Finland in 1987-1994. The multi-source inventory method combines data from field measurements, air-borne data and other space-borne data as well as digital map data. During the inventory 70 000 sample plots were measured, 3 000 permanent sample plots were used, 500 000 trees were tallied and 70 000 sample trees were measured. The total amount of different variables measured was 100 - 400. The ongoing Ninth National Forest Inventory started in 1996.

The accuracy of the estimates of the growing stock has been developed to a very high level: the sampling error for the total volume of the growing stock for the whole country is approximately ± 0.6%. Data can be provided at the regional level by combining the use of satellite imagery and numerical data. At the regional level, the sampling error for the total volume of the growing stock is approximately ± 2 - 5 %.

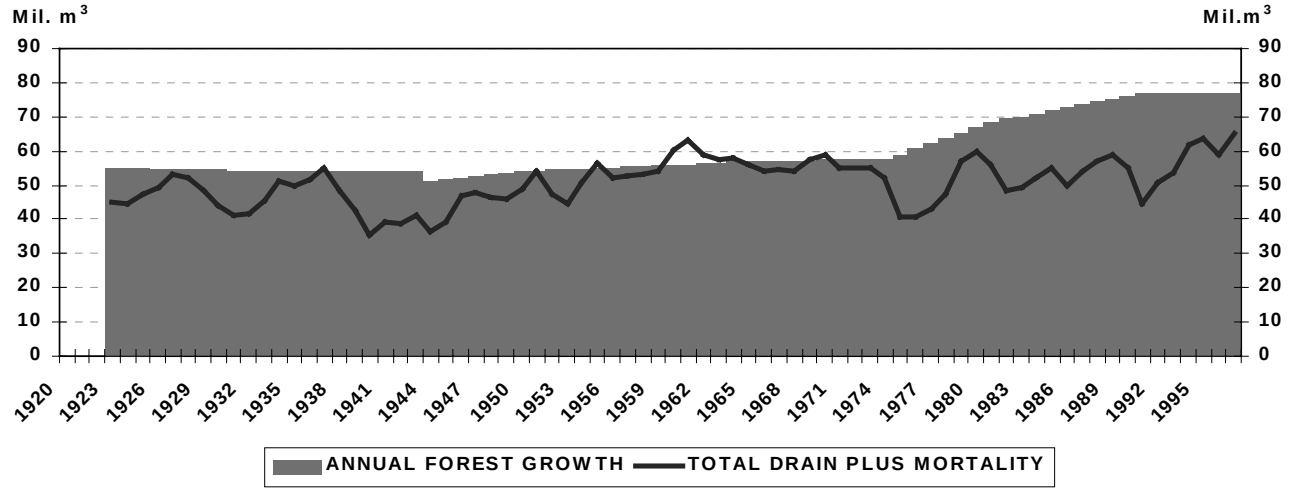

Figure 1. Changes in forest growth and drain in Finland 1924-1996.

Forest inventories provide data on stemwood increment, volume and drain. However, for carbon emission and removal inventory purposes, the whole-tree biomass as well as soil carbon, and, in particular, changes in these

pools are of interest. Present forest inventory techniques do not take all carbon pools into account, the methodologies on other pools are less developed and their accuracy is much more modest.

Forest inventory results and wood consumption statistics allow the conversion of stemwood volume, increment and drain into carbon amounts. Species-specific conversion factors to dry matter, total tree biomass and carbon can be applied. Dry weight densities, expansion factors and carbon contents vary within species, between regions and between age classes. Applied values are averages but should be more precise then the default values provided in the inventory guidelines. In Finland, approximately 58% of the carbon in tree biomass are in stemwood, 23% in roots, 14% in branches and 5% in foliage. These proportions vary, however, between tree species, and at different phases of stand development. Error in the total tree biomass estimate is currently ±10%.

5. Possible changes in carbon stocks.

In trees the carbon stock changes take place much faster than in soils. A number of studies show that the trend is in both cases ascending - increase of tree resources increases the carbon stock in biomass and, through growing forest littering in soils as well. The forest carbon stocks in Finland are expected to increase during the 2008-2012 by 0.8 - 2.7 TgC/a as presented in the table III.

6. Uncertainties.

See the references and text above.

Table III - Preliminary data and information provided by Finland on Article 3.4 activities, related net GHG emissions, involved areas, and projected carbon stock changes (additional activities under Article 3.4).

Article 3.4 Country specific data	Accounting framework	a_I (mill. ha)	$CO_{2,\ I}$ (mill.t CO_2)*	$CH_{4,\ I}$ (t CO_2 equiv.)*§	$N_2O_{,\ I}$ (t CO_2 equiv.)*§	a_{II} $(ha)_I$	$CO_{2,\ II}$ (mill. t CO_2)*	$CH_{4,\ II}$ (t CO_2 equiv.)*§	$N_2O_{,\ II}$ (t CO_2 equiv.)*§	a_{cp} (mill. ha)	$_{\Delta}C_{cp}$ (Gg C)	CO_2,cp (mill. t CO_2)	$CH_{4,\ cp}$ (t CO_2 equiv.)*§	$N_2O_{,\ cp}$ (t CO_2 equiv.)*§	Methods and approaches	Data sources, data quality, and uncertainties (e.g. ranges)	Other information relevant to decision-making
Forest management (including forest conservation)	Land based	23,0[5]	154,9	see explanatory text point 4.	see explanatory text point 4.	23,0[6]	198,2	see explanatory text point 4.	see explanatory text point 4.	23,0[7]	11 000[8]	40[9]	see explanatory text point 4.	see explanatory text point 4.	See explanatory text for table 3 below	See explanatory text for table 3 below	

* These columns would contain the sum over the years concerned of net annual emissions by sources and removals by sinks for the Article 3.4 activities proposed. A positive sign indicates either removals by sinks or an increase in carbon stocks.

a_I Area (ha) in 1995 involved in the Article 3.4 activity since 1990.

$CO_{2,\ I}$ Net CO_2 emissions (mill. t CO_2) by sources and removals by sinks related to the Article 3.4 activity, accumulated from 1990 to1995.

$CH_{4,\ I}$ CH_4 emissions (t CO_2 equivalent) by sources related to the Article 3.4 activity, accumulated from 1990 to 1995.

$N_2O_{,I}$ N_2O emissions (t CO_2 equivalent) by sources related to the Article 3.4 activity, accumulated from 1990 to 1995.

a_{II} Area (ha) in 1999 involved in the Article 3.4 activity since 1990.

$CO_{2,\ II}$ Net CO_2 emissions (mill. t CO_2) by sources and removals by sinks related to the Article 3.4 activity, accumulated from 1990 to 1998.

$CH_{4,\ II}$ CH_4 emissions (t CO_2 equivalent) by sources related to the Article 3.4 activity, accumulated from 1990 to 1998.

$N_2O_{,II}$ N_2O emissions (t CO_2 equivalent) by sources related to the Article 3.4 activity, accumulated from 1990 to 1998.

a_{cp} Projected area (ha) in 2012 involved in the Article 3.4 activity since 1990.

$_{\Delta}Ccp$ Projected carbon stock changes (t C) over the first commitment period related to the Article 3.4 activity since 1990.

CO_2,cp Projected net CO_2 emissions related contribution (mill. t CO_2) of the Article 3.4 activity to the first commitment period assigned amount of the Party.

CH_4,cp Projected CH_4 emissions related contribution (t CO_2 equivalent) of the Article 3.4 activity to the first commitment period assigned amount of the Party.

N_2O,cp Projected N_2O emissions related contribution (t CO_2 equivalent) of the Article 3.4 activity to the first commitment period assigned amount of the Party.

[5] Change in forest area is not considered in this assessment, but changes in carbon stocks are included in gross figures.
[6] Change in forest area is not considered in this assessment, but changes in carbon stocks are included in gross figures.
[7] Change in forest area is not considered in this assessment, but changes in carbon stocks are included in gross figures.
[8] Different estimates vary between 4 000 - 13 500 Gg C during 2008 - 2012
[9] Different estimates vary between 15 - 50 mill. t. CO_2 during 2008 - 2012

Methods and approaches

Specify:
a) Whether the definition of activity is considered broad or narrow (cf. Section 4.3.2. page 195 of the IPCC Special Report).

Forest management is considered as a broad activity, and it includes forest conservation.
.
b) How the estimates were computed.

See below (point 3(a).

c) Other.
-

EXPLANATORY TEXT (table III)

1. Activities and accounting:

a) Definitions and descriptions of all activities proposed.

In Finland all forest land is under management for wood production, for conservation or for other purposes.

b) Scope of activities and how they fit into broader managed land categories.

Forest management as understood as an aggregate result of different individual management operations and practices.

c) Accounting approaches.

Forest inventories and information systems provide data on stemwood increment, harvesting and drain. For assessing the carbon balance, annual carbon sequestration estimates of woody biomass are based on increment figures of the Finnish national Forest Inventory. Annual carbon release estimates are derived from harvesting statistics, estimated cutting waste and natural mortality.

d) Proposals for key accounting features, e. g. assumptions on baselines, basis for the area estimates covered by activity.

Future projections are based on the Finnish National Forestry Programme (approved by the Government of Finland in 1999. The National Forest Programme also aims at increasing use of wood for renewable source of energy by 2010.

2. Carbon pools included (e. g. above ground biomass, litter and woody debris, below- ground biomass, soil carbon, and harvested materials).

Present forest inventory techniques and the Finnish national reporting to the UNFCCC does take into account only limited carbon pools into account. The methods to cover other pools, in particular soils are less developed and their accuracy is much more modest. However, in this preliminary assessment above ground woody biomass, and below ground woody carbon are included.

3. Methodologies and data:

a) Data sources.

Data for 1990-1998 is registered and according to the national submission of data to the UNFCCC. Projections up to 2012 are according to the Finnish National Forest Programme, calculated by the Finnish forestry modelling and analysis program (MELA) of the Finnish Forest Research Institute. Basic data is collected and and analysed by the National Forest Inventory.

b) Sampling techniques.

See above. The Finnish National Forest Inventory is based on inventories on systematical sampling areas. The first inventory was made 1921-1924 and the last ongoing the 9th inventory started in 1996. The specific technical inventory illustration can be found e.g. on the website of Finnish Forest Research Institute, http://www.metla.fi/tutkimus/vmi/nfi.htm.

c) Models and key parameters.

See above.

d) Uncertainties.

See above. The Finnish National Forest Inventory data consists e.g. in the 8th inventory 70 000 sampling areas with amount of 500 000 trees - the relative standard error of stand volume is from 2 to 4 per cent.

4. Treatment of non CO_2 greenhouse gases.

Non- CO_2 greenhouse gases are not include in the assessment.

However some estimates are available. For example, the publication 'The Role of Peat in Finnish Greenhouse gas Balances.' (Crill et al. 2000) deals with non-CO_2 gases. Areas and annual soil greenhouse gas exchange ($g/m^2/a$) of undisturbed (non-managed) and drained peatlands for forestry purposes (managed) in Finland are available and summarised in the table below. Values are estimated for the year 2000. Positive values indicate gas flux from peat to atmosphere, negative values from atmosphere to peat. Official statistics show that most of the forest drainage has been done in 1960's to early 1980's. At present, in practice only ditch cleaning and supplementary ditching take place.

Peatland type	Area (1000 ha)	CO_2	CH_4 (GWP[10])	N_2O (GWP)
undrained	3 995	-75,3	13,51 (284)	0,005 (0,1)
drained for forestry	5720	-164,4	1,62 (34)	0,124 (2,6)

Data on non-CO_2 gases in mineral soils are not available.

5. Methods and key assumptions in projections for the first commitment period (2008– 2012) and discussion, if possible, of trends beyond the first commitment period.

See above.

[10] GWP = Global Warming Potential. GWP(CH_4) = 21, GWP(N_2O) = 310;

REFERENCES:

Crill, P., Hargraves, K., Korhola, A. 2000. The Role of Peat in Finnish Greenhouse Gas Balances. Ministry of Trade and Industry Finland.

Finnish Forest Research Institute 1999. Finnish Statistical Yearbook of Forestry.

Granholm, H. 1998. Estimated implications of the Kyoto Protocol Art. 3.3 to Finland. UNFCCC/SBSTA Workshop on land-use, land-use change and forestry, Rome, 24-25 September 1998.

Ministry of Agriculture and Forestry 1997. Metsien hiilitalous ja kestävyyden periaate.

Ministry of Agriculture and Forestry 2000. Forests in the UN Framework Convention on Climate Change and Kioto Protocol.

Ministry of Agriculture and Forestry 2000. Selvitys Suomen metsätaloudesta kansallista ilmasto-ohjelmaa varten. Background Paper.

Mäkipää & Tomppo 1998. Ilmastosopimuksen Kioton pöytäkirjan nielukysymysten taustaselvitys. Finnish Forest Research Institute.

Kauppi et al. 1997. Carbon Reservoirs in Peatlands and Forests in the Boreal Regions of Finland. Silva Fennica 31 (1) research articles.

Pingoud & Perälä 2000. Arvioita puurakentamisen kasvihuonekaasuvaikutuksista. VTT.

Sievänen, R. 2000. Kansallisen ilmasto-ohjelman metsätoimialan taustaselvitys. Finnish Forest Research Institute.

Tilli, T., Toivonen, R. 2000. Maatalousmaan metsityksen kehitysnäkymät Suomessa ja hiilinielupotentiaali vuoteen 2012. Pellervon taloudellinen tutkimuslaitos.

Table 1 - Preliminary data and information provided by France on carbon stock changes and areas related to Article 3.3 activities

Article 3.3	Définitions	Accounting Framework	Type	a1 (ha)	VarC1 ktC	a2 (ha)	VarC2 ktC	acp (ha)	VarCcp ktC
Afforestation / Refforestation	IPCC	Activity based	artificial	51,078	334	85,130	841	195,799	2,510
			natural	453,576	2,767	755,960	7,254	1,738,708	15,373
Afforestation	FAO	Activity based	artificial	51,078	334	85,130	841	195,799	2,510
	FAO	Activity based	natural	453,576	2,767	755,960	7,254	1,738,708	15,373
Reforestation	FAO	Activity based	artificial	244,938	230	408,230	928	938,929	8,300
	FAO	Activity based	natural	185,286	90	308,810	599	710,263	3,864
Deforestation	IPCC/FAO	Activity based		91,494	- 5,124	152,490	- 9,066	350,727	- 5,625
Total ARD	IPCC		AR artificial only		- 4,790		- 8,225		- 3,115
			AR total		- 2,023		- 972		12,258
	FAO		AR artificial only		- 4,560		- 7,298		5,185
			AR total		- 1,703		556		24,423

a1 = area (ha) afforested and reforested, or deforested since 1990 up to 1995 (i.e., over a 6-year period)
VarC1 = carbon stock change (ktC) since 1990 up to 1995 on land afforested, reforested, and deforested
a2 = area (ha) afforested and reforested, or deforested since 1990 up to 1999 (i.e., over a 10-year period)
VarC2 = carbon stock change (ktC) since 1990 up to 1999 on land afforested, reforested, and deforested
acp = projected area (ha) afforested and reforested, or deforested since 1990 up to 2012 (i.e., over a 23-year period)
VarCcp = projected carbon stock change (ktC) over the first commitment period (2008 - 2012) on land afforested, reforested, and deforested

Table 2 - Preliminary data and information provided by France on carbon stocks and area estimates (First sentence of Article 3.4)

Land system	Area (1000 ha)	Carbon stocks in 1990 (ktC)
Forest lands	18,283	2,207,038
Agriculture lands	16,473	784,966
Rangelands/grasslands	13,701	822,036
Wetland/tundra	1,791	60,893
Other	4,672	77,399
Total (as listed above)	54,919	3,952,332

Table 3 - Preliminary data and information provided by France on Article 3.4 additional activity, related net GHG emissions, involved areas, and projected carbon stock changes (rest of Article 3.4)

Article 3.4	Accounting framework	a1 (1000 ha)	C02,1 (kt)	a2 (1000 ha)	C02,2 (kt)	acp (1000 ha)	C02cp (kt)
Reference	Land based	13,948.1	167,421.6	13,948.1	279,036.1	13,948.1	139,518.0
Activity 1	Land based	1,610.1	3,900.9	1,610.1	6,501.6	1,610.1	3,250.8
Activity 2	Land based	1,983.7	18,351.6	1,983.7	30,586.0	1,983.7	15,293.0
Activity 3	Land based	2,496.5	34,793.4	2,496.5	57,989.1	2,496.5	28,994.5
Activity 4	Activity based	110.4	513.0	184.0	855.0	423.2	1,966.0
Activity 5	scenario A: economic growth = +1%						13,000.0
	scenario A: economic growth = +3%						32,000.0

Reference = contribution of French forests
Activity 1 = forest management in state forests
Activity 2 = forest management in other public forests
Activity 3 = forest management in private forests
Activity 4 = conversion of mixed coppice/high forest stands into high forests
Activity 5 = enhancement of carbon sink in wood products in France (except for paper and paper board)

a1 = area (ha) at 1995 involved in the Article 3.4 activity since 1990
CO2,1 = net CO2 emissions (ktCO2) by sources and removals by sinks related to the activity, accumulated from 1990 to 1995
a2 = area (ha) at 1999 involved in the Article 3.4 activity since 1990
CO2,2 = net CO2 emissions (ktCO2) by sources and removals by sinks related to the activity, accumulated from 1990 to 1999
acp = area (ha) at 2012 involved in the Article 3.4 activity since 1990
CO2,cp = projected net CO2 emissions (ktCO2) related contribution of the activity to the first commitment period assigned amount

FRANCE

LANDUSE, LANDUSE CHANGE AND FORESTRY

Country Specific Data

Explanatory Text

Table 1 – Article 3.3

1. Definitions

Forest. According to the definitions of the French National Forest Inventory, forests are formations of trees and shrubs, included in an established list of forest species, with a crown cover of more than 10% of the land and an area of more than 0.05 ha; the canopy of such formations must be wider than 15 m. Young stands with at least 500 seedlings / ha (or 300 seedlings / ha for widely spaced artificial plantations) are also included under forests.

Afforestation, Reforestation and Deforestation. Afforestation is a landuse change from non-forest to forest; it can be either "natural" (i.e., by natural seeding of land where previous non-forest use has been discontinued) or "artificial" (i.e., by planting or seeding). Reforestation is establishment of forest on lands that had them before; it can be either "natural regeneration" (i.e., by natural seeding from trees either left on the land for that purpose or from trees on neighboring land) or "artificial regeneration" (i.e., by planting or seeding). Deforestation is a landuse change from forest to non-forest.

2. Methods and Data

Most of the data relevant to forests in France are provided by the National Forest Inventory which was established progressively between 1960 and 1970. The main purpose of IFN is to provide information on land use and cover and on forest resources and their ecological conditions to a wide range of public and private users: central and local Governments, for the needs of national or local land use, forest and environment policies; the wood processing industry to guide their supply strategy; public and private forest owners for the management of their resources; and the scientific community for which IFN is the main source of nation-wide and objective information on forests.

Forest inventories are designed and carried out on a 10-year rotation at the level of the "département"; France has about 100 "départements", each covering about 550,000 ha in average including 150,000 ha of forests. Starting with aerial photographs (scale: 1/17,000 to 1/20,000), inventory activities include identifying landuse categories, measuring areas covered by each category, identifying and mapping (scale: 1/25,000) the main forest types of the "département". Further sampling includes (i) surveying, on the photographs, 15,000 to 20,000 "points" covering the whole "département"; and (ii) carrying out field measurements on a sample of about 1,200 "points" – one for about 130 ha of forests -- under a stratification scheme based on the ecological region (309 for the whole country), ownership (public and private), and forest types.

Standard data and maps are produced for each "département", including areas and volumes (stock and increment) according to many different criteria (e.g., forest types, species composition, stand structure). The main trends of the evolution of forest cover and resources can also be documented since, depending on the "département", inventories have now been carried out 2 to 4 times. "Département" level data are aggregated at the national level; depending on whether they relate to aerial photographs or field measurements, the average reference date at the national level is 1990 or 1992, for the last inventory, and 1979 or 1981 for the inventory before the last.

Thanks to its computerized data bases (measurements of stands and trees, geographical and ecological data) and information systems, the National Forest Inventory is also able to provide detailed information to meet the particular needs of the users in terms of location, area, and type of forest resources. In addition, the National Forest Inventory has recently taken a leading role in quantifying the indicators of sustainable management of the forests of France, according to the 6 criteria adopted at the Ministerial Conferences for the Protection of Forests in Europe (Helsinki and Lisbon).

3. Carbon Pools Included

Carbon pools taken into account under Table 1 include above-ground biomass, below-ground biomass and soil carbon.

4. Carbon Accounting

Changes in Forest Carbon. Changes in forest biomass are estimated on the basis of stand volume data measured by the National Forest Inventory and further converted into total above-ground and below-ground biomass thanks to FAO coefficients (see "Les ressources forestières de la région de la CEE / Europe, URSS et Amérique du Nord – 1986), and then into corresponding carbon amounts using a rate of 0.5 ton of carbon per ton of wood,. The assumptions made regarding biomass changes are the following:

- Deforestation: immediate loss of the total biomass;
- Afforestation and reforestation: estimates of biomass build-up are based on specific Volume / age relationships developed separately for coniferous (with different formulas for artificial and natural stands) and broadleaved species. The respective share of conifers and braodleaves are derived from assessments by the National Forest Inventory. According to the FAO activity based scenario, losses in biomass resulting from harvesting are not taken into account.

Changes in Soil Carbon. Changes in carbon soil are estimated under afforestation and deforestation only (i.e., only under a landuse change situation) on the basis of models developed recently (see J. Balesdent et D. Arrouays / Colloque AGRIGES – May 1999) on the following assumptions:

- Deforestation: the "destination" of deforested land is agriculture land (48%), grazing land (12%), "artificialized" land (34%), and water & wetlands (6%);
- Afforestation: the "origin" of afforested land is agriculture land (20%), grazing land (30%), and heathland (50%).

5. Treatment of non-CO_2

Not treated.

6. Projections

The evolution of areas from 1990 to 1995 and 1999, and the projections to 2012 are based on the assumptions that the annual rates of afforestation, reforestation and deforestation measured by the National Forest Inventory for the period 1981 – 1990 remain stable. These rates are the following:

- "natural" afforestation: 75,596 ha / year
- "artificial" afforestation: 8,513 ha / year
- "natural regeneration": 30,881 ha / year
- "artificial regeneration": 40,823 ha / year
- deforestation: 15,249 ha / year.

Table 2 – Article 3.4 (First Sentence)

1. Land Categories

Land categories shown under Table 2 are those in use under the annual landuse survey carried out in France (TERUTI) by the Ministry in charge of agriculture. They have the following meaning:
Forest lands: forests and other woodlands, in accordance with FAO definitions, including forests, woodlands, poplar plantations, scattered trees, hedges and heathland;
Agriculture lands: cultivated land, fallow land, orchards and vineyards, family gardens;
Rangelands/grasslands: agriculture land under herbaceous cover;
Wetland/tundra: water and wetlands;
Other: bare rock areas, "artificialized" land, urbanized land, and "off limit" areas.

2. Carbon Accounting

Soil carbon estimates are based on the same sources, models and assumptions as those presented in para. 4 under Table 1. Carbon stocks in biomass has been estimated for forest , woodlands and poplar plantations only, based on measurements by the National Forest Inventory.

Table 3 – Additional Activities under Article 3.4

1. Activities

Activities proposed under Article 3.4 include:

- Forest management in State forests which had an approved management plan in 1990;
- Forest management in other public forests which had an approved management plan in 1990;
- Forest management in private forests which had an approved management plan in 1990;
- Conversion of mixed coppice/high forest stands into high forests;
- Enhancement of carbon sink in wood products in France.

2. Methods and Data

See para. 2 under Table 1.

3. Carbon Pools Included

Carbon pools taken into account under Table 3 include above-ground biomass, below-ground biomass, and harvested materials.

4. Treatment of non-CO_2

Not treated.

5. Projections

Data regarding activities 1 to 4 in Table 3 are based on the assumption that the annual stocking of carbon measured by the National Forest Inventory during the 1981 – 1992 period will remain stable. Data regarding activity 5 are proposed under 2 different economic growth scenarios (A: +1%; and B: +3%).

GERMANY

Table I Preliminary data and information provided by Germany on carbon stock changes and areas related to article 3.3 activities

Article 3.3 Country specific data	Definitions	Accounting framework	a_I (ha)	ΔC_I (t C)	a_{II} (ha)	ΔC_{II} (t C)	a_{cp} (ha)	ΔC_{cp} (t C)	Methods and approaches	Data sources, data quality, and uncertainty (e.g. ranges)	Other information relevant to decision-making
Afforestation Reforestation	IPCC	Activity based	47,003	214,000	72,750	599,999	157,250	1,082,000	see explanatory text		
		Land based									
Afforestation	FAO	Activity based	47,003	214,000	72,750	599,999	157,250	1,082,000	see explanatory text		
		Land based									
Reforestation	FAO	Activity based	252,000	1,323,000	420,000	3,456,000	966,000	6,615,000	only artificiel regeneration by planting and seeding has been included; areas as reported in TBFRA2000 for 1987 to 1996, assuming that this rate is maintained.		
		Land based I	252,000	-33,912,000	420,000	-55,269,000	966,000	-22,748,000			
		Land based II	252,000	-1,144,000	420,000	-3,004,000	966,000	-5,012,000			
Reforestation	FAO II	Activity based	420,000	2,205,000	700,000	5,775,000	1,610,000	11,025,000	both artificiel and natural regeneration have been included; areas as reported in TBFRA2000 for 1987 to 1996, assuming that this rate will be maintained.		
		Land based I	420,000	-56,520,000	700,000	-92,100,000	1,610,000	-37,913,000			
		Land based II	420,000	-1,906,000	700,000	-4,991,000	1,610,000	-8,354,000			
Afforestation Reforestation	Other	Activity based									
		Land based									
Deforestation	IPCC/FAO	Activity based	14,842	-1,558,000	25,325	-2,660,000	60,425	-1,418,000	above- and below-ground biomass included		
		Land based									
	IPCC/FAO incl. Soil Carbon	Activity based	14,842	-2,179,000	25,325	-3,811,000	60,425	-2,144,000	above- and below-ground biomass + soil-C included		
		Land based									

a_I : Area (ha) afforested and reforested, or deforested since 1990 up to 1995 or possibly an earlier specific year.

$\triangle C_I$: Carbon stock change (t C) since 1990 up to the same year as used in a_I on land afforested, reforested, and deforested.

a_{II} : Area (ha) afforested and reforested, or deforested since 1990 up to 1999 or an earlier specific year.

$\triangle C_{II}$: Carbon stock change (t C) since 1990 up to the same year as used in a_{II} on land afforested, reforested, and deforested.

a_{cp}: Projected area (ha) afforested and reforested, or deforested since 1990 up to 2012.

$\triangle C_{cp}$: Projected carbon stock change (t C) over the first commitment period on land afforested, reforested, and deforested since 1990 up to 2012.

Methods and approaches

Specify:

a) Forest definition used;

b) Definitions for afforestation, reforestation and deforestation used;

c) Applied accounting approaches;

d) Included carbon pools;

e) Other.

EXPLANATORY TEXT (table I)

Parties should submit information under all headings listed below where the information is relevant to the approach taken in their submission and to the extent that data and methodologies exist.

1.Definitions and accounting:
   a) Forest,
   b) Afforestation, reforestation, and deforestation,
   c) Accounting approaches.
2.Carbon pools included (e.g. above-ground biomass, litter and woody debris, below-ground biomass, soil carbon, and harvested materials);
3.Stratification (e.g. biomes and regions);
4.Methodologies and data:
   a) Data sources,
   b) Sampling techniques,
   c) Models and key parameters,
   d) Uncertainties.
5.Treatment of non-CO_2 greenhouse gases.
6.Methods and key assumptions in projections for the first commitment period (2008–2012) and discussion, if possible, of trends beyond the first commitment period.

Table II - Preliminary data and information provided by Germany on carbon stocks and area estimates (First sentence of Article 3.4)

Land system	Area (ha)	Carbon stock in 1990 (t C)
Forest lands	10,740,000	2,290,000,000
C in wood products	not applicable	340,000,000
Agriculture lands	14,292,000	1,200,000,000
Rangelands/grasslands	5,251,000	622,000,000
Wetland/tundra	not applicable	
Buildings	2,066,000	130,000,000
Recreational lands	231,000	29,100,000
Transportation	1,633,000	68,600,000
Water Covered	780,000	
Other	1,012,000	85,000,000
Total (as listed above)	**36,005,000**	**4,764,700,000**

EXPLANATORY TEXT (table II)

Parties should submit information under all headings listed below where the information is relevant to the approach taken in their submission and to the extent that data and methodologies exist.

1.Description of land categories, including any land categories not covered.
2.Carbon pools - distinctions and assumptions.
3.Data sources.
4.Methods.
5.Possible changes in carbon stocks.
6.Uncertainties.

Table III - Preliminary data and information provided by Germany on Article 3.4 activities, related net GHG emissions, involved areas, and projected carbon stock changes (additional activities under Article 3.4)

Article 3.4 Country specific data	Accounting framework	a_I (ha)	$CO_{2,I}$ (t CO_2)*	$CH_{4,I}$ (t CO_2 equiv.)* §	$N_2O_{,I}$ (t CO_2 equiv.)* §	a_{II} (ha)	$CO_{2,II}$ (t CO_2)*	$CH_{4,II}$ (t CO_2 equiv.)* §	$N_2O_{,II}$ (t CO_2 equiv.)* §	a_{cp} (ha)	$\triangle C_{cp}$ (t C)	$CO_{2,cp}$ (t CO_2)*
Forest management	*Land based*	10,740,000	168,596,900	n.e.	n.e.	10,740,000	335,748,266	n.e.	n.e.	10,740,000	43,000,000	155,000,000
	Activity based											
Activity 2	*Land based*											
	Activity based											
Activity 3	*Land based*											
	Activity based											
…												
…												
…												
…												

CH_4, $_{cp}$ (t CO_2 equiv.)* §	N_2O, $_{cp}$ (t CO_2 equiv.)* §	Methods and approaches	Data sources, data quality, and uncertainties (e.g. ranges)	Other information relevant to decision-making
n.e.	n.e.	see explanatory text		

***** These columns would contain the sum over the years concerned of net annual emissions by sources and removals by sinks for the Article 3.4 activities proposed.
A negative sign indicates either emissions by sources or a decrease in carbon stocks. A positive sign indicates either removals by sinks or an increase in carbon stocks.
To convert a carbon amount to CO_2 multiply it by 3.67.

§ CH_4 and N_2O emissions are converted to CO_2 equivalent emissions by using the global warming potential (GWP) values of 21 for CH_4 and 310 for N_2O (Source: Second Assessment Report of the IPCC, 1995)

a_I :	Area (ha) in 1995 or possibly an earlier specific year involved in the Article 3.4 activity since 1990.
$CO_{2,\ I}$:	Net CO_2 emissions (t CO_2) by sources and removals by sinks related to the Article 3.4 activity, accumulated from 1990 to the same year as used in a_I.
$CH_{4,\ I}$:	CH_4 emissions (t CO_2 equivalent) by sources related to the Article 3.4 activity, accumulated from 1990 to the same year as used in a_I.
$N_2O_{,\ I}$:	N_2O emissions (t CO_2 equivalent) by sources related to the Article 3.4 activity, accumulated from 1990 to the same year as used in a_I.
a_{II} :	Area (ha) in 1999 or possibly an earlier specific year involved in the Article 3.4 activity since 1990.
$CO_{2,\ II}$:	Net CO_2 emissions (t CO_2) by sources and removals by sinks related to the Article 3.4 activity,accumulated from 1990 to the same year as used in a_{II}.
$CH_{4,\ II}$:	CH_4 emissions (t CO_2 equivalent) by sources related to the Article 3.4 activity, accumulated from 1990 to the same year as used in a_{II}.
$N_2O_{,\ II}$:	N_2O emissions (t CO_2 equivalent) by sources related to the Article 3.4 activity, accumulated from 1990 to the same year as used in a_{II}.
a_{cp} :	Projected area (ha) in 2012 involved in the Article 3.4 activity since 1990.
$\triangle C_{cp}$:	Projected carbon stock changes (t C) over the first commitment period related to the Article 3.4 activity since 1990.
$CO_{2,\ cp}$:	Projected net CO_2 emissions related contribution (t CO_2) of the Article 3.4 activity to the first commitment period assigned amount of the Party.
$CH_{4,\ cp}$:	Projected CH_4 emissions related contribution (t CO_2 equivalent) of the Article 3.4 activity to the first commitment period assigne amount of the Party.
$N_2O_{,\ cp}$:	Projected N_2O emissions related contribution (t CO_2 equivalent) of the Article 3.4 activity to the first commitment period assigned amount of the Party.

EXPLANATORY TEXT (table III)

Parties should submit information under all headings listed below where the information is relevant to the approach taken in their submissions and to the extent that data and methodologies exist.

1.Activities and accounting:
- a) Definitions and descriptions of all activities proposed,
- b) Scope of activities and how they fit into broader managed land categories,
- c) Accounting approaches,
- d) Proposals for key accounting features, e.g. assumptions on baselines, basis for the area estimates covered by activity.

2.Carbon pools included (e.g. above ground biomass, litter and woody debris, below-ground biomass, soil carbon, and harvested materials).

3.Methodologies and data:
- a) Data sources,
- b) Sampling techniques,
- c) Models and key parameters,
- d) Uncertainties.

4.Treatment of non CO_2 greenhouse gases.

5.Methods and key assumptions in projections for the first commitment period (2008–2012) and discussion, if possible, of trends beyond the first commitment period.

EXPLANATORY TEXT (TABLE I)

Preliminary remark

Country specific data are given for different definitions and accounting frameworks for information only. This should not be interpreted as if Germany was advocating for any of the definitional and accounting scenarios for which data are presented in this table.

General information concerning all rows of the table

Forest definition used throughout this table:

Forest

Legal definition:

A Forest in the meaning of the Federal Forest Act (Article 2) is "any area of land stocked with forest plants. Forest also includes: clear-cut or thinned areas of land, forest roads, forest marking-off-and safety strips, gaps in the forest cover as well as clearings, forest meadows, game feeding points, timber yards and other areas connected with forests and ancillary to them. Smaller lots plated with individual clusters of trees, lines of trees or hedges or serving as forest nurseries and being situated on farmland or within built-up areas are not forests in the meaning of the Federal Forest Act".

For the purpose of the National Forest Inventory, this legal definition has been operationalized as follows:

“Forest for the purposes of the National Forest Inventory is, regardless of the information in the cadastral or similar records, any basal area stocked with woody plants. Forests include clear-felled or cleared areas, forest roads, forest meadows, game pasture, timber yards, pipe routes located in the forest, further recreation facilities connected with the forest, overgrown heathens and moors, overgrown former meadows, alpine areas and rough grazings as well as dwarf pine and green alder areas. Heathens, moors, meadows, alpine areas and rough grazings are considered overgrown when the naturally occurring stocking has an average age of 5 years and at least 50% of the area is stocked. Stocked areas in the field or in built-up areas less than 1,000 sq. m., strips of woody plants less than 10 m wide and Christmas tree and ornamental branch crops as well as parks in residential areas are not forests according to the NFI.”

Reference years:

Reference years for a_I, ΔC_1 and a_{II}, ΔC_{1I} are 1995 and 1999, respectively; however 1999 results are partly based on projections, since not all of our 16 federal states were able to present data for the years 1997-1999 by 15 July 2000.

Background information on the estimate of carbon stock changes from ARD can be found in the annex to this explanatory text on **Afforestation, Reforestation and Deforestation** and the annex tables.

Explanatory text for the individual lines of table I:

Afforestation IPCC/FAO

1. Definitions and accounting:

a) Forest: see box above

b) Afforestation (and Reforestation under the IPCC-definition) is defined as establishment of forest on non-forest land.

c) The accounting is “activity based” in the sense that aggregate afforestation areas as reported by the *laender* (federal states) are the basis for calculations and estimates. Land based data from individual areas of land afforested or reforested since 1990 are not available.

2. Carbon pools: only above-ground biomass included
3. Stratification: none

4., 5., 6. : Information on Methodologies and data, methods and key assumptions: see annex on **Afforestation, Reforestation and Deforestation**

Reforestation FAO

1. Definitions and accounting:

a) Forest: see box above
b) Reforestation is defined, according to the FAO-approach, as artificial regeneration of land that was previously forested (post-harvest and post disturbance regeneration) by planting or seeding.
c) Accounting approaches are those described in the IPCC Special Report on Land-Use, Land-Use Change and Forestry, table 3.1, page 130-131. (However forest definition slightly different, as reported above).

2. Carbon pools: only above-ground biomass included
3. Stratification: none

4., 5., 6. : Information on Methodologies and data, methods and key assumptions: see annex on **Afforestation, Reforestation and Deforestation.**

Reforestation FAO II

The accounting approaches are the same as under the FAO definition, with the only difference that natural regeneration has been included, according to the “regeneration”-definition of TBFRA2000 which includes both, natural and artificial regeneration.

Information on Methodologies and data, non-CO_2 gases, methods and key assumptions: see annex on **Afforestation, Reforestation and Deforestation.**

Deforestation

1. Deforestation is defined as the conversion of forest to non-forest (= to another land-use).
2. Two options are presented in the table, one including above- and below-ground biomass only, the second including biomass and soil carbon (comprising humus layer and mineral soil from 0-90 cm).
3. Stratification: none

Further information see annex on **Afforestation, Reforestation and Deforestation.**

4. Trace gases from deforestation are included in Annex table to the above-mentioned text.

Afforestation, Reforestation and Deforestation

The data included in the greenhouse gas inventories 1990-1998 do not yet include deforestation and afforestation.

Germany's total forest area has been increasing by about 0,5 mio ha since the 60ies[1]. Deforestation is over-compensated by afforestation (in area, not necessarily in biomass or carbon stocks, as will be shown later) and deforestation rates are very small as compared to the total forest area. Therefore, they were considered insignificant and have not been reported in greenhouse gas inventories.

Afforestation and Reforestation

[1] Federal Ministry of Food, Agriculture and Forestry

Information on the tree species used for **afforestation** is only available for those areas which have been afforested under promotion schemes involving funding from the federal budget. This covers only about 50% of the total afforestation area.

In afforestations funded with grants from the federal budget, mainly broadleaf trees were used. Therefore it has been assumed that the yearly C-sequestration will be no more than 2 t C/ha*y. Estimates for the yearly C-uptake of accumulated afforestation areas since 1990 have been calculated with an assumed uptake of 1 t C/ha and of 2 t C/ha.

For **Table I** an average of 1,5 t C per ha and year has been used, hence the expected range would be ± 33 %.

For 1990-1996 the afforestation areas reported by the *laender* were used; these data may be incomplete since not all *laender* were able to report afforestation areas in early 90ies. For the subsequent years, the afforestation rate has been estimated, assuming that it remains stable over time.

Forest extension through natural regeneration after the agricultural or pastoral use of the land has been stopped has not been included in any of the scenarios under afforestation. The amount of these areas is surrounded by great uncertainties and might significantly exceed the area of active afforestation through planting, seeding and encouraging natural regeneration. In TBFRA 2000 it has been estimated at 3000 ha/p. y. during the decade 1987 to 1996.

"Reforestation"-rates under the FAO definition scenario are drawn from TBFRA 2000. Two sub-scenarios have been examined, one including only artificial regeneration and the other including both, planting and natural regeneration. The C-uptake by regrowing vegetation on reforested areas has been estimated at 1,5±0,5 t C per ha and year.

The areas of "reforestation", accumulated over 20 years, result in 1,4 mio. ha if natural regeneration is included. This is more than the 1,1 mio. ha of 0-20 year old stands (first age class) which can be found in forest inventories. This is due to natural regeneration over long regeneration time frames: some of the regenerated areas never enter the first age class - when the last trees of the old stand are being harvested, the young stand is already more than 20 years old.

For the FAO land based I and land based II-scenarios, data on the stocks which were present on the involved areas just before harvest and regeneration (or at the beginning of the commitment period) are required.
While such data are important inputs for planning and control at the management level unit, they are not available in aggregate form at the federal level; they might be available at *laender*-level, but for state forests only which count for about 34% of the total forest area.

There are however different ways to derive those data from other data. One possibility is to derive them from harvest statistics. In Germany, harvest statistics include both, selective fellings related to forest tending and harvesting at the end of rotation period ("harvesting" in the strict sense). An estimate of the fraction of the total fellings which is removed in harvesting at the end of the rotation period could be based on yield tables.
This gives accurate data only if

- the age classes are even distributed (concept of "normal forest") and
- if the underlying assumptions on thinning included in yield tables reflect the actual silvicultural treatment of the forest stands.

Neither of these conditions is fulfilled in German forests: Young and middle-aged stands are slightly over-represented (due to reforestation and afforestation after World War II) and, while searching for cost-effectiveness of forest operations, thinning regimes are being applied which are very different from the models on which the yield tables are based.

Keeping these restrictions in mind, it has been assumed that about 50% of the yearly fellings occur in harvest at the end of the rotation period.

Based on yearly fellings of about 40 mio. m³ under bark, this means that 20 mio. m³ u.b. or **26 mio m³ o.b.** are felled per year in harvest at the end of the rotation period.

An alternative estimate can be derived from the area regenerated per year and growing stock at maturity. According to the results of the national forest inventory (1986-1990)[2] for the old *laender*, the volume p. ha is between 350 and 500 m³ o.b. in the age of harvest; in the new *laender* it was between 300 and 400.[3]
Multiplied with the annual regeneration area of 70000 ha, the yearly harvest can be estimated at 21 to 35 mio. m³ o.b. with an average of **28 mio. m³ o.b.**

For the calculations under the FAO Land based I and II scenarios, an average value of **27 mio. m³ o.b.** has been used. It has been assumed that 1 m^3 of wood contains 0,5 t of dry material and expansion factors have been used to cover the total biomass.
For the FAO-Land-based II approach, an estimate of delayed decay of biomass (slash, woody debris) after harvest is necessary. The assumption used for estimates in table I is that 40 % of the total above- and below ground biomass is left to decay over 20 years post harvest; linear decay rates have been assumed.

Estimates for land based I and land based II scenario have been made for both, total regeneration area and the part of it which is artificially regenerated through planting and seeding.

For the latter estimate, only 60 % of the total harvest have to be included. This calculation based on the fraction of the regeneration area which is artificially regenerated brings however additional uncertainties into the estimate: the fractions of artificial and natural regeneration are not even-distributed over all tree species. Artificial regeneration is mainly used for Norway spruce, scotch pine and oak, while beech and other broadleaf trees are mainly regenerated by natural means.

Other accounting problems arise if the total regeneration area, including natural regeneration, is included: if the regeneration time-frame is long (especially for shadow-tolerant tree species, such as beech and silver fir) and harvest takes place trough repeated selective fellings over 20 to 30 years or more, the exact moment of "reforestation" is impossible to establish and only part of the harvest will take place during the commitment period. (In uneven-aged *plenter*-forests, it is not possible at all to distinguish between tending, harvesting and regeneration, but those forests count for less than 1 % of the German forest area).
In forest planning, the year of regeneration is conventionally fixed in the middle of the regeneration time frame or only a fraction of the total forest stand, corresponding to the fraction of the crown cover which is removed, is considered to have been "regenerated" during the 10-year-timeframe which is generally used for planning.

Deforestation

To estimate C-stock changes and other greenhouse gas emissions from "deforestation" in Germany, an activity based approach of "deforestation" has been adopted, based on records from the *laender* of areas which have been **converted to another land use** since 1990.

Only aggregate yearly areas of deforestation are available at the federal level.
In early 1990ies, not all of the laender especially of the new ones, were able to report deforestation areas. For this reason, data on deforestation and afforestation are incomplete for the beginning of the

[2] BML 1992
[3] BML 1994

90ies. The areas of land subjected to deforestation have been estimated, assuming that the deforestation rates were the same as in subsequent years.

Data on site conditions (especially soil types), tree species and age or volume of deforested stands partly are scattered over several hundreds of local management and administration units and are not available at regional or federal level.
Therefore, estimates of the related C-stock changes were based on the average data on biomass and soil carbon (See **Annex table 1**).

It was assumed that the carbon from the biomass is released in the year of felling.

Deforestation occurs in Germany mainly for the construction of roads, industrial plants, extraction of mineral resources or gravel, housing etc. In these cases, above- and below-ground biomass is completely removed from the site and there is nothing left to decay on the site. Hence delayed release from decaying slash, stumps etc. has not been taken into account.

Furthermore, the following assumptions on the fate of wood from deforested areas have been made: 60% of the aboveground wood is used in products. Since this portion may already be included in harvest statistics, the related C-loss would have to be subtracted from the harvest-related C-loss for the calculation of C-stock-changes in forests, to avoid double counting. (This was not yet done in our GHG-Inventories, since we did not report on deforestation separately).

It has been assumed that 20 % is burned on site and the remaining 20 % are chopped up and the chips used off site. Pending on the purpose they are used for, part of them might undergo decay over several years. This applies also to the below ground biomass, which is removed from the site and used or left to decay off site.
For the estimate however, it has been assumed that all biomass is oxidised in the year of clearing. It is not clear from the reporting guidelines whether below-ground biomass has to be included or not; in our estimate, it is included.

For non CO_2 trace gases, the default emission ratios given in the reference manual of IPCC guidelines for greenhouse gas inventories, as revised in 1996, have been used. The fraction of C for the calculation of CO_2 from on-site burning has been reduced by 7 % accordingly, to take into account CH_4 and CO.

The preliminary results are shown in **Annex table 3.**

Soil Carbon
The upper soil horizon is often removed from deforested areas and the soil material used later for recultivation.
It was assumed that half of the carbon contained in forest soils is released over 20 years after deforestation and that the soil carbon stock then remains constant on the new level reached.
A non-linear decrease of soil carbon after deforestation was assumed.

Literature
BML (1992): Bundeswaldinventur 1986-1990. Inventurbericht für das Bundesgebiet nach dem Gebietsstand bis zum 03.10.1990 einschließlich Berlin (West). BML, Bonn.

BML (1994): Der Wald in den neuen Bundesländern (Eine Auswertung vorhandener Daten nach dem Muster der Bundeswaldinventur). BML, Bonn.

Federal Ministry of Food, Agriculture and Forestry: Forest Report by the Federal Government

EXPLANATORY TEXT (table II)

A. Forest lands

1. Description of a Forest:

Forest

Legal definition:

A Forest in the meaning of the Federal Forest Act (Article 2) is "any area of land stocked with forest plants. Forest also includes: clear-cut or thinned areas of land, forest roads, forest marking-off-and safety strips, gaps in the forest cover as well as clearings, forest meadows, game feeding points, timber yards and other areas connected with forests and ancillary to them. Smaller lots plated with individual clusters of trees, lines of trees or hedges or serving as forest nurseries and being situated on farmland or within built-up areas are not forests in the meaning of the Federal Forest Act".

For the purpose of the National Forest Inventory, this legal definition has been operationalized as follows:

“Forest for the purposes of the National Forest Inventory is, regardless of the information in the cadastral or similar records, any basal area stocked with woody plants. Forests include clear-felled or cleared areas, forest roads, forest meadows, game pasture, timber yards, pipe routes located in the forest, further recreation facilities connected with the forest, overgrown heathens and moors, overgrown former meadows, alpine areas and rough grazings as well as dwarf pine and green alder areas. Heathens, moors, meadows, alpine areas and rough grazings are considered overgrown when the naturally occurring stocking has an average age of 5 years and at least 50% of the area is stocked. Stocked areas in the field or in built-up areas less than 1,000 sq. m., strips of woody plants less than 10 m wide and Christmas tree and ornamental branch crops as well as parks in residential areas are not forests according to the NFI.”

2. Carbon pools

The pools included are shown in the following table:

Carbon Stock per ha in Germany’s Forests (1990)

	m³/ha	exp.fact	t d.m./m³	t d.m./ha	**t C/ha**
Growing stock	270				
Woody biomass		1,45	0,5	195,75	**97,9**
above-ground		*1,20*	0,5	*162,00*	*81,0*
below-ground		*0,25*	0,5	*33,75*	*16,9*
Leaves+needles				11,00	**5,5**
Dead wood	6		0,5	3,00	**1,5**
Forest floor vegetation				1,00	**0,5**
Soil Carbon (0-90cm, including humus layer)					**108,6**
humus layer					*20,7*
0-30 cm					*65,2*
30-90 cm					*22,7*
Total	**276**				**214,0**

Germany’s total forest area is **10,7 mio. ha**. If multiplied with the C-stock per ha reported in the table, the total carbon stock of Forests in Germany can be estimated at approximately **2,29 * 10^9 t C**.

Carbon stocks in wood products (including buildings and paper) have been estimated at 340 mio. t C.[1]

3. Data sources

Up to October 1990, Germany's territory included two States, the Federal Republic of Germany in the West and South and the former German Democratic Republic in the East. Today, the Federal Republic of Germany comprises 16 federal states (*"laender*"), eleven of which in the western and southern part (referred to as "old *laender*") and five of them which were formed on the territory of the former GDR and acceeded to the FRG in 1990 ("new *laender*").
Hence it was necessary to draw data from two databases established by different methods.
Data for the old *laender* are drawn from the **national forest inventory** which took place from 1986 to 1990 by systematic sampling on a 4*4 km-grid[2]**.** The data of the new laender are drawn from the new laenders' **Forest Database** which was obtained by up-scaling statistical data from individual management units and may contain a sampling error the amplitude of which is unknown. Therefore it is not possible to give confidence intervals for the national totals of forest area and growing stock.
For the old *laender*, which include about 72% of Germany's total forest area and about 79 % of its growing stock, the standard error for the area was ±1,1 % and for the growing stock it was ± 0,8%.[3]

The data on soil carbon are based on the forest soil inventory which took place from 1987 to 1993 on a 8*8 km-grid. A study on the carbon content has been conducted, based on those data along with additional information on site conditions.[4]

4. Methods

For the calculation of the C-content of the growing stock, default data for wood density and carbon content from the IPCC guidelines for greenhouse gas inventories revised in 1996 have been used. It was felt that those default data were appropriate for a preliminary over-all estimate, but they would not be sufficient for the monitoring of changes in carbon stocks.

Wood density varies in a wide range, not only between different tree species, but also between different stands of the same species, pending on silvicultural treatment and site conditions, such as vegetation period length or the availability of water and nutrients, and within the same stand. Differences occur even within the same tree: It has been shown, e.g. that the density of root wood is lower than the density of stem-wood, while the density of crown wood is higher; there are even differences in wood density between the upper and the rear side of the same branch.[5]

A best estimate of wood density for individual tree species can be given, based on statistical sampling and a great number of measurements. Such values can been drawn from the literature.
However, most of the extended studies on physical properties of the wood of central European tree species have been conducted by the middle of the 20th century[6]. Thinning regimes have been altered since then, especially with the aim to reduce the costs of forest tending, and plantations are established today with significantly less plants p. hectare than 50 or 100 years ago.
Both, altered thinning regimes and reduced numbers of plants in plantations, along with longer vegetation periods due to climate change and forest fertilisation by air-born nutrient depositions can be expected to influence the growth of trees, resulting in general in broader year rings. This will also alter wood density. The reaction of wood density to altered year ring width is not uniform: in conifers, wood density is reduced as year rings get broader; for ring-pored hardwood (such as oak and ash), it is the contrary.

[1] Frühwald, Wegener, Krüger, Beudert (1994)
[2] For some regions, a 1kmx1km-grid was used
[3] BML 1992
[4] Baritz 1999
[5] BOSSHARD , Hans Heinrich (1982)
[6] KOLLMANN (1951); KNIGGE UND SCHULZ (1966)

These uncertainties on wood density bring considerable uncertainties into any estimate of carbon stocks in forests. Additional work would be necessary to quantify these uncertainties.

Compared to the uncertainties surrounding wood density, the variability of the carbon content of biomass expressed as a percentage of dry material is insignificant, and 50% is seen as an appropriate default value over all vegetation compartments, including herbaceous and shrubby plants on the forest floor.

The expansion factor of 1.45 for the transformation of growing stock (above ground woody biomass including all wood with more than 7 cm in diameter) into total woody biomass has been drawn from BURSCHEL (1993).

For the estimate of leaf and needle biomass it has been estimated, that broadleaf stands have 3 t of leafs while coniferous stands have about 15 t of needles per ha. This is consistent with the findings of forest ecosystem research, e.g. in the Solling mountain[7]. In 1990, there were 66% of coniferous and 34% of broadleaf trees in Germany's forests; if weighted with these proportions of areas, the average biomass of leafs and needles can be estimated at 11 t dry mat. p. ha.
Dead wood: rough estimate, since dead wood was not estimated during the National Forest Inventory.

The estimation of soil carbon is described in BARITZ (1999). For our calculation, the national averages have been used. Soil Carbon includes litter/humus layer and mineral soil from 0 to 90 cm in depth.

5. Possible changes in carbon stocks

In managed productive forests, the carbon stock in above-ground growing stock is increasing by 8 to 9 mio. t of carbon every year (see table III).

6. Uncertainties

Information on uncertainties, as far as available, has been included in para 3 and 4 on data sources and methods.

Literature

BARITZ, RAINER; ADLER, GERT H., WOLFF, BARBARA, WILKE, BERND-MICHAEL (1999): Regional Distribution of Carbon in German Forest Soils and its Relation to Climate Change. Zeitschrift für angewandte Geologie, 45, 1999, 4, p.218-227

BML (1992): Bundeswaldinventur 1986-1990. Inventurbericht für das Bundesgebiet nach dem Gebietsstand bis zum 03.10.1990 einschließlich Berlin (West). BML, Bonn.

BML (1994): Der Wald in den neuen Bundesländern (Eine Auswertung vorhandener Daten nach dem Muster der Bundeswaldinventur). BML, Bonn.

BOSSHARD, Hans Heinrich: Holzkunde, 2nd ed., Basel, Boston, Stuttgart 1982

BURSCHEL, KÜRSTEN, LARSON (1993): Die Rolle von Wald und Forstwirtschaft im Kohlenstoffhaushalt. Eine Betrachtung für die Bundesrepublik Deutschland. Forstliche Forschungsberichte München Nr. 126

ELLENBERG, MAYER, SCHAUERMANN: Ökosystemforschung- Ergebnisse des Sollingprojekts 1966-1986. Stuttgart 1986

[7] ELLENBERG, MAYER, SCHAUERMANN (1986)

FRÜHWALD, WEGENER, KRÜGER, BEUDERT (1994): Informationsdienst Holz: Holz – ein Rohstoff der Zukunft, nachhaltig verfügbar und umweltgerecht. Deutsche Gesellschaft für Holzforschung e. V., München

KNIGGE, SCHULZ (1966): Grundriss der Forstbenutzung

KOLLMANN, F. (1951): Technologie des Holzes und der Holzwerkstoffe, 1. Bd., 2. Aufl.

B. Agriculture and Other Lands

1. Land Typs

Agriculture lands
There are two terms commonly used in German agrostatistics to describe agriculture lands "Landwirtschaftlich genutzte Fläche" LN and "Landwirtschaftsfläche" LF. While LF describes the total area devoted to agriculture, LN decribes only that part of LN which is actually used and set aside land, private parks, lawns and decorational gardens are excluded.
LN is reported here and covers all area used for agriculture, horticulture and viticulture. In German agrostatistics the subclasses grassland and grassland to graze animals are usually report within LN. we excluded it here, as it seems reasonable to report it in under the next category.

Rangelands/ grasslands
This term is not to be found in German agrostatistics, however the subclasses grassland and grassland to graze animals fit into this category. Thus, we excluded it from the total LN (19,543,000 ha) to be found in the official agrostatistics and reported them (5,251,000 ha) separately.

Wetland/ tundra
This type of land is absent in Germany.

Buildings and surroundings
This term describes areas covered by buildings as well as the surrounding free areas which have a functional association to the use of the buildings, such as playgrounds home gardens, yards and others.

Recreational land
All types of sport grounds, or areas devoted to present animals (zoological gardens) or plants (botany gardens).

Transportation and traffic area
Areas devoted for transportations by road-, rail-. air- or water traffics.

Water covered
Inland areas covered permanently or non permanently by water, regardless of natural or manmade origin, including river banks towing paths and similar.

Other
All uses not attributable to above mentioned categories.

2. Carbon pools - distinctions and assumptions.

For all other categories except forest land only the pool of organic carbon, present in the top 0.3 m of soil has been considered to be a carbon pool that may undergo changes due to human activities. As no better data, covering Germany in total, are available to couple the land use with the soil type on which the land use occurs, rough assumptions had to be made to calculate the carbon stocks.

i. a mean soil density of 1.4 kg/l has been assumed for all soil use categories reported, resulting in a mean soil mass of $4.2 * 10^6$ kg per ha,

ii. different assumptions have, however, been made about the organic soil carbon content in soils under different use. The following organic C contents were assumed (agriculture land 2%, grassland 3%, buildings and surroundings 1.5 %, recreational land 3%, transportation and traffic 1 %, other 2%.

3. Data sources.
As stated earlier, up to October 1990, Germany's territory included two States, the Federal Republic of Germany in the West and South and the former German Democratic Republic in the East. Agro-statistics and area statistics are thus not available in a concluding manner to serve as a reliable database for the base year 1990. Statistical data for the year 1993 were used whenever no data were available for Germany as a whole for 1990. Error introduced by this practice will be small due to the fact, that severe changes in landuse have not taken place in Germany. The official statistics compendium " Statistisches Jahrbuch über Ernährung Landwirtschaft und Forsten 1999" has been used as a data source to evaluate the areas reported in table II .
Reasonable data sources for organic carbon contents applicable to the above land use categories are lacking. Even the approach to draw from textbook knowledge Schachtschabel et al. (1998) on this topic is more than questionable but was the only.

4. Methods.
Due to the poor data sources available the method of calculation for the above figures is a simple multiplication of reported land area, assumed soil density and assumed organic C content.

5. Possible changes in carbon stocks.
Only in agriculture lands and grasslands significant changes in carbon stocks are likely to be achievable by human interaction. The degree of changes achievable is however hardly to estimate. As an upper limit we assume that by modifing agricultural practices a 10% positive change in the carbon stocks can be achieved. This carbon sink effect will however be limited for a period of a about 50-100 years, as than soil carbon dynamics will have equilibrated to the new regime.

6. Uncertainties.
No instrument currently exists to verify the carbon stocks or carbon stock changes in soils on a regular and area covering base. Thus uncertainties are very high and remain to be so until instruments to scope with the problem become developed. Geographic information systems (GIS) and modified soil survey approaches are needed to reduce the uncertainties to an acceptable level.

Literature

BML (1999): Statistisches Jahrbuch über Ernährung Landwirtschaft und Forsten, Landwirtschaftsverlag, Münster-Hiltrup.

Schachtschabel P., Blume H.-P., Brümmer G., Hartge, K. H. Schwertmann, U.(1998) Scheffer/Schachtschabe Lehrbuch der Bodenkunde, Ferdinand Enke Verlag, Stuttgart

EXPLANATORY TEXT (Table III)

Preliminary remark

Preliminary data are provided merely for information. This data submission should not be interpreted as if Germany was advocating for the inclusion of any of these activities during the first commitment period.

Forest management

1. The activity comprises the sustainable multipurpose management of forests for wood and non-wood goods and services, protection and recreation. Typically, production, protection and recreation aims are reached through sustainable management on the same area. Carbon sequestration is only one of the multiple functions of sustainable managed forests.
   Carbon sequestration has been estimated by comparing biomass increment and harvest, using the methodology for greenhouse gas inventories (IPCC guidelines for GHG Inventories).

   Data for a_I, ΔC_I refer to the year 1994, those for a_{II}, ΔC_{II} to the year 1999.

2. In accordance with the IPCC 1996 revised guidelines for greenhouse gas inventories, above ground biomass has been included.
   Litter, below-ground biomass and soil carbon have been considered to remain constant over time under sustainable management and have not been included.
   The default assumption used here was that harvested wood, including woody debris (slash) remaining in the forest are oxidised in the year of harvest, hence harvest results in a CO_2 source. In total, a net sink results, because biomass growth exceeds the amount of biomass removed by harvesting.

3. Methodologies and data are those used for the estimate of the net CO_2 removal included in chapter 5 A of the annual greenhouse gas inventory. A detailed description of the methods and data sources for the estimates carbon stock changes in forests included in greenhouse inventories since 1990 are given below.

4. Non CO_2 greenhouse gases have not been estimated. There is a small proportion of on-site slash burning related to harvest, which results in non CO_2 greenhouse gas emissions. However, on-site burning of slash is more and more replaced by other technologies, such as chopping up woody debris and leaving them to decay or using them for energy and other purposes.

5. The assumption for the commitment period was that increment and harvest remain the same as today, with a range for C-stock increase during the commitment period of 40 to 45 Mt C and for the related CO_2-sink of 145 to 165 Mt CO_2.
   For later commitment periods, growth and harvesting rates are becoming more uncertain.

Sinks and sources from the forestry sector included in greenhouse gas inventories

The net increment by tree species has been estimated, based on yield tables and on field measurements of tree diameters and heights which had been made during the national forest inventory in 1986-1990. The results have been included in **annex table 2.**
While the calculation of the average carbon stock p. ha and the total carbon stock is based on the total forest area which includes some actually non-stocked areas of forest land, table 2 includes only the areas of "productive managed forests". Productive forests includes all forest stands which yield more than 1 m^3 p.ha*y.

The overall increment of 8,3 m³/ha*y resulting from this study is a careful assessment of forest growth in Germany. Some regional studies have shown current growth rates to exceed significantly the estimates based on yield tables.[1]

The annual harvest has been drawn from harvest statistics.[2]. The data included in this statistic are provided to the Federal Ministry of Food, Agriculture and Forestry by the *laender* and come from different sources: Data on commercial timber and industrial round-wood extraction in state and communal forests are based on direct measurements of tree volumes (full measurement of all stems for timber, or measurement of a sample for industrial round-wood) or measurement of their weight. Data from privately owned forests are partly based on estimates, especially for the portion of timber and fire-wood which forest owners are harvesting for their own use (non-commercial harvest). Hence the data included in harvest statistics are heterogeneous and the related uncertainty is difficult if not impossible to estimate.

The second national forest inventory which will take place in 2002, is expected to yield more accurate data, both on growth rates and on harvest.

To calculate the total above-ground[3] woody biomass, expansion factors have been used, both for the net growth and for harvest.

The expansion factors used to calculate the total woody biomass might appear low as compared to the default data included in the IPCC guidelines for greenhouse gas inventories for temperate forests. It should be noted that the growing wood volume includes conventionally, in German Forestry, all wood thicker than 7 cm in diameter, including branches, and not just the stem wood volume.

In the 19th century, when even wood and twigs smaller than 7 cm in diameter were of economic interest (firewood, raw material for besoms, baskets and other uses), quite accurate tables for the estimation of these parts of the growing stock have been established; these estimates have been confirmed recently by ecosystem studies, such as the Solling project[4].

Leaves/needles have not been included; they have been considered to remain more or less constant over time.

Studies in the Solling-project[5] have shown for both, beech (Fagus silvatica) and spruce (Picea abies) stands, only small differences in the biomass of leaves/needles between young, middle-aged and old stands, while the inter-annual variation can be significant, due to weather conditions and herbivorous insects. While the wood volume is increasing, the leaf or needle biomass is remaining more or less constant over decades, once the initial accumulation of leaf/needle biomass in very young up-growing stands has been achieved. Hence there is no direct relationship between woody biomass growth and increase in leaf or needle biomass. There seems to be, however, some "compensatory" growth of leaf/needle biomass after thinnings, since over several years, the absolute amount of leafs/needles is not influenced by thinning either.

Since harvested wood is only measured after felling in Germany, additional tree species specific expansion factors have been used to recalculate the standing volume of the harvested trees before felling, taking into account slash, harvest losses and stumps which remain in the forest.

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[1] SPIECKER et. al (1996); Böswald (1996)
[2] Federal Ministry of Food, Agriculture and Forestry (1990 ff.)
[3] According to the IPCC Guidelines for Greenhouse Gas Inventories, revised in 1996, only the above-ground biomass has been included
[4] ELLENBERG, MAYER, SCHAUERMANN (1986)
[5] ELLENBERG, MAYER, SCHAUERMANN (1986)

It has been assumed that all C contained in harvested trees (including slash and stumps) is released to the atmosphere in the year when the harvest occurs. This simplification, which is in line with the IPCC Guidelines for Greenhouse Gas Inventories, does not affect the results if the annual harvest rates remain more or less constant over several years.

For the calculation of C-Stock changes, the C-content of wood needs to be known. From wood research it is known that carbon counts for about 50% of the total dry material, regardless of the tree species. It is wood density which is critical for C-stock estimates. Contrary to materials such as iron or steel, wood does not have a well defined "specific weight". Wood density varies in a wide range, not only between different tree species, but also between different stands of the same species, pending on site conditions, such as vegetation period length or the availability of water and nutrients, and within the same stand. Differences occur even within the same tree: It has been shown, e.g. that the density of root wood is lower than the density of stem-wood, while the density of crown wood is higher; there are even differences in wood density between the upper and the rear side of the same branch.[6]

A best estimate of wood density for individual tree species can be given, based on statistic sampling and a great number of measurements. The values included in the spreadsheet for the calculation of annual C-removals from Forests (**annex table 2**) have been drawn from the literature.

Most of the extended studies on physical properties of the wood of central European tree species have been conducted in the middle of the 20th century. Thinning regimes have been altered since then, especially with the aim to reduce the costs of forest tending, and plantations are established today with significantly less plants p. hectare than 50 or 100 years ago.
Both, altered thinning regimes and reduced numbers of plants in plantations, along with longer vegetation periods due to climate change and forest fertilisation by air-born nutrient depositions can be expected to influence the growth of trees, resulting in general in broader year rings. This will also alter wood density. However, the reaction of wood density to altered year ring width is not uniform: in conifers, wood density is reduced as year rings get broader; for ring-pored hardwood (such as oak and ash), it is the contrary.

The calculation and its results for the years 1990-1994 are shown in **annex table 2.**

Results for the years 1995-1998 are quite similar and are not shown here; they can be found in Germany's greenhouse gas inventories. Results for 1997 have been included in document FCCC/SBSTA/2000/3.

Literature

BÖSWALD (1996): Zur Bedeutung des Waldes und der Forstwirtschaft im Kohlenstoffhaushalt, eine Analyse am Beispiel des Bundeslandes Bayern. Schriftenreihe der Forstwissenschaftlichen Fakultät der Universität München und der Bayerischen Landesanstalt für Wald und Forstwirtschaft, Nr. 159.

BOSSHARD, Hans Heinrich: Holzkunde, 2nd ed., Basel, Boston, Stuttgart 1982

BURSCHEL, KÜRSTEN, LARSON (1993): Die Rolle von Wald und Forstwirtschaft im Kohlenstoffhaushalt. Eine Betrachtung für die Bundesrepublik Deutschland. Forstliche Forschungsberichte München Nr. 126

ELLENBERG, MAYER, SCHAUERMANN: Ökosystemforschung- Ergebnisse des Sollingprojekts 1966-1986. Stuttgart 1986

Federal Ministry of Food, Agriculture and Forestry: Statistisches Jahrbuch über Ernährung, Landwirtschaft und Forsten, 1990 ff.

SPIECKER, H.; MIELIKÄINEN, K.; KÖHL, M; SKOVSGAARD, J.P. (1996): Growth trends in European Forests. Research Report No. 5 European Forest Institute (EFI), Joensuu, Finland. Springer Berlin/Heidelberg.

[6] BOSSHARD , Hans Heinrich (1982)

Table 2: Carbon Stock Changes in Germany's Forests 1990-1994

				Oak	Beech	other broad-leaf trees, l.	other broad-leaf trees,s.	Spruce	Silver Fir	Douglas fir	Pine	Larch	**Total**
1	Area	ha		876,476	1,424,206	397,860	744,835	3,299,281	160,277	133,683	2,807,175	300,088	10,143,881
2	Increment	m³ o.b./ha*y	roundwood > 7cm o.b.	6.1	8.9	4.6	4.0	11.4	8.3	8.9	6.9	8.4	8.3
3	Increment	m³ o.b./y	roundwood > 7cm o.b.	5,346,504	12,675,433	1,830,156	2,979,340	37,611,803	1,330,299	1,189,779	19,369,508	2,520,739	84,194,212
4	*Conversion factor*	m³ o.b./m³ u.b.	roundwood > 7cm	*1.511*	*1.273*	*1.499*	*1.559*	*1.278*	*1.082*	*1.362*	*1.317*	*1.512*	
5				Oak	Beech and other broad-leaf trees			Spruce and other conifers			Pine and Larch		**Total**
6	Increment	m³ o.b./y	roundwood > 7cm o.b.	5,346,504		17,484,929			40,131,881			21,890,247	84,853,561
7	*Expansionsfactor*	*total a.-g. wood volume/wood>7 cm*		*1.24*		*1.24*			*1.14*			*1.14*	
8	Increment	m³ o.b./y	above-ground wood volume	6,629,664		21,681,312			45,750,345			24,954,881	99,016,203
9	*Conversion factor*	*t/m³*	*above-ground woody biomass*	*0.56*		*0.55*			*0.37*			*0.43*	
10	**Increment**	t/y	*above-ground woody biomass*	**3,712,612**		**11,924,722**			**16,927,627**			**10,730,599**	43,295,560
11	Harvest	m³ u.b./y	roundwood > 7cm u.b.	1,086,200		6,161,000			25,930,400			6,380,600	39,558,200
12	*Conversion factor*	m³ o.b./m³ u.b.	roundwood > 7cm	*1.511*		*1.345*			*1.274*			*1.339*	
13	Harvest	m³ o.b./y	roundwood > 7cm o.b.	1,641,247		8,289,612			33,043,390			8,545,446	51,519,695
14	Harvest	m³ o.b./y	above-ground wood volume	2,035,146		10,279,118			37,669,465			9,741,808	59,725,538
15	**Harvest**	t/a	*above-ground woody biomass*	**1,139,682**		**5,653,515**			**13,937,702**			**4,188,978**	**24,919,876**
16	Stock Change	t/a	*above-ground woody biomass*	2,572,930		6,271,207			2,989,925			6,541,621	18,375,684
17	Stock Change	t/a*ha	*above-ground woody biomass*	2.9		2.4			0.8			2.1	1.8
18	*Proportion of C in biomass*			*50%*		*50%*			*50%*			*50%*	
19	**C-Stock Change**	t/a	*C in a.-g. woody biomass*	**1,286,465**		**3,135,603**			**1,494,963**			**3,270,811**	**9,187,842**
20	**CO2-Sequestration**	*3.67 CO2/C*	t CO2/year	**4,721,327**		**11,507,664**			**5,486,513**			**12,003,875**	**33,719,380**

No.	Explanatory notes for table 2/ Data sources
1	Forest Area from - National Forest Inventory 1986-1990 for the old laender („Bundeswaldinventur 1986-1990 - Inventurbericht und Übersichtstabellen für das Bundesgebiet nach dem Gebietsstand vor dem 3.10.1990 einschließlich Berlin (West)“, Tabelle 1.3, BML, 1992) - Forest Database of the new laender („Der Wald in den neuen Bundesländern – Eine Auswertung vorhandener Daten nach dem Muster der Bundeswaldinventur“, BML, 1994, Tabelle 1.3) The area in table 2 includes only productive managed forest area while table 1 includes the total forest area.
2	The increment has been estimated, based on yield tables and on field measurements of tree diameters and heights which had been made during the national forest inventory in 1986-1990, by H. Englert (Federal Research Centre for Forestry and Forest Products) as an input for the EFI New European Forest Resource Database, EFI Internal Document no. 1, Nabuurs, G.J., Joensuu, 1996
3	= (1) * (2)
4	Conversion factors derived from the volume functions used for the National Forest Inventory
5	Tree species with comparable physical wood properties have been aggregated to broader categories, since harvest statistics is available only for these categories, not for individual tree species
6	totals from line (4)
7	Expansion factors drawn from an internal Study of the Federal Research Centre for Forestry and Forest Products on the default data of the IPCC Guidelines for GHG Inventories: „Stellungnahme zu den Defaultwerten und Datenherleitung im IPCC-Treibhausgas-Inventar“, R. Baritz, BFH, Institut Für Forstökologie und Walderfassung, 1995, Kapitel 4.2 d)
8	= (6)* (7)
9	wood density drawn from the literature („Stellungnahme zu den Defaultwerten und Datenherleitung im IPCC-Treibhausgas-Inventar“, R. Baritz, BFH, Institut Für Forstökologie und Walderfassung, 1995, Kapitel 4.2 d))
10	= (8)*(9)
11	Average over the years 1990-1994 drawn from harvest statistics of the Federal Ministry of Food, Agriculture and Forestry
12	see line 4
13	=(11)*(12)
14	= (13)*(7)
15	= (14)*(9)
16	= (15)-(10)
17	= (16)/(1)

Table 3: Emissions from deforestation (above and below ground biomass)													
A	B	C	D	E	F	G	H	I	J	Non-CO2 gas emissions			
										N/C-Ratio			*0.01*
Year	Area	Carbon Stock		C-Stocks in	C from above-gr. biomass going to...			C-Stocks in	**Total**				
		above-	below-	above-ground	Industrial	other forest	on site	below-ground	**CO2-source**	*Trace Gas emission ratios*			
		ground	ground	biomass	Round wood	products and	burning	biomass	**from biomass**	CH4	0.012		
					60%	off site burning				CO	0.060		
						20%	20%			N2O	0.007		
										NOx	0.121		
	ha	t C/ha	t C/ha	Gg C	Gg C	Gg C	Gg C	Gg C	**Gg CO2**	**Gg CH4**	**Gg CO**	**Gg N2O**	**Gg N0x**
1990	2700	88	17	238	143	48	48	46	1027	0.760	6.653	0.0052	0.189
1991	2700	88	17	238	143	48	48	46	1027	0.760	6.653	0.0052	0.189
1992	2700	88	17	238	143	48	48	46	1027	0.760	6.653	0.0052	0.189
1993	2618	88	17	230	138	46	46	45	996	0.737	6.451	0.0051	0.183
1994	1985	88	17	175	105	35	35	34	755	0.559	4.891	0.0038	0.139
1995	2139	88	17	188	113	38	38	36	814	0.602	5.270	0.0041	0.150
1996	2383	88	17	210	126	42	42	41	907	0.671	5.872	0.0046	0.167
1997	2700	88	17	238	143	48	48	46	1027	0.760	6.653	0.0052	0.189
1998	2700	88	17	238	143	48	48	46	1027	0.760	6.653	0.0052	0.189
1999	2700	88	17	238	143	48	48	46	1027	0.760	6.653	0.0052	0.189
2000	2700	88	17	238	143	48	48	46	1027	0.760	6.653	0.0052	0.189
2001	2700	88	17	238	143	48	48	46	1027	0.760	6.653	0.0052	0.189
2002	2700	88	17	238	143	48	48	46	1027	0.760	6.653	0.0052	0.189
2003	2700	88	17	238	143	48	48	46	1027	0.760	6.653	0.0052	0.189
2004	2700	88	17	238	143	48	48	46	1027	0.760	6.653	0.0052	0.189
2005	2700	88	17	238	143	48	48	46	1027	0.760	6.653	0.0052	0.189
2006	2700	88	17	238	143	48	48	46	1027	0.760	6.653	0.0052	0.189
2007	2700	88	17	238	143	48	48	46	1027	0.760	6.653	0.0052	0.189
2008	2700	88	17	238	143	48	48	46	1027	0.760	6.653	0.0052	0.189
2009	2700	88	17	238	143	48	48	46	1027	0.760	6.653	0.0052	0.189
2010	2700	88	17	238	143	48	48	46	1027	0.760	6.653	0.0052	0.189
2011	2700	88	17	238	143	48	48	46	1027	0.760	6.653	0.0052	0.189
2012	2700	88	17	238	143	48	48	46	1027	0.760	6.653	0.0052	0.189
area: 1990-1992 and 1997-2012 estimate; 1993-1996 areas reported by the laender													

IRELAND

Country specific data for Ireland relating to Articles 3.3 and 3.4 of the Kyoto Protocol

Explanatory notes to Table 1

- Afforestation is land approved for planting grants by the Forest Service. This includes Coillte (Irish Forestry Board) planting. Source: Forestry Statistics (Forest Service).

- Reforestation (FAO definition) is land regenerated (by planting in all cases) one to two years after final felling by Coillte and the private sector. Source: Coillte Annual Reports 1990-1999 (data for 1994 personal communication, Coillte) and Forest Service statistics.

- Deforestation represents a small area of land taken out of forest for house construction or road building. It is estimated to be 20 ha an^{-1} (source Forest Service). As the amount of carbon that would be debited (estimated to be 1300 t C ha^{-1} an^{-1}) are so small in relation to the other carbon stocks that it is not reported in Table 1.

- Land based I reforestation takes into account carbon released by felling in the year prior to reforestation. However, carbon released from felling associated with 1990 reforestation (which would have occurred in 1989 in the great majority of cases) is not included in a_I and a_{II}, nor is the release from 2008 reforestation included in a_{cp}.

- In the case of reforestation, the land based II approach takes into account carbon released by harvesting residues (estimated to be 7 t C ha^{-1}) on land following the activity. An instantaneous release of carbon from harvesting residues was assumed for calculation purposes.

- Carbon pools for afforestation and reforestation include above ground biomass, litter and woody debris and below ground biomass.

Data sources and calculation assumptions associated with Table 1.

Private sector reforestation was estimated from the cost of grant aid for reforestation in the period 1996-1999 divided by the average grant aid per ha for the same period (average 200 ha yr^{-1}).

For the purpose of calculating carbon stocks it was assumed that 80% of annual planting was Yield Class 16 Sitka spruce and 20% Yield Class 4 beech (Forestry Commission yield models). The same assumption was made for reforestation. A periodic mean annual increment of 4.4 m^3 ha^{-1} an^{-1} was assumed for Sitka spruce less than 17 years, and
16.2 m^3 ha^{-1} an^{-1} for Sitka spruce between 17 and 22 years. A periodic mean annual increment of 0.9m^3 ha^{-1} an^{-1} was assumed for all broadleaved species. The basic density of Sitka spruce was assumed to be 0.35 kg m^{-3}, the ratio of stemwood volume to total biomass (above and below ground) 1.3 and the carbon content of the wood 40%. For broadleaved species the basic density was assumed to be 0.55kg m^{-3}, the ratio of stemwood volume to total biomass (above and below ground) 1.3 and the carbon content of wood 45%. Loss of carbon as a result of felling associated with reforestation was assumed to be 65 t C ha^{-1} (Cruickshank *et al.*, 1998). The loss of carbon from slash was estimated to be 7 t C ha^{-1} (based on a estimate of slash dry matter of 50 t ha^{-1}.

Explanatory notes to Table 2.

The areas in the vegetation cover classes were estimated from the CORINE land cover (Ireland) project (O'Sullivan, 1994). Woodland cover was estimated as the sum of the Broad-leaved forest, Coniferous forest, Mixed forest and Transitional woodland/scrub categories. The area of tillage was estimated as the sum of the Non-irrigated arable land and half of the Complex cultivation patterns categories. The area of grassland was estimated to be the sum of Pastures, Land principally occupied by agriculture with significant areas of natural vegetation, Natural grassland and half of the Complex cultivation patterns (C242) and Natural grassland categories. The area of peatland was estimated as the sum of Peat bogs, the Moors and heathland, and half of the Natural grassland. Other comprises Green urban areas and Sport and leisure areas.

Data sources and calculation assumptions associated with Table 1.

The carbon content of vegetation under tillage was estimated at 3000 kg dm ha^{-1} (Teagasc – The Agriculture and Food Development Authority) with an organic carbon content of 40%. The carbon content of vegetation under pasture was estimated at 1,500 kg dm ha^{-1} (Teagasc) with an organic carbon content of 40%.

The carbon content of soil under tillage was calculated to 15 cm depth, assuming an organic carbon content of 3.43% and a bulk density of 1.3 g cm^{-3} (McGrath, 1982).
The carbon content of soil under pasture was calculated to 15 cm depth, assuming an organic carbon content of 5.3% and a bulk density of 1.3 g cm^{-3} (Brogan 1966).

The carbon content of peatlands was calculated by first deriving the volume of peat. In the case of the Corine peat bogs category, a weighted average peat depth was calculated from Hammond (1979). The volume was obtained by simple multiplication of the area by the depth. The peat was assumed to have a dry matter content of 15% with a carbon content of 40% dry matter. In the case of the two remaining categories designated as woodland an average peat depth of 0.3 m was assumed.

BIBLIOGRAPHY

Brogan, J.C. 1966. Organic carbon in Irish pasture soils. Irish Journal of Agricultural Research, 5:169-176.

Cruickshank, M.M., Tomlinson, R.W., Devine P.M. and Milne, R. 1988. Carbon in he vegetation and soils of Northern Ireland. Biology and Environment. Proceedings of the Royal Irish Academy. Vol. 98B (1) 9-21.

Hammond, R.G. 1979. The peatlands of Ireland. Soil Survey Bulletin No 35. An Foras Talúntais, Dublin.

McGrath, D. 1982. Organic carbon levels in Irish soils. *In*: Soil Degradation. Eds. Boels, D., Davies D.B. and Johnston, A.E. Proceedings of the land use seminar on soil degradation. Wageningen, 13-15 October 1980. A.A. Balkema, Rotterdam.

O'Sullivan, G. (ed.) 1994. *CORINE land cover project (Ireland).* Project Report. Council of the European Commission, Directorates-General XI (Environment) and XIV (Regional Policy). Dublin and Belfast. Ordnance Survey of Ireland and Ordnance Survey of Northern Ireland.

Table 1 Preliminary data and information provided by Annex 1 Party on carbon stock changes and areas related to article 3.3 activities

Article 3.3 Country specific data	Definitions	Accounting framework	a_I 000 ha	$\cong C_I$ kt C	a_{II} 000 ha	$\cong C_{II}$ kt C	A_{cp} 000 ha	$\cong C_{cp}$ kt C	Methods and approaches
Afforestation Reforestation	IPCC	Activity based	86	148	172	591	367	4573	See below
		Land based	86	148	172	591	367	4573	See below
Afforestation	FAO	Activity based	86	148	172	591	367	4573	See below
		Land based	86	148	172	591	367	4573	See below
Reforestation	FAO	Activity based	22	45	59	190	160	2313	See below
		Land based I	22	-1106	59	-3313	160	-345	See below
		Land based II	22	-79	59	-323	160	-199	See below

Table II. Preliminary data and information provided by Annex I Party on carbon stocks and area estimates (First sentence of Article 3.4)

LAND USE	Area M ha	Soil carbon stock in 1990 Mt C	Vegetation carbon stock in 1990 Mt C	Total carbon stock in 1990 Mt C
Woodland	0.4	122.2	13.9	136.1
Tillage	0.4	27.0	1.3	28.3
Grassland	4.5	564.3	18.0	582.3
Peatland	1.4	1597.6	1.4	1599.0
Other	0.0	1.1	0.0	1.1
TOTAL	**6.7**	**2312.2**	**34.6**	**2346.8**

ITALY

Table I - Preliminary data and information provided by Annex I Party on carbon stock changes and areas related to Article 3.3 activities

Article 3.3 Country specific data	Definitions	ACCOUNTING FRAMEWORK	A_I (ha)	ΔC_I (MtC)	A_{II} (ha)	ΔC_{II} (MtC)	A_{cp} (ha)	ΔC_{cp} (MtC)	Methods and approaches	Data sources, data quality, and uncertainty (e.g. ranges)	Other information relevant to decision-making
Afforestation Reforestation	IPCC	Activity based/ Land based	32513	0,121	75082	0,692	221879	2,365			
Afforestation	FAO	Activity based/ Land based	32513	0,121	75082	0,692	221879	2,365			
Reforestation	FAO	Activity based									
		Land based I									
		Land based II									
Afforestation Reforestation	Other	Activity based									
		Land based									
Deforestation	IPCC/FAO	Activity based									
		Land based									
	Other	Activity based									
		Land based									

a_I Area (ha) afforested and reforested, or deforested since 1990 up to 1995 or possibly an earlier specific year.
ΔC_I Carbon stock change (t C) since 1990 up to the same year as used in a_I on land afforested, reforested, and deforested.
a_{II} Area (ha) afforested and reforested, or deforested since 1990 up to 1999 or an earlier specific year.
ΔC_{II} Carbon stock change (t C) since 1990 up to the same year as used in a_{II} on land afforested, reforested, and deforested.
a_{cp} Projected area (ha) afforested and reforested, or deforested since 1990 up to 2012.
ΔC_{cp} Projected carbon stock change (t C) over the first commitment period on land afforested, reforested, and deforested since 1990 up to 2012.

EXPLANATORY TEXT (table I)

As a consequence of the Common Agricultural Policy reform, Regulation 2080 has been approved in 1992 to provide incentives to the farmer to convert their agricultural land to forests. To provide preliminary information on the implementation of Article 3.3, we have used figures provided by the Ministry for Agricultural Policies on new farm woodlands established under this grant scheme. The amount of carbon currently stored in new farm woodlands, a carbon budget model has been used (details are provided in the subsequent paragraph). Figures on areas planted in Italy without grant-aid are not available. In addition, since 1994, information on areas of new planting and restocking carried out under local authorities (Regions, Mountain Communities) projects is not anymore provided from the National Institute of Statistics.

Table II - Preliminary data and information provided by Annex I Party on carbon stocks and area estimates (First sentence of Article 3.4)

Land system	***Area (ha)***	***Carbon stock in 1990 (Mt C)***
Forest lands	9973861	810,78
Agriculture lands	12678258	560,41
Rangelands/grasslands	4106080	298,10
Wetland/tundra		
Other		
Total (as listed above)	26758199	1669,29

Land system	***Area (ha)***	***Carbon stock in 1997 (Mt C)***
Forest lands	10028667	815,87
Agriculture lands	12524373	550,74
Rangelands/grasslands	3860167	280,25
Wetland/tundra		
Other		
Total (as listed above)	26413207	1646,86

EXPLANATORY TEXT (table II)

As part of the information required by the first sentence of Article 3.4 of the Kyoto Protocol, the amount of carbon currently stored in Italy's forest vegetation and soil is being estimated by means of a carbon budget model. On an annual basis, the model, called FOCSEM (FOrest Carbon Storage Evaluation Model) also estimates the rate of exchange between ecosystem components and the atmosphere.

According to this model, current carbon storage is estimated separately for several forest ecosystems components: trees, soil, forest floor and understory vegetation. The definitions of these components are broad enough to include all sources of organic carbon in the forest ecosystem. The tree portion includes all above- and below-ground portions of all live and dead trees, including the merchantable stem, the limbs, tops, and cull section, the stump, the foliage, the bark and rootbark, and coarse tree roots. The soil components include all organic carbon in mineral horizons to a depth of 1 m, excluding coarse tree roots. The forest floor includes all dead organic matter above the mineral horizons except standing trees, i.e. litter, humus and other woody debris. Understory vegetation includes all live vegetation except live trees.

Carbon storage is estimated in a four-stage process corresponding to the four major ecosystem components.

Estimates of carbon storage in trees are based on Corine Land Cover survey (forested area), on the Italian Institute of Statistics (ISTAT) figures (historical estimates of forested area, removals, fires). Growing stock and net annual increment have been drown from the 1985 National Forest Inventory and commonly collected forest inventories on regional and sub-regional scale; the INDEFO surveys on the state of the forests provided data on mortality, while regional administration provided data on new forest stand establishments. The approach used to compute the carbon budget is based on the use of these figures, linked to forest tree growth and yield functions and converted to tree carbon using conversion factors, derived from comprehensive biomass studies. Carbon in the above-mentioned other pools is estimated by empirical equation based on several site-specific information from ecological studies.

In the estimation of changes in carbon storage over time, different types of forests: high forests (conifers, broadleaves, mixed); coppices; farm woodlands; urban forests; maquis and abandoned agricultural lands) have been considered; data are disaggregated on a regional basis.

The carbon stored in agriculture lands and grasslands has been estimated according to the 1996 IPCC Revised Guidelines for the activity "CO_2 Emissions and Uptake from Land-Use Change and Management".

Table III - Preliminary data and information provided by Annex I Party on Article 3.4 activities, related net GHG emissions, involved areas, and projected carbon stock changes (additional activities under Article 3.4)

Article 3.4 Country specific data	ACCOUNTING FRAMEWORK	A_I (HA)	$CO_{2,I}$ ($ktCO_2$)	$CH_{4,I}$ ($ktCO_{2\ eq.}$)	$N_2O_{,I}$ ($ktCO_{2\ eq.}$)	A_{II} (HA)	$CO_{2,II}$ ($ktCO_2$)	$CH_{4,II}$ ($ktCO_{2\ eq.}$)	$N_2O_{,II}$ ($ktCO_{2\ eq.}$)	A_{cp} (HA)	$CO_{2,cp}$ ($ktCO_2$)	$CH_{4,cp}$ ($ktCO_{2\ eq.}$)	$N_2O_{,cp}$ ($ktCO_{2\ eq.}$)	Methods and approaches	Data sources, data quality, and uncertainty (e.g. ranges)	Other information relevant to decision-making
Activities to avoid carbon emissions (fires prevention)	Land based															
	Activity based	11286	2237,6	32,0	3,3	81019	4201,3	127,7	13,0							
Conversion of grazing lands to forest	Land based															
	Activity based	436767	4954,5			630737	8125,4			1308339	20320,8					
	Land based															
	Activity based															

* These columns would contain the sum over the years concerned of net annual emissions by sources and removals by sinks for the Article 3.4 activities proposed.

A negative sign indicates either emissions by sources or a decrease in carbon stocks. A positive sign indicates either removals by sinks or an increase in carbon stocks.

To convert a carbon amount to CO_2 multiply it by 3.67.

§ CH_4 and N_2O emissions are converted to CO_2 equivalent emissions by using the global warming potential (GWP) values of 21 for CH_4 and 310 for N_2O (Source: Second Assessment Report of the IPCC, 1995)

a_I Area (ha) in 1995 or possibly an earlier specific year involved in the Article 3.4 activity since 1990.

$CO_{2,I}$ Net CO_2 emissions (t CO_2) by sources and removals by sinks related to the Article 3.4 activity, accumulated from 1990 to the same year as used in a_I.

$CH_{4,I}$ CH_4 emissions (t CO_2 equivalent) by sources related to the Article 3.4 activity, accumulated from 1990 to the same year as used in a_I.

$N_2O_{,I}$ N_2O emissions (t CO_2 equivalent) by sources related to the Article 3.4 activity, accumulated from 1990

$N_2O_{, I}$ N_2O emissions (t CO_2 equivalent) by sources related to the Article 3.4 activity, accumulated from 1990 to the same year as used in a_I.

a_{II} Area (ha) in 1999 or possibly an earlier specific year involved in the Article 3.4 activity since 1990.

$CO_{2, II}$ Net CO_2 emissions (t CO_2) by sources and removals by sinks related to the Article 3.4 activity, accumulated from 1990 to the same year as used in a_{II}.

$CH_{4, II}$ CH_4 emissions (t CO_2 equivalent) by sources related to the Article 3.4 activity, accumulated from 1990 to the same year as used in a_{II}.

$N_2O_{, II}$ N_2O emissions (t CO_2 equivalent) by sources related to the Article 3.4 activity, accumulated from 1990 to the same year as used in a_{II}.

a_{cp} Projected area (ha) in 2012 involved in the Article 3.4 activity since 1990.

ΔC_{cp} Projected carbon stock changes (t C) over the first commitment period related to the Article 3.4 activity since 1990.

$CO_{2, cp}$ Projected net CO_2 emissions related contribution (t CO_2) of the Article 3.4 activity to the first commitment period assigned amount of the Party.

$CH_{4, cp}$ Projected CH_4 emissions related contribution (t CO_2 equivalent) of the Article 3.4 activity to the first commitment period assigned amount of the Party.

$N_2O_{, cp}$ Projected N_2O emissions related contribution (t CO_2 equivalent) of the Article 3.4 activity to the first commitment period assigned amount of the Party.

EXPLANATORY TEXT (table III)

As concerns the contribution of additional human-induced activities to the national carbon budget of Annex I countries, Italy is an interesting study case for the following reasons:

- large part of the forest land is covered by semi-natural stands, with a growing stock well below the maximum long-term average;
- the abandonment of marginal agricultural area is favouring the natural conversion of grazing land to forest;
- large amount of wood removals is used for energy with substitution effects for fossil fuel consumption;
- fires are one of the major causes of carbon emissions from natural ecosystems in the region, and several strategies have been launched in order to limit this phenomenon;
- wood working industries are specialised in high quality furniture making, with a considerable, long-term carbon sequestration in wood products.

Broadly defined activities would be easier to include in national carbon budgets: this would support verifiability, practicability and cost-efficiency of accounting, and would take into account both increases and decreases in carbon stock at aggregated levels. Activities should be restricted to actively managed forest lands, or to forest lands that meet some certification criteria.

With reference to the Mediterranean context, the main activities contributing to the increase of carbon stocks could be grouped as follows:

1. Activities to avoid carbon emissions;
2. Soil carbon conservation;

3. Forest conservation;
4. Forest management and silvicultural techniques.

In Table III, we have provided estimates for the two following activities, for which statistical information is already available in our country:

- Activities to avoid carbon emissions (fires prevention)
- Conversion of grazing lands to forest.

Activities to avoid carbon emissions (fires prevention)

Fires are one of the major causes of carbon emissions from natural ecosystems in the Mediterranean region. Data on number of events and hectares hit by fire are provided by the Yearbook of Forest Statistics (ISTAT); their quality is fairly good. As the nature of these events is clearly anthropogenic, the related emissions have been reported in the national GHG inventory (1st and 2nd National Communication). In the last decades, several strategies – based on better monitoring, clear assignment of tasks to the different administrations and training of personnel working at the local level - have been launched in order to limit this phenomenon.
When the reduction of forest fires can be clearly attributed to these policies, the resulting reduction in carbon emissions can be measured as avoided GHG emissions with reference to a specific baseline (in our case, we assumed the average surface hit by fire in the period 1980-1989), and considered as an additional activity under Art. 3.4.

Conversion of abandoned grazing lands to forest

As a consequence of a clear commitment made by the European Community and the national authorities to reduce the price protection policy for many agricultural products, marginal agricultural land is abandoned and naturally converted to forestland. This is not a “natural” process, being linked to Common Agricultural Policy reform, to a new model of rural development based on a multi-sectoral economy (tourism and recreation, handicraft, high quality agricultural products for niche market, timber production, etc.).

NETHERLANDS

Table I Preliminary data and information provided by Annex I Party on carbon stock changes and areas related to article 3.3 activities

Article 3.3 Country specific data	Definitions	Accounting framework	a_I(ha) (1995)	ΔC_I(t C)	A_{II}(ha) (1999)	ΔC_{II}(t C)	a_{cp}(ha) (2012)	ΔC_{cp}(t C)	Methods and approaches	Data sources, data quality, and uncertainty (e.g. ranges)	Other information relevant to decision-making
Afforestation[1)]	IPCC	Activity based	0	0	0	0	0	0	see below	see below	see below
		Land based[3)]	0	0	0	0	0	0			
Reforestation[1)]	IPCC	Activity based	5400	48600	6340	95100	10240-55660	76800-417450			
		Land based[3)]	5400	48600	6340	95100	10240-55660	76800-417450			
Afforestation[1)]	FAO	Activity based	5400	48600	6340	95100	10240-55660	76800-417450			
		Land based[2)]	5400	48600	6340	95100	10240-55660	76800-417450			
Reforestation[1)]	FAO	Activity based	15600	37440	26000	104000	52000	208000			
		Land based I	15600	-570960	26000	-1456000	52000	-468000			
		Land based II	15600	-102960	26000	-676000	52000	-130000			
Deforestation[1)]	IPCC/FAO	Activity based	1323	-79358	2204	-132264	5070	-66132			
		Land based	1323	-78036	2204	-130060	5070	-65030			

Sum of Afforestation Reforestation and Deforestation[4)]	**IPCC**	**Activity based**		**-30758**		**-37164**		**10668**
		Land based		**-29436**		**-34960**		**11770**
	FAO	**Activity based**		**6682**		**66836**		**218668**
		Land based I		**-600396**		**-1490960**		**-456230**
		Land based II		**-133718**		**-713164**		**-119332**

[1)] Because no data on soil carbon losses during deforestation are available, soil carbon is excluded. Soil carbon sequestration due to afforestation and reforestation is assumed to be very small (0,1 tC/ha/y) and not accounted, to keep similarity

[2)] For The Netherlands afforestation FAO Land based is split up in Land based I and Land based II, with values for ΔC_I of 24300 and 32400, for ΔC_{II} of 47550 and 63400 and for ΔC_{cp} of 76800 and 102400 (all in t C), respectively; values presented in the table are averages of Land based I and Land based II. For further details on calculations please refer to explanatory material below.

[3)] Afforestation IPCC is zero for both Activity based and Land based in The Netherlands (see also explanatory text). Reforestation IPCC is the same as afforestation FAO (*in practical terms for the Netherlands)*. It has been calculated the for activity based, land based I and land based II accounting approaches. The values presented in the table are the averages of Land based I and Land based II.

[4)] Sum includes 10240 ha (aff FAO / ref IPCC), and does not include the high estimated 55660 ha.

a_I : Area (a) afforested and reforested, or deforested since 1990 up to 1995 or possibly an earlier specific year.
ΔC_I : Carbon stock change (t C) since 1990 up to the same year as used in a_I on land afforested, reforested, and deforested.
a_{II} : Area (ha) afforested and reforested, or deforested since 1990 up to 1999 or an earlier specific year.
ΔC_{II} : Carbon stock change (t C) since 1990 up to the same year as used in a_{II} on land afforested, reforested, and deforested.
a_{cp}: Projected area (ha) afforested and reforested, or deforested since 1990 up to 2012.
ΔC_{cp}: Projected carbon stock change (t C) over the first commitment period on land afforested, reforested, and deforested since 1990 up to 2012.

EXPLANATORY TEXT (Information relevant to the approach taken in table I):

1. Definitions and accounting

1a) Forest definition used in this assessment:
Land with tree crown cover (or equivalent stocking level) of more than 20% and area of more than 0.5 ha. Trees should be able to reach a minimum height of 5 m at maturity in situ. Furthermore, in The Netherlands a forest must have a minimum average width of 30 meters. May consist of close formations where trees of various stores and undergrowth cover a high proportion of ground or open forest formations with a continuous vegetation cover in which tree crown cover exceeds 20%. Young natural stands and all plantations established for forestry purposes which have yet to reach a crown density of 20 percent or tree height of 5m are included under forest, as are areas normally forming part of forest area which are temporarily unstocked as a result of human intervention or natural causes but which are expected to revert to forest. The Dutch forest law requires a tree crown cover of 20%, whereas the UN-ECE/FAO (2000) compilation of national forest inventory data uses only 10%. Dutch forest area statistics according to the 10% crown cover limit are not available.

1b) Definitions and accounting approaches for afforestation, reforestation and deforestation, used in this assessment:

Afforestation IPCC: "Planting of new forests on lands that historically have not contained forests".
For the purpose of this assessment, we have assumed this land to be 0 ha, because practically all lands in the Netherlands were covered with forest in pre historic times (Buis 1985, Mather 1990, Rackham 1998). Therefore, all planting of new forests on lands that were in use for agriculture at the time of planting do not fall under this definition of afforestation. It is assumed that afforestation on reclaimed lands in the polders is also 0 ha. That is an underestimation. Data are available on polder areas which are afforested, but not accounted in this assessment.
If afforestation were defined as "land that did not have forest for 50 years" (as in the EU proposal), then IPCC afforestation would comprise almost the same number as we report under "FAO reforestation" (see below). I

Reforestation IPCC: "Planting of forests on lands that have previously contained forests but that have been converted to some other use."

The definition of '*Reforestation IPCC*' in the Netherlands leads to similar results as '*Afforestation FAO*'.

Afforestation FAO: "Artificial establishment of forest on lands that previously did not carry forest within living memory.": 5400 ha. The Netherlands has as part of its forest policy the aim to expand the current forest area with some 75,000 ha before the year 2020. However, up to now it seems that that goal will not be achieved (Edelenbosch 1996, Hinssen 1998). An ex post evaluation was carried out of the rate of forest expansion since 1990 (Edelenbosch 1996). He reports an area of new forests on previous agricultural lands of 5400 ha between 1990 and 1995. Since the annual rate of forest expansion is decreasing fast, we have assessed an additional forest area expansion of only 940 ha between 1996 and 1999 (Hinssen 1998).
For the period 1990-2012, it was assumed that the interest of the Dutch Government in forest area expansion would continue. According to the forest policy aim of 75000 ha between 1989 and 2020 this would imply a yearly expansion of 2420 ha. This is also the assumption of the National Climate Policy Implementation Plan. This results in a total area increase, since 1990, in 2012 of 55660 ha.
This expansion would be achieved through, inter alia, a system of "tradeable forest certificates". However, on the basis of the areal expansion in the second half of the 1990's as assessed by the ex post evaluation, this number of 2420 ha/yr may not be achieved. To reflect this projection-uncertainty, we have assumed, as the lower range of this projected area that the rate of forest expansion will be 300 ha per year (after 2000) yielding a total area increase of 10,240 ha since 1990 (see also Nabuurs et al. 1999, 2000).

Reforestation FAO: "Artificial establishment of forest on lands that carried forest before"
The current practice of final felling and replanting or seeding is carried out on some 2600 ha per year (Seubring 1997). For the period 1990-1995, this gives a total area of 2600*6 = 15,600 ha.
It was assumed that the same rate could be applied to the whole of the period 1990-1999. However, for the period 1999 to 2012, we assumed that the annual reforestation area will go down to 2000 ha per year, because forest owners may pay less attention to the timber production function of the forest in the future. This gives a total area of reforestation for the period 1990-2012 of 52,000 ha.

Activity based, Land based I, and Land based II accounting systems have been used in this assessment according to definitions in the IPCC Special reports p. 131.

Deforestation IPCC/FAO: Conversion of forest to non-forest.
UN-ECE/FAO (2000) report for the EU 15 countries an annual deforestation rate of 0.066%. We have applied this same annual value throughout each period (slow degradation, expansion of cities, road building etc. are going on in The Netherlands too), for more detailed data are lacking for the Netherlands. For the 3 periods this results in a total deforestation of 1323, 2204, and 5070 ha.

I.e. the carbon loss is reported for the total area loss in each accounting period. This in contrast to when you would give an annual balance of the sum of ARD in the commitment period. In that case the sum of areas of AR since 1990 is taken and only one year of D between 2008 and 2012 is taken.

1c) Accounting approach:
Full carbon accounting is used for all three approaches (Activity based, Land based I, and Land based II) in a manner by which C-stock changes are based on area times an uptake factor.

Period 1990-1995: 6 years. *The reported carbon stock changes are for the full period.*
Period 1990-1999: 10 years *The reported carbon stock changes are for the full period.*
Period 1990-2012: 23 years. *The reported carbon stock changes are only for the first commitment period i.e. 2008-2012: 5 years*

2) Carbon pools included
All carbon pools are included for re- and afforestation: whole tree biomass (including roots), litter, slash, and wood products), except for soil carbon. Soil Carbon was excluded from afforestation and reforestation activities for consistency with deforestation , because no data are available on soil carbon losses during deforestation (see below). The stand level model CO2FIX was run (see fig 1). CO2FIX gives a dynamic C balance for a full rotation of any given forest type, including soil and products. The long term net resulting balance is used for the Dutch estimate, although we realise that products actually do not play a role in this short term (1990-2012) as required for the submission. Even in the long term, the role of products is very small, so the inaccuracy is very small.
In deforestation all pools (including loss of whole tree carbon content) but without soil carbon is taken into account (see below at 4c). We decided not to include soil carbon loss estimates here, because there are no data available. Deforestation in the Netherlands consists of gradual degradation, road building, city expansion etc. What happens to the soil varies a lot (sols may get covered by concrete, or are removed). The uncertainty is therefore very large.

3) Stratification
For the Dutch forest, the average carbon pools in the forest biomass and average regrowth rates are used. No further stratification, except for sampling (see 4b below), has been applied apart from regrowth rates for forests on agricultural lands and regrowth rates for the existing forest that is being harvested. For the subsequent periods simple assumptions were made for the regrowth rates times area per age class. We did not distinguish between forest growth rates (and soil carbon losses) on former cropland or pasture, or different soil types.

4) Methodologies and data:

a) Data sources

See explanation for area estimates above and explanation of effectiveness estimates below under c.

b) Sampling techniques

Results of the Dutch National Forest Inventory are used (Seubring 1997). The Dutch forest inventory consists of 3000 permanent plots of which 1/5th is re-measured every year. The selection of plots has been done through a stratified systematic sampling scheme that was drawn from the area statistic that was done the last time in 1983 (CBS 1985). In each plot (usually consisting of some 25 trees) height, diameters, etc are recorded. Also harvesting is recorded. Together with harvesting accounts from mills, and forest owners, a full account of harvesting is gathered. Through repeated measurements of the plots in combination with growth models, the increment is assessed.

c) Models and key parameters

For the assessment of C stock changes in this table we have multiplied the "areas" by an "uptake factor". Below we describe the uptake factors used in the assessment.

Afforestation FAO

Because no soil carbon is included, there is no difference between the following three scenarios.

- Activity based: 3.0 Mg C ha^{-1} y^{-1} was used (this is the proceeding average as indicated in figure 1). This is based on simulations with the model CO2FIX (Mohren et al. 1999, Nabuurs and Mohren 1993a, 1993b, 1995). The long-term average sequestration rate was used, even through we realise that we're dealing with young forest mostly here. Especially for the period 1990-1995, this sequestration rate may be too high.
- Land based I: previous land use was either pasture or cropland. In both cases carbon loss due to soil preparation is assumed. Exact loss is uncertain, but is expected to be higher under pasture than under cropland. We think the carbon loss is approximately 0,1 Mg C ha^{-1} y^{-1}, but it is not taken into account to keep straight with deforestation (also no soil carbon taken into account, due to lack of data).
- Land based II: previous land use was either pasture or cropland. In both cases, some soil carbon loss due to soil preparation is assumed. Exact loss is uncertain, but is expected to be higher under pasture than under cropland. For the same reason as Land based I, no soil carbon losses are accounted.

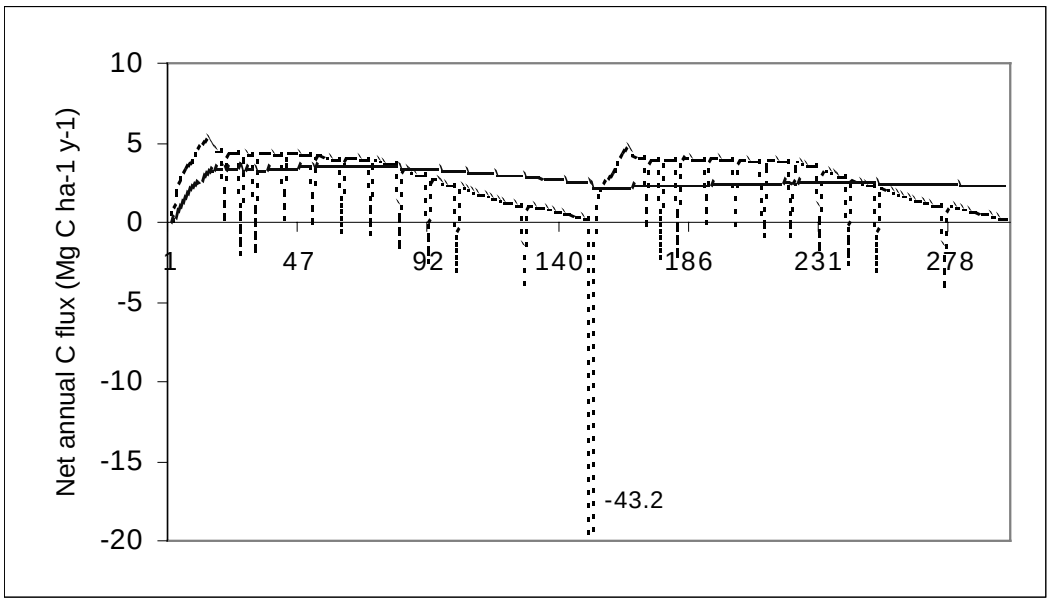

Figure 1. Annual C flux (dashed line) in two oak rotations in The Netherlands. The continuous line presents the proceeding average of the annual flux.

Reforestation IPCC is same as Afforestation FAO (*in practical terms for the Netherlands*)

Reforestation FAO Activity based: 0.8 tC ha^{-1} y^{-1} as a national average was used, because this activity is applied in the existing forest which, in the Netherlands, is situated on poor sites. Therefore regrowth is assumed to be much lower than in afforestation situations on former agricultural land. (Nabuurs and Mohren 1993b). This is used as an average value for each subsequent period, i.e. we do not take into account the ageing of forests and the effect that growth rates accelerate at higher ages. This is probably an overestimate because the 0.8 tC ha^{-1} y^{-1} is the national average sequestration rate for the current forest as it exists today in the Netherlands. In the periods up to 2012, the regrowing forests is on average some 11 years old in 2012. The growth rates of these young forests may be at about half of the sequestration rates mentioned above. This is highly uncertain because in inventories and in growth and yield measurements very little attention was paid to these young forest stages in the past.

Reforestation FAO Land based I: The full forest harvest has to be accounted, which means a loss of some 60 t C. It is assumed that the initial loss is only half of that (30 tC ha^{-1}), the other half being wood products and litter on the site (slash). The 30 tC slash will be lost within 10 years, so every year 3 tC ha^{-1}. Regrowth is assumed to be the same as afforestation: 0,8 tC ha^{-1} y^{-1}.

Reforestation FAO land based II: From the start of activity we account, but then full accounting, therefore decaying slash (3 tC ha^{-1} y^{-1}) and regrowth (0.8 tC ha^{-1} y^{-1}) is taken into account, but no harvest.

Deforestation IPCC&FAO (*activity based and land based II*): accounting starts at the start of the activity. We assume that the total whole tree carbon content is lost due to deforestation, i.e. 60 Mg C ha^{-1}. Loss of forest soil organic matter is not taken into account here, although it may be another 20 t C ha^{-1}.

Deforestation IPCC&FAO (*land based I*): Accounting starts on 1 January 2008, irrespective of the start of the activity. Therefore, it is possible forests are standing until the year 2011, which gives some C-sequestration. That's why the effectiveness is less negative compared to the 'Deforestation IPCC & FAO (land based I)': a net loss of 59 Mg C ha^{-1} is estimated. Loss of forest soil organic matter is not taken into account here, although it may be another 20 t C ha^{-1}.

NB: The uptake factors of afforestation and reforestation are divided by 2 for the period 1990-1995 and 1990-1999, because at the beginning of these periods no afforestation land existed; during the period this area is growing and only at the end of the period the full afforestation area is reached. So during the period the uptake factor can't be multiplied by the full area, but the average area during the period is half of the area. We have chosen to divide the uptake rate by a factor 2. This does not count for the 2008-2012 period, because in that period the full area almost exists during the whole period (Appendix A).
This correction is not applied to deforestation, because this is counted for only one year and thus has not to be corrected by dividing by 2.

d) Uncertainties
Forest inventories are usually reported to be very accurate. Uncertainties are less than 5% (Tomppo 1996). Main uncertainties are in assumptions for area estimates, and averaging of growth rates for the whole of the Netherlands that leads to the estimates on C stocks and fluxes.

5) Treatment of non-CO_2 greenhouse gases

Not treated; as water management during ARD activities is not changed, no fluxes are anticipated. In Dutch forest management in existing forests some fertilizer is being applied (mainly liming).We have assumed that that will not influence non CO2 emissions. In new afforestations fertilisation is usually not done.

6) Methods and key assumptions in projections for the first commitment period (2008-2012) and discussion, if possible, of trends beyond the first commitment period

For the period 1990-2012, it was assumed that the interest of the Dutch Government in forest area expansion would continue. According to the forest policy aim of 75000 ha between 1989 and 2020 this would imply a yearly expansion of 2420 ha. This is also the assumption of the National Climate Policy Implementation Plan. This results in a total area increase, since 1990, in 2012 of 55660 ha.
This expansion would be achieved through, inter alia, a system of “tradeable forest certificates”. However, on the basis of the areal expansion in the second half of the 1990’s as assessed by the ex post evaluation, this number of 2420 ha/yr may not be achieved. To reflect this projection-uncertainty, we have assumed, as the lower range of this projected area that the rate of forest expansion will be 300 ha per year (after 2000) yielding a total area increase of 10,240 ha since 1990 (see also Nabuurs et al. 1999, 2000).

Table II – Preliminary data and information provided by Annex I Party on carbon stocks and area estimates
(First sentence of Article 3.4)

Land system	Area (ha) 1990	Carbon stock in 1990 (t C)
Forest lands	339000	64410000
Agriculture lands	909000	45450000
Rangelands/grasslands	1097000	109700000
Wetland/tundra	22418	33627000
Other	1029582	10295820
Total (as listed above)	**3397000**	**263482820**

EXPLANATORY TEXT (Table II)

1) Description of land categories, including any land categories not covered.
Table A

Land system	Definition	Source	Anticipated change 1999 and 2012	C-stock
Forest lands	Crown cover 20%, minimum area 0.5 ha, minimum average width 30 m. CBS,1985, UN-ECE/FAO 2000	CBS,1985, UN-ECE/FAO 2000	Area will increase slightly (appr. 300 ha per year). Average growing stock per ha in existing forest will increase as well.	60 t C/ha aboveground (+130 t C/ha below-ground incl. Soil) (Nabuurs and Mohren 1993, Seubring 1997)
Agriculture lands	see below	CBS,1998	Assumed constant (CBS data confirm this for 1999 compared to 1990)	estimate of 50 t C/ha is based on carbon content of 1% in the top 50 cm layer at bulk density of 1.0
Rangelands / grasslands	Including grasslands in low areas of the Netherlands	CBS,1998	Area 1990 has decrease by 10 % in 1999 and further decrease to 918000 ha in 2012 expected	Estimate of 100 t C/ha is based on carbon content of 2% in the top 50 cm layer at bulk density of 1.0 (excluding organic, peat layers, and organic carbon below 50 cm)
Wetland/tundra	see below	Wetland International	Area will slightly increase towards 2012 with 1000 ha per year	Estimate of 1500 t C/ha is based on carbon content of 30% in the top 50 cm layer at bulk density of 1.0
Other	see below	CBS,1998	Area expected to increase by appr. 150000 ha in 2012	Estimate of 10 t C/ha is based on 0.2% C in the top 50 cm layer at a bulk density of 1.0.

The area of agricultural lands include permanent crops, arable land, vegetables, greenhouses and flower cultivation; the area has remained constant between 1990-1998 (CBS, 1998) and is expected to remain constant until 2012.
The area of grassland in 1998 was 1032000 ha (CBS, 1998) and a further decrease is anticipated; linear extrapolation of the rate of change from 1990-1998 until 2012 will give an area of grassland in 2012 of 918000 ha.
The area of wetlands (Wetland International, 1998) includes designated areas in the Netherlands but does not include coastal zones (i.e. Waddensea).
The area of other land includes urban land, lakes, rivers and infrastructure for 449000 ha, nature areas for 141000 ha and 440000 ha for other land-use (CBS, 1998); the area is expected to increase with appr. 150000 ha from 1990-2012 (balancing the change in other land categories (estimate from expert opinion).

2) Carbon pools - distinctions and assumptions.
The estimates for the size of the carbon stocks in forest vegetation (whole tree biomass) are based on widely applied conversions of forest inventory (stemwood volume) data to whole tree carbon. For the conversions international literature and IPCC reporting guidelines are used. For forest soil carbon, the distribution of Dutch forests over soil types was assessed. For each soil type, profile descriptions are used to assess organic matter content to 1 m depth. Those were converted to carbon.

The estimates for the size of the carbon stocks in agricultural vegetation types are largely based on assumptions and expert opinion; the estimates include standing crop, below-ground biomass, litter and soil organic matter. There is no extensive database available on the C-content of soils. Carbon stocks in soils are substantial and may differ significantly between soil types and land uses even within distinguished categories such as wetland, nature, other, etc. The specific assumptions and distinctions are presented in table A in this explanatory text.

3) Data sources.
Inventories published by CBS (1998), Wetland International (1999). For the total area of forest in The Netherlands the Dutch Forest area statistic of 1983 was used (CBS 1985). These same values are also reported by FAOSTAT and by the UN-ECE/FAO (2000).

4) Methods.
The estimates for the size of the carbon stocks in forest vegetation are based on widely applied conversions of forest inventory (stemwood volume) data to whole tree carbon. For the conversions international literature and IPCC reporting guidelines are used. For forest soil carbon, the distribution of Dutch forests over soil types was assessed. For each soil type profile descriptions are used to assess organic matter content. Those were converted to carbon. Though, no data on soil carbon are used, due to fex reliable data on this issue, especially for deforestation.

5) Possible changes in carbon stocks.
Possible changes in carbon stocks would be largely based on changes in areas and less on changes in carbon content, that accompany changes in land-use. Estimates would be highly uncertain and no extensive database exist yet. Estimates could be made available in the next 3 years on the basis of model calculations using soil maps.

6) Uncertainties.
The area estimate for land categories has a minor uncertainty (<5%). The estimates on carbon content have uncertainties in the order of 10-50% (A. van Amstel (2000) Monitoring CO2 sinks in the Netherlands. Proceedings, Wageningen University Research Centre, pp. 47)

Table III - Preliminary data and information provided by Annex I Party on Article 3.4 activities, related net GHG emissions, involved areas, and projected carbon stock changes (additional activities under Article 3.4)

Article 3.4 Country specific data	Accounting framework	a_I (ha) (1995)	$CO_{2,\ I}$ (t CO_2)*	$CH_{4,\ I}$ (t CO_2 equiv.)* §	$N_2O_{,\ I}$ (t CO_2 equiv.)* §	a_{II} (ha) (1999)	$CO_{2,\ II}$ (t CO_2)*	$CH_{4,\ II}$ (t CO_2 equiv.)* §	$N_2O_{,\ II}$ (t CO_2 equiv.)* §	a_{cp} (ha) (2012)	ΔC_{cp} (t C)	$CO_{2,\ cp}$ (t CO_2)*	$CH_{4,\ cp}$ (t CO_2 equiv.)* §	$N_2O_{,\ cp}$ (t CO_2 equiv.)* §	Methods and approaches	Data sources, data quality, and uncertainties (e.g. ranges)	Other information relevant to decision-making
Activity 1	***Land based***	5400	59400	n.a.	n.a.	6340	69740	n.a.	n.a.	10240	153600	563200	n.a.	n.a.	see explanatory text	expert judgement	
Forestry Improved management	***Activity based***	5400	59400	n.a.	n.a.	6340	69740	n.a.	n.a.	10240	153600	563200	n.a.	n.a.			
Activity 2	***Land based***	54540	59994	n.a.	n.a.	90900	99990	n.a.	n.a.	209070	62721	229977	n.a.	n.a.	see explanatory text	expert judgement	
Cropland	***Activity based***	54540	59994	n.a.	n.a.	90900	99990	n.a.	n.a.	209070	62721	229977	n.a.	n.a.			
Activity 3	***Land based***	2700000	-16200000	n.a.	n.a.	4500000	-27000000	n.a.	n.a.	10350000	-3681818	-13500000	n.a.	n.a.	see explanatory text	expert judgement	
Grazing land	***Activity based***	2700000	-16200000	n.a.	n.a.	4500000	-27000000	n.a.	n.a.	10350000	-3681818	-13500000	n.a.	n.a.			
Activity 4																	
Activity 5																	
…																	

Footnote 1 - this value is an overestimation - the area a_{cp} in 2012 is likely to be not constant during the 5 years of the 1st commitment period (cp) and be less at the start of the 1st cp in 2008.

***** These columns would contain the sum over the years concerned of net annual emissions by sources and removals by sinks for the Article 3.4 activities proposed.
A negative sign indicates either emissions by sources or a decrease in carbon stocks. A positive sign indicates either removals by sinks or an increase in carbon stocks.
To convert a carbon amount to CO_2 multiply it by 3.67.
[§] CH_4 and N_2O emissions are converted to CO_2 equivalent emissions by using the global warming potential (GWP) values of 21 for CH_4 and 310 for N_2O (Source: Second Assessment Report of the IPCC, 1995)

a_I: Area (ha) in 1995 or possibly an earlier specific year involved in the Article 3.4 activity since 1990.
$CO_{2,\ I}$: Net CO_2 emissions (t CO_2) by sources and removals by sinks related to the Article 3.4 activity, accumulated from 1990 to the same year as used in a_I.
$CH_{4,\ I}$: CH_4 emissions (t CO_2 equivalent) by sources related to the Article 3.4 activity, accumulated from 1990 to the same year as used in a_I.
$N_2O_{,\ I}$: N_2O emissions (t CO_2 equivalent) by sources related to the Article 3.4 activity, accumulated from 1990 to the same year as used in a_I.
a_{II}: Area (ha) in 1999 or possibly an earlier specific year involved in the Article 3.4 activity since 1990.
$CO_{2,\ II}$: Net CO_2 emissions (t CO_2) by sources and removals by sinks related to the Article 3.4 activity,accumulated from 1990 to the same year as used in a_{II}.
$CH_{4,\ II}$: CH_4 emissions (t CO_2 equivalent) by sources related to the Article 3.4 activity, accumulated from 1990 to the same year as used in a_{II}.
$N_2O_{,\ II}$: N_2O emissions (t CO_2 equivalent) by sources related to the Article 3.4 activity, accumulated from 1990 to the same year as used in a_{II}.
a_{cp}: Projected area (ha) in 2012 involved in the Article 3.4 activity since 1990.
ΔC_{cp}: Projected carbon stock changes (t C) over the first commitment period related to the Article 3.4 activity since 1990.
$CO_{2,\ cp}$: Projected net CO_2 emissions related contribution (t CO_2) of the Article 3.4 activity to the first commitment period assigned amount of the Party.
$CH_{4,\ cp}$: Projected CH_4 emissions related contribution (t CO_2 equivalent) of the Article 3.4 activity to the first commitment period assigned amount of the Party.
$N_2O_{,\ cp}$: Projected N_2O emissions related contribution (t CO_2 equivalent) of the Article 3.4 activity to the first commitment period assigned amount of the Party.

EXPLANATORY TEXT (table III)

Activities I, II and III are listed in table 3 and explained in text below.

Activity I: Forest management

1) Activity and accounting – *definition and description*

Managed forest: practically all Dutch forest was already managed in 1990.
This management includes thinning and normal harvest and regeneration cycle. Most of the forest area has been managed in even-aged stands as monocultures in regular rotations of 60 to 100 years. Managed is changing towards stand which are uneven-aged and mixes and more selective cutting and longer rotations (80-120 years). Management today does hardly include any drainage of sites or fertilization or liming except in cases of restoration of nutrient balances following acidification and/or eutrification. Forest fires are rare and management does not include pest control.
Only new areas of forest can be assumed to come into management after 1990. Therefore the area estimates for forest expansion are used here again. We use same effectiveness as in Table I, but now reported in t CO_2 (!). Here is a risk of double counting (Special Report p. 135) of new areas of forest which are also reported in Table 1 (Article 3.3). We have clearly decided to take only the new forest areas, because there is no additional forest management since 1990 in the existing forest area in 1990. Thereby, few data are available on forest management activities in 1990.

2) Carbon pools included
All carbon pools are included: whole tree biomass (including roots), litter, soil organic matter, slash, and wood products)

3) Methodologies and data
For the Dutch forest, the average carbon pools in the forest biomass and average regrowth rates are used. No further stratification has been applied apart from regrowth rates for forests on agricultural lands and regrowth rates for the existing forest that is being harvested. For the subsequent periods simple assumptions were made for the regrowth rates times area per age class. We did not distinguish between forest growth rates (and soil carbon losses) on former cropland or pasture, or different soil types.
Data sources: see explanation for Table I for area estimates and effectiveness.

4) Treatment of non CO2 greenhouse gases
Not treated

5) Methods and key assumptions in projections for the first commitment period (2008-2012) and discussion, if possible, of trends beyond the first commitment period.
For the period 1990-2012, it was assumed that the interest of the Dutch Government in forest area expansion would continue. According to the forest policy aim of 75000 ha between 1989 and 2020 this would imply a yearly expansion of 2420 ha. This is also the assumption of the National Climate Policy Implementation Plan. This results in a total area increase, since 1990, in 2012 of 55660 ha. This expansion would be achieved through, inter alia, a system of “tradeable forest certificates”. However, on the basis of the areal expansion in the second half of the 1990’s as assessed by the ex post evaluation, this number of 2420 ha/yr may not be achieved. To reflect this projection-uncertainty, we have assumed, as the lower range of this projected area that the rate of forest expansion will be 300 ha per year (after 2000) yielding a total area increase of 10,240 ha since 1990 (see also Nabuurs et al. 1999, 2000).

Activities II: Cropland management

1) Activity and accounting – definition and description
Improved cropland management includes reduced tillage (more shallow and less frequent), improved management and application of crop residues (aimed at reducing the loss of residue N and thus of C), less bare-fallow (introducing cover crops), increased ley-arable farming on former arable land (as a result of expanding the area where biological farming principles are applied and no mineral fertilizer is applied).
Conventional cropland management is most likely a source for CO_2 (and N_2O) through conventional tillage, removal of crop residues, etcetera. Cropland management as broadly defined activity would cover both the increases and decreases of C stocks on the lands that are managed (both improved and conventional management). This is currently not reflected by the numbers reported in this table for they only relate to improved management and disregard sources associated with conventional management. Source-data related to conventional management are currently incomplete and often lacking.

The rate of carbon gain is estimated from SRLUC table 4.5, page 203 to 1.1 tCO_2 (0.3 t C) per ha per year. The area to which this type of activities is applied in the Netherlands is not well known and estimated to 1% per year as of 1990 (1% of 909000 times 6 years gives 54540 ha). This will result in application on 20% in 2010 and is half of the estimated value in the SRLUC of 40% (p. 14). A large part of the Dutch cropland concerns crop rotations that require soil tillage at some point in time.

2) Carbon pools included
Carbon pools include, based on assumptions specified below, below-ground C in litter and soil.

3) Methodologies and data
Methodologies and **data** are scarce; calculations for the C stocks soil could be made based on model calculations and soil types. With these model exercises, N_2O emissions for agriculture in the Netherlands have been estimated (ROB-Agro-Report, in prep).
The accounting approaches are based on statistical data from annual inventories on agricultural practices and farm management that are available from LEI-DLO and CBS as sources of statistical data; these are considered to be equal to FAO inventories.
Data on soil C contents are scarce especially concerning the change in soil C following (changes of) agricultural management.

4) Treatment of non CO2 greenhouse gases
Data on **non CO_2-greenhouse gases** from fertilizer use and direct and indirect N_2O losses are scarce. The Netherlands report N_2O emissions from mineral and organic fertilizers. Estimates on emissions should be available by autumn 2000 (ROB agro – report, Kuikman et al., in prep). Some of the measures will effect the emissions of nitrous oxide and of methane as well. Research is going on to provide measures of the (changes in) emissions following specific management practices.

5) Methods and key assumptions in projections for the first commitment period (2008-2012) and discussion, if possible, of trends beyond the first commitment period.
Projections for the first commitment period include a reduce application of mineral fertilizer due to improved fertilizer use efficiency and reduced losses of nitrate in the Netherlands. This alone will result in reduced N_2O emissions (estimated at 0.5-1.7 Mt CO_2-equivalents in N_2O, ROB agro – report, in prep).

Activities III: Grazing land management

1) Activity and accounting – *definition and description*

According to the EU definition, permanent grassland is grassland that is not in rotation and that is continuous grassland for 5 or more consecutive years.

- In the Netherlands, a large area of grassland is regularly subject to ploughing and reseeding to maintain productivity and introduce new and more productive grass varieties. This practice would qualify as grassland management.This form of management on permanent grassland will release soil organic carbon at an estimated rate of 3.5 tCO_2 per ha per year on the short term (estimated loss for N and N_2O will be provided by September 2000 by ROB (Reductieplan Overige Broeikasgassen, reductionplan greenhouse gases other than CO_2)-project on the basis of IPCC default values for indirect emissions from nitrate leaching, ROB report, in prep). This management is repeated every 5-10 years to a large part of the grassland area and concerns on average 50000 ha per year. As for now, we assume that the losses of soil C will be compensated by the increased productivity in the years following ploughing and reseeding (on the long term: 5-10 years). This practice requires additional nitrogen fertilization to compensate for the nitrogen lost. Associated with this fertilization is emission of CO_2 (energy and transport) and N_2O of unknown quantities.
As a consequence of the above, in 2012 most grassland on sand and 50% of grassland on clay is under this form of management (500000 ha and excludes the grassland area in the western, lower part of the Netherlands).

- In the Netherlands, peatlands are often covered by grazing land. Drainage management is very important on these areas. This causes a maximum source of CO_2 of 12 tons a year. The total area is 450.000 ha. An assumption is made that 450000*6 tons CO_2 a year is emitted. The area is constant between 1990 and 2012. This accounts for all of the numerical values included in table 3.

-The area of grassland is continuously decreasing due to urban and infrastructure development and due to conversion to cropland (mostly in rotation of grass-ley or for the production of flowers). The latter area is estimated to 5000 ha per year (data from "ROB – Herinzaai grasland" by Vellinga and Kuikman on the basis of CBS data (Van Eerdt, 1999). The rate of change of soil C is estimated to be –3.5 t CO_2 per ha per year and assumed constant for the period of 1990-2012. This will give 548365 t C_{cp} = 115.000 ha $\times$ 5 (years 2008-2012) $\times$ –3.5 tCO_2 ha^{-1} $year^{-1}$ $\times$ 1/3.67. However, this is not counted as grazing land management; it would be included in an activity such as "grassland conversion"

- Measures for improved grazing land management would include reducing the area and intensity of improving grassland productivity through ploughing and reseeding and replace with a practice where reseeding is done without ploughing "old" and permanent grassland or where ploughing and re-seeding is applied in spring and not in autumn. This would reduce the loss of soil C (and of soil N) and N_2O. No estimates as to the area in 2012 are available.

Methods and approaches for estimation of non CO_2-greenhouse gasses
No literature is available on gaseous losses of N from grassland following conversion to cropland or ploughing and re-seeding. The estimated loss of C is based on losses of N from soils and the N_2O emission will be estimated using the N-loss and the default IPCC emission factor for indirect emissions of N_2O of 2.5%. No information for CH_4 emissions is available.

2) Carbon pools included
Carbon pools include aboveground and based on assumptions specified below, below-ground C in litter and soil.

3) Methodologies and data

Methodologies and **data** are scarce; calculations for the C stocks soil could be made based on model calculations and soil types. With these model exercises, N_2O emissions for agriculture in the Netherlands have been estimated (ROB-Agro-Report, in prep).

The accounting approaches are based on statistical data from annual inventories on agricultural practices and farm management that are available from LEI-DLO and CBS as sources of statistical data; these are considered to be equal to FAO inventories.

Data on soil C contents are scarce especially concerning the change in soil C following (changes of) agricultural management.

4) Treatment of non CO2 greenhouse gases

Data on **non CO_2-greenhouse gases** from fertilizer use and direct and indirect N_2O losses are scarce. The Netherlands report N_2O emissions from mineral and organic fertilizers. Estimates on emissions should be available by autumn 2000 (ROB agro – report, Kuikman et al., in prep). Some of the measures will effect the emissions of nitrous oxide and of methane as well. Research is going on to provide measures of the (changes in) emissions following specific management practices.

5) Methods and key assumptions in projections for the first commitment period (2008-2012) and discussion, if possible, of trends beyond the first commitment period.

Projections for the first commitment period include a reduce application of mineral fertilizer due to improved fertilizer use efficiency and reduced losses of nitrate in the Netherlands. This alone will result in reduced N_2O emissions (estimated at 0.5-1.7 Mt CO_2-equivalents in N_2O, ROB agro – report, in prep).

References

Buis, J. 985. Historia forestis. De Nederlandse bosgeschiedenis. The dutch forest history. Proefschrift Vakgroep Boshuishoudkunde, Landbouwuniversiteit Wageningen. Vol 1 & 2. Studia Historica No 14.

CBS 1985. Centraal bureau voor de Statistiek in samenwerking met het Staatsbosbeheer. 1985 De nederlandse bosstatistiek, deel 1: de oppervlakte bos, 1980-1983. The dutch forest statistics, part 1; the forest area. Centraal bureau voor de Statistiek, Hoofdafdeling Landbouwstatistieken.'s-Gravenhage, Staatsuitgeverij/ CBS-publikaties.

CBS (Centraal Bureau voor de Statistiek) (2000) CBS-landbouwdatabank 1980-2000 (CD-rom)

Edelenbosch, N.H. 1996. Ex post evaluatie van het bosuitbreidingsbeleid in Nederland 1990-1995. IBN rapport 230. Wageningen 62 p.

Hinssen, P.J.W. 1998. Achtergronden van de Natuurbalans 1998: Aspecten van het Natuurbeleid. Wageningen 172 p.

Kuikman et al (2000) ROB – agro Development of Best Management Practices to reduce emissions of nitrous oxide from agriculture (in preparation) (in Dutch), pp. 35

Mather, A.S. 1990 Global forest resources. Chapter 3. Historical perspectives on forest resource use. Timber Press. Portland. OR pp. 30-57

Mohren, G.M.J., J.F. Garza Caligaris, O. Masera, M. Kanninen, T. Karjalainen and G.J. Nabuurs 1999 CO2FIX for windows: a dynamic model of the CO2 fixation in forests, version 1.2. IBN Research report 1999/3. Report Instituto de Ecologia de la UNAM, Centro Agronomico Tropical de Investigacio y Enseflanza (CATIE), European Forest Institute. Wageningen The Netherlands, Patzcuaro Mexico, Turrialba Costa Rica, Joensuu Finland. 33 p.

Nabuurs, G.J. & G.M.J. Mohren 1995 Modelling analysis of potential carbon sequestration in selected forest types. Canadian Journal of Forest Research 25: 1157-1172.

Nabuurs, G.J. & G.M.J. Mohren. 1993a Carbon fixation through forestation activities. A study of the carbon sequestering potential of selected forest types, commissioned by the Foundation Face. Face. Forests Absorbing Carbon dioxyde Emission. Arnhem. Institute for Forestry and Nature Research. Wageningen. IBN Research report 93/4. 205 pp.

Nabuurs, G.J. & G.M.J. Mohren. 1993b Carbon in Dutch forest Ecosystems. Netherlands Journal of Agricultural Science. 41 (4): 309-326.

Nabuurs, G.J., A.V. Dolman, E. Verkaik, A. Whitmore, W. Daamen, O. Oenema, P. Kabat and G.M.J. Mohren 1999 Resolving issues on terrestrial biospheric carbon sinks in the Kyoto Protocol. Report 410 200 030. Dutch National Research Programme on Global Air pollution and Climate Change. Bilthoven, The Netherlands. 100 p.

Rackham, O., 1998. Savanna in Europe. In: Kirby, K.J. & C. watkins (eds.), The ecological history of European forests. Cambridge University Press. Cambridge UK. P 1-24.

Seubring, A.M. 1997 Hout in het Nederlandse bos, analyse van de ontwikkelingen van voorraad, bijgroei en oogst van het Nederlandse bos in de periode 1988-1996. Stichting Bosdata, Wageningen 34 p.

Tomppo, E. 1996 Multi source national forest inventory of Finland In: R. Päivinen, J. Vanclay & S. Miina (eds.), New thrusts in Forest Inventory. EFI proceedings No 7. p. 27-41

UN-ECE/FAO 2000 Forest resources of Europe, CIS, North America, Australia, Japan and New Zealand Geneva Timber and Forest Study papers No 17. United Nations Economic Committee for Europe. Food and Agricultural Organisation. Geneva, Switzerland.

Appendix A

Uptake rate accountings.

Afforestation / reforestation

For all activities, except for deforestation, the uptake rate is divided by a factor 2 for the periods 1990-1995 and 1990-1999 for the following reason:

Example:

	Planted (ha)	Total (ha)	Uptake rate (tC /ha/y)	tC/y
1990	300	300	1	300
1991	300	600	1	600
1992	300	900	1	900
1993	300	1200	1	1200
1994	300	1500	1	1500
1995	300	1800	1	1800

Originally, 1800*1*6=10800 tC would be accounted. Reality shows it is only 6300 tC, which is approximately half of 10800tC.
This does not count for the period 2008-2012, because in that period the full area exists during the whole period. Neither does it count for deforestation, because deforestation is counted for only one year, in contradiction to afforestation and reforestation, and has thus not to be corrected by dividing by 2.

Reforestation FAO:

To distinguish the different scenarios (activity / land I and II based), we divide the uptake rates in planting (P), harvest (H) and slash (S).

Content scenarios:

Activity based	P
Landbased I	P, H, S
Landbased II	P, S

Activity based:

	Plant/harv/ slash	Accounting uptake rate (tC ha^{-1} y^{-1})[1)]	Total uptake rate (tC ha^{-1} y^{-1})
1990-1995	P	0,8/2	0,4
1990-1999	P	0,8/2	0,4
1990-2012	P	0,8/2	0,4
2008-2012	P	0,8	0,8

1) The effectiveness is divided by years or factor 2 (see below)

Landbased I:

	Plant/harv/ slash	Accounting uptake rate (tC ha^{-1} y^{-1})[1)]	Uptake rate (tC ha^{-1} y^{-1})	Total uptake rate (tC ha^{-1} y^{-1})
1990-1995	P	0,8/2	0,4	
	H	-30/6	-5	-6,1
	S	-3/2	-1,5	
1990-1999	P	0,8/2	0,4	
	H	-30/10	-3,0	-4,1
	S	-3/2	-1,5	
1990-2012	P	0,8/2	0,4	
	H	-30/23	-1,3	-2,2
	S	-3*10/23	-1,3	
2008-2012	P	0,8	0,8	
	H	-30/23	-1,3	-1,8
	S	-3*10/23	-1,3	

1) The effectiveness is divided by years or factor 2 (see below)

Landbased II:

	Plant/harv/slash	Accounting uptake rate (tC ha^{-1} y^{-1})[1)]	Uptake rate (tC ha^{-1} y^{-1})	Total uptake rate (tC ha^{-1} y^{-1})
1990-1995	P	0,8/2	0,4	-1,1
	S	-3/2	-1,5	
1990-1999	P	0,8/2	0,4	-1,1
	S	-3/2	-1,5	
1990-2012	P	0,8/2	0,4	-0,9
	S	10*-3/23	-1,3	
2008-2012	P	0,8	0,8	-0,5
	S	10*-3/23	-1,3	

1) The effectiveness is divided by years or factor 2 (see below)

PORTUGAL

ARBORIZAÇÃO (ha)

Ano	1990	1991	1992	1993	1994	total (90-94)	1995	1996	1997	1998	1999	TOTAL (90-99)	2012	TOTAL (90-2012)
PAF	20,888	15,320	16,906	11,312	6,054	70,480	5,141	564	-	-	-	76,185	-	76,185
2080	-	-	-	-	19,937	19,937	35,882	22,578	29,584	23,452	30,320	161,753	325,000	486,753
2328 (797)	-	-	5,061	2,225	-	7,286	-	-	-	-	-	7,286	-	7,286
PDF/PDR	-	-	-	-	-	0	19,925	15,749	8,338	8,816	5,784	58,612	117,000	175,612
TOTAL	20,888	15,320	21,967	13,537	25,991	97,703	60,948	38,891	37,922	32,268	36,104	303,836	442,000	745,836

Fonte: IFADAP — 98 (10^3 ha) — 304 (10^3 ha) — 746 (10^3 ha)

Fonte: DGF

Odete Duarte:
15 000 ha/ano * 60% (arborização)
15 000 ha * 13 anos= 195 000 ha nos 13 anos

Odete Duarte:
25 000 ha/ano
25000*13 anos = 325 000 ha nos 13 anos

REARBORIZAÇÃO (ha)

Ano	1990	1991	1992	1993	1994	total (90-94)	1995	1996	1997	1998	1999	TOTAL (90-99)	2012	TOTAL (90-2012)
PAF	-	-	-	-	-	0	-	-	-	-	-	0		0
2080	-	-	-	-	-	0	-	-	-	-	-	0		0
2328 (797)	-	-	-	-	-	0	-	-	-	-	-	0		0
PDF-incultos	-	-	-	-	1,150	1,150	1,766	922	1,305	341	4,597	10,081		10,081
PDF-ardidos	-	-	-	-	2,815	2,815	8,672	5,556	2,391	1,819	3,570	24,823	78,000	102,823
TOTAL	0	0	0	0	3,965	3,965	10,438	6,478	3,696	2,160	8,167	34,904	78,000	112,904

Fonte: IFADAP — 4 (10^3 ha) — 35 (10^3 ha) — 113 (10^3 ha)

Fonte: DGF

Odete Duarte:
40% da area total considera-se que será de rearborização = 195 000 * 40 % = 78 000

DESARBORIZAÇÃO (ha)

Ano	1990	1991	1992	1993	1994	total (90-94)	1995	1996	1997	1998	1999	TOTAL (90-99)	2012	TOTAL (90-2012)
SB + AZ (redução)	-	1,692	920	1,071	1,433	5,116	2,034	1,055	287	211	171	8,874	2,600	11,474
TOTAL	0	1,692	920	1,071	1,433	5,116	2,034	1,055	287	211	171	8,874	2,600	11,474

Fonte: IFADAP — 5 (10^3 ha) — 9 (10^3 ha) — 11 (10^3 ha)

Fonte: DGF — 3,758

Odete Duarte:
Considerou-se que a desarborização seria de 200 ha/ano, uma vez que se verificou uma tendência para a redução das áreas desarborizadas, que se presumiu virem a ser reforçadas com a entrada em vigor da nova

Article 3.3 Country specific data	Definitions	Accounting framework	a_I (1000 ha)	ΔC_I (t C)	a_{II} (1000 ha)	ΔC_{II} (t C)	a_{cp} (1000 ha)	ΔC_{cp} (t C)	Methods and approaches	Data sources, data quality, and uncertainty (e.g. ranges)	Other information relevant to decision-making
Afforestation	IPCC	Activity based	98		304		746				
Reforestation		Land based	98		304		746				
Afforestation	FAO	Activity based	98		304		746				
		Land based	98		304		746				
Reforestation	FAO	Activity based	4		35		113				
		Land based I	4		35		113				
		Land based II	4		35		113				
Afforestation	Other	Activity based	-	-	-	-	-	-	-	-	-
Reforestation		Land based	-	-	-	-	-	-	-	-	-
Deforestation	IPCC/FAO	Activity based	5		9		11				
		Land based	5		9		11				
	Other	Activity based	-	-	-	-	-	-	-	-	-
		Land based	-	-	-	-	-	-	-	-	-

Odete Duarte:
Consideramos apenas os cortes de redução de Sb e Az (áreas > 1ha)

Odete Duarte:
Consideraram-se as rearborizações de áreas ardidas e de cortes - valores contratados

Odete Duarte:
dados provenientes dos projectos 2080; 2328; PAF; PDF

Odete Duarte:
Como devemos calcular este valor?
- Considerar um valor médio por ha para todos os povoamentos e contabilizar também o carbono do solo

Espécie	Ano 1998 Área (1000 ha)	Ano 2008 Área (1000 ha)	Variação Área (1000 ha)	Variação/ano Área (1000 ha)	Variação (%)	Variação/ano (%)
Eucalyptus globulus	705	705	-	-	-	-
Pinus pinaster	1034	1184	150	15	14.5	1.5
Outras Resinosas	125	175	50	5	40.0	4.0
Outras Folhosas	1482	1682	200	20	13.5	1.3
Total	3346	3746	400	40	12.0	1.2

Espécie	Ano 1990	Ano 1998 Área (1000 ha)	Ano 2000 Área (1000 ha)	Ano 2008 Área (1000 ha)
Eucalyptus globulus		705	705	705
Pinus pinaster		1034	1064	1184
Outras Resinosas		125	135	175
Outras Folhosas		1482	1522	1682
Total		3346	3426	3746

+ 170 000 ha (1990 a 1997)

+ 200 000 ha (1990 a 2000)

+ 600 000 ha (1990 a 2008)

Espécie	Ano 1998 taxa crescimento (m3/ha/ano)	Ano 2008 taxa crescimento (m3/ha/ano)
Eucalyptus globulus	9.5	10.5
Pinus pinaster	5.6	6.0
Outras Resinosas	5.6	6.0
Outras Folhosas	0.5	0.5

Espécie	Ano 1998 Área (1000 ha)	Ano 2008 Área (1000 ha)	Variação Área (1000 ha)	Variação/ano Área (1000 ha)	Variação (%)	Variação/ano (%)
Eucalyptus globulus	705	705	-	-	-	-
Pinus pinaster	1034	1184	150	15	14.5	1.5
Outras Resinosas	125	175	50	5	40.0	4.0
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Eucalyptus globulus	9.5	10.5
Pinus pinaster	5.6	6.0
Outras Resinosas	5.6	6.0
Outras Folhosas	0.5	0.5

SPAIN

Table I.- Preliminary data and information provided by Annex I Party on carbon stock changes and areas related to Article 3.3 activities

Article 3.3 Country specific data	Definitions	Accounting framework	a_I (ha)	C_I (tC)	a_{II} (ha)	C_{II} (tC)	a_{cp} (ha)	C_{cp} (tC)	Methods and approaches	Data sources, data quality and uncertainly (e.g. ranges)	Other information relevant to decision making
Afforestation Reforestation	IPCC	Activity based	----	----	----	----	----	----	----	----	----
		Land based	73,889	44,890	482,644	293,220	----	----	see below	see below	see below
Afforestation	FAO	Activity based	----	----	----	----	----	----	----	----	----
		Land based	73,889	44,890	482,644	293,220	----	----	see below	see below	see below
Reforestation	FAO	Activity based	----	----	----	----	----	----	----	----	----
		Land based	529,765	323,594	1,059,530	647,188	----	----	see below	see below	see below
		Land based II	----	----	----	----	----	----	----	----	----
Afforestation Reforestation	Other	Activity based	----	----	----	----	----	----	----	----	----
		Land based	----	----	----	----	----	----	----	----	----
Deforestation	IPCC/FAO	Activity based	----	----	----	----	----	----	----	----	----
		Land based	n.s.	n.s.	n.s.	n.s.	----	----	see below	see below	see below
	Other	Activity based	----	----	----	----	----	----	----	----	----
		Land based	----	----	----	----	----	----	----	----	----

a_I Area (ha) afforested and reforested, or deforested since 1990 up to 1995 or possibly an earlier specific year.
C_I Carbon stock change (t C) since 1990 up to the same year used in a_I on land afforested, reforested, and deforested.
a_{II} Area (ha) afforested and reforested, or deforested since 1990 up to 1999 or possibly an earlier specific year.
C_{II} Carbon stock change (t C) since 1990 up to the same year used in a_I on land afforested, reforested, and deforested.
a_{cp} Projected area (ha) afforested and reforested, or deforested since 1990 up to 2012.
C_{cp} Projected carbon stock change (t C) over the first commitment period on land afforested, reforested, and deforested since 1990 up to 2012.

Table I. EXPLANATORY TEXT.

Afforestation

Methods and approaches

(1) There are not global scale measurements of C, but local experimentation areas. Method of calculation is based in biomass data provided by the Second National Forest Inventory (*IFN-2*). This inventory has been executed between 1985 and 1995 using a square grid of 1 km that covers all the spanish territory. According the *IFN-2* data and the conversion factors calculated in forest experimental plots by the Forest Research Department of Agriculture Ministery (*INIA*), the dasometric values obtained are computed as biomass (Table 301 of the *IFN-2* and Forest Growth experimental plots of *INIA*). Biomass data is transformed in dry matter weight and in C equivalent values, using extrapolation factors obtained in the experimental forest plots of *INIA*.

Data sources

(1) Source: Ministery of Agriculture, Spain: Afforestation of Agriculture land Program (RD 378/93).
(*Ministerio de Agricultura, Pesca y Alimentación. Subdirección General de Acciones de Desarrollo Rural: Programa de Forestación de Tierras Agrarias*). In terms of surface subjeted to afforestation.

(2) Source: INF2 and INIA in terms of C calculatios.

Other information

Most of the spanish forest systems are in the Mediterranean area. There are also small but significant temperate and high altitude forests.
According our measurement system, it is not possible to separate areas included in the IPCC and FAO definitions. Both systems do not give remarkable differences in Spain.

Reforestation

Methods and approaches

(1)There are not global scale measurements of C, but local experimentation areas. Method of calculation is based in surface data provided by the difference between the the Second National Forest Inventory (*IFN-2*) and the First National Inventory (INF-1). After discounting the afforested area. The Second National Inventory has been executed between 1985 and 1995 using a square grid of 1 km that covers all the spanish territory, and the First National Inventory has as a base year 1970. According the *IFN-2* data and the conversion factors calculated in forest experimental plots by the Forest Research Department of Agriculture Ministery (*INIA*), the dasometric values obtained are computed as biomass (Table 301 of the *IFN-2* and Forest Growth experimental plots of *INIA*). Biomass data is transformed in dry matter weight and in C equivalent values, using extrapolation factors obtained in the experimental forest plots of *INIA*.

The following formula {area*Cant.p.men.*0.00314*1.4} for calculation of the increase in forestry biomass uses the terms indicated below:

1) the growth in larger trees, where the factorof 1.6 allows VCC to be expanded into the volume of total live biomass, for reforestation no large trees were considered;

2) the growth in smaller trees, where the factor 0.00314 gives the volume in m^3 of a smaller trunk and the factor 1.4 allows this volume to be expanded into the volume of total live biomass;

Data sources

VCC;Cant.p.men. Taken directly from Table 201 «Existencias por especie y Comunidad Autónoma» in the publication entlited «Segundo Inventario Forestal Nacional - Vol. España».

Other information

Most of the spanish forest systems are in the Mediterranean area. There are also small but significant temperate and high altitude forests.

According our measurement system, it is not possible to separate areas included in the IPCC and FAO definitions. Both systems do not give remarkable differences in Spain.

Deforestation

We consider that Deforestation according the definition used does not exit at significative scale nowadays in Spain:

- Forest fire affected areas. Spain do not allows land use changes after fires by law.- in a very short period of time, natural and man-induced reforestation proccess start (more of the forest fire affected areas does not suffer a total loose of vegetation).
- Changes in land use.- Now, there are not changes from forest land to agriculture or urban use at significative scale in Spain. Since the tendency of afforestation predominates and it is supported by the Governement.
- Desertification proccess.- Sudeast of Spain is affected by this topic mainly historically in non forested areas. However, new forest are created to control erosive process.
- Clear cutting zones are inmediately reforested through a natural or man induced proccess.

Uncertainty: The IFN-2 has 10%

Table II. - Preliminary data and information provided by Annex I Party on carbon stocks and areas estimates (First sentence of Article 3.4)

Land system	***Area (ha)***	***Carbon stock in 1990 (t C)***
Forest lands	13,905,000	237,674,532
Agriculture lands		
Rangelands/grasslands		
Wetland/tundra		
Other		
Total (as listed above)		

Table II EXPLANATORY TEXT.

Methods

The following formula {VCC*1.6} for calculation of the increase in forestry biomass uses the terms indicated below: the growth in larger trees, where the factorof 1.6 allows VCC to be expanded into the volume of total live biomass;

The formula has ignored the potential contribution of undergrowth and sparse trees in cleared forestry areas, as being, in the first case, contributions difficult to estimate precisely and, in the second case, of a low amount, perhaps less than 2%. In addition, the contribution of trees on non-forestry land (urban trees, etc.) is ignored.

Other than forested lands were not taked into account for C stocks. Thus stocks are understimated. Further information on agricultural lands, grasslands and wetlands are been compiled.

Data sources

VCC: Taken directly from Table 201 «Existencias por especie y Comunidad Autónoma» in the publication entlited «Segundo Inventario Forestal Nacional - Vol. España».

Table III.- Preliminary data information provided by Annex I Party on Article 3.4 activities, related net GHG emissions, involved areas, and projected carbon stock changes (additional activities under Article 3.4)

Article 3.4 Country specific data	Accounting framework	a_I (ha)	$CO_{2,I}$ (t CO_2)*	$CH_{4,I}$ (t CO_2 equiv.)*§	$N_2O_{,I}$ (t CO_2 equiv.)*§	a_{II} (ha)	$CO_{2,II}$ (t CO_2)*	$CH_{4,II}$ (t CO_2 equiv.)*§	$N_2O_{,II}$ (t CO_2 equiv.)*§	a_{cp} (ha)	$\_C_{cp}$ (tC)	$CO_{2,cp}$ (t CO_2)*	$CH_{4,cp}$ (t CO_2 equiv.)*§	$N_2O_{,Icp}$ (t CO_2 equiv.)*§	(a)	(b)	(c)
Activity 1	Land based	13.905.000	949.239	n.d.	n.d.	13.905.000	1.855.238	n.d.	n.d.	---	----	----	-----	------			
	Activity based	---------	---------	---------	-------	---------	---------	---------	-------	---	----	----	-----	--------			

* These columns would contain the sum over the years concerned of net annual emissions by sources and removals by sinks for the Article 3.4 activities proposed. A negative sign indicates either emissions by sources or a decrease in carbon stocks. A positive sign indicates either removals by sinks or an increase in carbon stocks.

To convert a carbon amount to CO_2 multiply it by 3.67.

§ CH_4 and N_2O emissions reconverted to CO_2 equivalent emissions by using the global warming potencial (GWP) values of 21 for CH_4 and 310 for N_2O (Source: Second Assenssment Report of the IPCC, 1995)

a_I Area (ha) in 1995 or possibly an earlier specific year involved in the Article 3.4 activity since 1990.
$CO_{2,I}$ Net CO_2 emissions (t CO_2) by sources and removal by sinks related to the Article 3.4 activity, accumulated from 1990 to the same year as used in a_I.
$CH_{4,I}$ CH_4 emissions (t CO_2 equivalent) by sources related to the Article 3.4 activity, accumulated from 1990 to the same year as used in a_I.
$N_2O_{,I}$ N_2O emissions (t CO_2 equivalent) by sources related to the Article 3.4 activity, accumulated from 1990 to the same year as used in a_I.
a_{II} Area (ha) in 1999 or possibly an earlier specific year involved in the Article 3.4 activity since 1990.
$CO_{2,II}$ Net CO_2 emissions (t CO_2) by sources and removal by sinks related to the Article 3.4 activity, accumulated from 1990 to the same year as used in a_{II}.
$CH_{4,II}$ CH_4 emissions (t CO_2 equivalent) by sources related to the Article 3.4 activity, accumulated from 1990 to the same year as used in a_{II}.
$N_2O_{,II}$ N_2O emissions (t CO_2 equivalent) by sources related to the Article 3.4 activity, accumulated from 1990 to the same year as used in a_{II}.

(a) Methods and approaches; (b) Data sources, data quality, and uncertainties (e.g. ranges); (c) Other information relevant to decision-making.

Table III. EXPLANATORY TEXT.

Methods and approaches

(1) There are not global scale measurements of C, but local experimentation areas. Method of calculation is based in VCC data provided by the difference between the the Second National Forest Inventory (*IFN-2*) and the First National Inventory (INF-1). After discounting the the VCC from Afforestation and Reforestation in table I. The Second National Inventory has been executed between 1985 and 1995 using a square grid of 1 km that covers all the spanish territory, and the First National Inventory has as base year 1970. According the *IFN-2* data and the conversion factors calculated in forest experimental plots by the Forest Research Department of Agriculture Ministery (*INIA*), the dasometric values obtained are computed as biomass (Table 301 of the *IFN-2* and Forest Growth experimental plots of *INIA*). Biomass data is transformed in dry matter weight and in C equivalent values, using extrapolation factors obtained in the experimental forest plots of *INIA*.

SWEDEN

Requested country-specific data on land use, land-use change and forestry

Table I. Preliminary data and information provided by Sweden on carbon stock changes related to Article 3.3 activities. *Curr*. means harvesting at current level (74 mill. m^3/yr).

	Defini -tions		Area (1000 ha) 1990-1995	Area (proj.) (1000 ha) 1990-2012	Estimated C stock change (Tg C) 1990-1995	(Tg C) 1990-2012	(Tg C/yr) 2008-2012
I. Article 3.3							
Afforestation/ Reforestation	IPCC	**Activity based** Land based [i]	**69**	**242**	**0.03**	**1.6**	**0.17**
Deforestation	FAO/ IPCC	A. Forest to farmland [ii]	18	18	-0.001	-0.001	-0
		B. Forest to roads, etc. [iii]	29	128	-0.96	-4.2	-0.19
		C. Forest to built-up land [iv]	20	88	-0.33	-1.5	-0.07
		D. Defor. sum	**67**	**234**	**-1.3**	**-5.7**	**-0.26**
Reforestation on forest land	FAO	E. Activity based[v]	950	*Curr.*: 4180	0.5	28	3.0

i) Afforestation/reforestation: Area classified as farmland in the inventory 1988-1992 and as forest land in the inventory 1993-1998 divided by 5.5 yr multiplied with 5 yr. Afforestation and reforestation cannot be separated. To some extent is included land on which farming will be applied again - see ii, and land which has been used for forest managment shorter than 20 years ago. Thus, the A. area is subtracted from the expected afforestation area during 1995-2012.

ii) Forest to farmland: Area classified as forest land in the inventory 1988-1992 and as farmland in 1993-1998 divided by 5.5 yr and multiplied with 5 yr. This is to a high extent land that has been abandoned for only a few years or land on which the present land use was difficult to determine at either inventory. Clearing of mature forest in purpose to extend cultivation or grazing is non-significant today. A loss of 0.1 Mg C/ha is asssumed).

iii) Forest to roads, etc: Net conversion from forest land to roads, railway and power line clearings between 1988-1992 and 1993-1998. An immediate loss from an average Swedish forest stand is assumed (33 Mg C/ha).

iv) Forest to built-up land: Net conversion from forest land to built-up land between 1988-1992 and 1993-1998. In many cases, a high tree density (canopy cover) remain after the conversion (> 10 %), and in other cases, the tree density was low before the conversion. An immediate loss c. half the size of an average forest is assumed (16.6 Mg C/ha).

v) Reforestation: Area on which reforestation (regeneration) has followed upon forest harvesting, i.e. all clear-cut area.

1. Definitions and accounting

a) Forest

- Forest land according to the Swedish Forestry Act is all land that i) is not used for other purposes than wood production, and ii) that may support an average stemwood production exceeding 1 m^3 per hectare per year. Recently abandoned farmland is therefore forest even if no active afforestation yet has taken place. However, according to the Forestry Act, action must be taken to provide sufficient tree plant density within a few years, unless the land is again used for other purposes.

- Land that has a stemwood production exceeding 1 m^3 per hectare per year but which has another active land-use than forest management is thus not forest. This could be e.g. pasture, built-up land, and preserved areas.

b) Afforestation, reforestation and deforestation

Data from the permanent plots of the National Forest Inventory (see 4.) has been used to estimate present land-use change rates (see Table I/III footnotes), and these rates have been used to predict coming rates (exception for af-, reforestation - see footnote i and ii).

c) Accounting approaches

(See above and below.)

2. Carbon pools included

Carbon pools included are above- and belowground biomass. The knowledge about the rate of litter and slash decomposition, and about the change in soil C pools after a certain land-use change on various land types is still too scarce or uncertain to be applied here.

3. Stratification

(See 4. Methodologies and data)

4. Methodologies and data

The following conversion factors were used:
- 1 g d.w. = 0.46 g C
- 1 m^3 wood = 0.40 Mg d.w.

The Swedish National Forest Inventory (NFI) is carried out by the Department of Forest Recource Management and Geomatics at the Swedish University of Agricultural Sciences in Umeå. The NFI has been undertaken since 1923 and the main purpose is to describe the stock and growth rate of stemwood with a relatively high resolution.

The inventory includes roughly 18 000 sample plots per year, systematically distributed over the whole of Sweden. The distance between the plots is shorter in southern than in northern Sweden. A quarter of the plots are permanent, which means they are revisited each five-year-period, whereas the rest are temporary. All types of land are included in the survey, but the detailed information is collected on forest land. Within the plot, all tree diameters are measured as well as the heights of a sample of trees.

Due to the well-based knowledge on stemwood development, the uncertainty of the data on stock changes and growth rates of stemwood is relatively small, and thus also of the prediction on stemwood stock changes at various harvesting levels. Functions for relations between branches/root parts and the stemwood are also based on a relatively large sampling data base. Knowledge about the variation of these relations with various stand parameters was used in the predictions of total biomass stock changes on all forest land. The estimations of biomass stock changes due to af- and reforestation are fairly uncertain since little effort has been put on producing well-based functions for that young forest stands (< 20 yr) in Scandinavia. The estimations of actual C stock losses at various types of deforestation are based on crude estimations. At this stage, only NFI information concerning afforestation and deforestation *areas* were used. In a coming analysis, data on stem volumes on these areas could be analysed as well. However, on land with other classification than forest, no tree stand data is collected at the plot.

5. Treatment of non-CO_2 greenhouse gases

Non-CO_2 greenhouse gases are not treated in this report. Our current estimates of both methane- and nitrousoxideemissions from area sources (forest and agricultural lands) are judged to be too uncertain to be tabled at the present stage. We suppose that both gases are emitting substantial amounts annually: methane mainly from peatland and nitrousoxide mainly from wetlands and fertilized agricultural lands. Also different kinds of forests play a certain role, especially those on thick organogenic soils with strong wet/humic profiles. It is also difficult to sort out human induced emissions from those coming from non-human induced natural areas.

A rough estimate from LULUCF –land categories which need to be corrected later on, shows
- methane-emission 12 Mt/year CH_4 given as CO_2-equivalent at a GWP_{CH4} = 24;
- nitrousoxide-emission 12 " N_2O " GWP_{N2O} =310;

6. Methods and key assumptions in projections for the first commitment period (2008-2012)

Concerning assumptions on land-use change rates - see Table I/III footnotes and 1 b.

Assumptions on C pool changes and land-use change rates:
Curr. : means harvesting at current level (74 million m^3/yr);
High.: means harvesting at a higher level presumed for the first commitment period (81 million m^3/yr);

Table I b

Land use category:	**Average C pool growth** 2008-2012 [Mg/ha/yr]	**Average area affected** 2008-2012 [1000 ha]
Afforestation	1.7	222
Reforestation.	0.79	Curr: 3800 High: 3984
Forest management (add.activity art. 3.4)	Curr: 0.19 High 0.14	23 000 (all forest land)
	Instant C pool decrease 2008-2012 [Mg/ha]	Average area affected 2008-2012 [1000 ha/yr]
Forest to farmland	0	0
Forest to roads	33	5.8
Forest to built-up lands	17	4.0

Table II
Preliminary data and information on carbon stocks (in biomassa and soils) and area estimates.

Land system	***Area (ha)***	***Carbon stock in 1990 (Mt C)***
Forest lands	22 910 000	2 800 [1]
Agriculture lands	3 140 000	230[2]
Pasture/grasslands	500 000	45[2]
Wetlands/Peatlands	4 600 000	4 500[3]
Forest Conservation	630 000[4]	28[5]
Other (mountains, nature res. urban areas, infrastr., etc)	9 300 000	-
Total land area	41 080 000	7 603

[1] Total carbon content in above- and belowground forest biomass and soil organic carbon estimated to 1 m depth.
[2] Total carbon content in agricultural / pasture soils including biomass, average estimates.
[3] Total carbon content in wetlands/peatlands estimating average peatdepth to 2 m, mainly on non-human induced land areas.
[4] Productive forest area under conservation 1990.
[5] The average carbon content in forest biomass estimated to 45 t C/ha.

Table III
Preliminary data and information on Article 3.4 activities, related net greenhousegas emissions, involved areas, and projected carbon stock changes (additional activities under Article 3.4)

Activity	Accounting framework	a_I (M ha)	$CO_{2,I}$ (M T CO_2)	a_{II} (M ha)	$CO_{2,II}$ (M t CO_2)	a_{cp} (M ha)	$_{\Delta}C_{cp}$ (Tg C)	$CO_{2,cp}$ (Mt CO_2)
Forest Management	Land based	23	198	23	297	23	22,5	82,5
”	* discount 5%						1,1	4,1
Forest Conservation	LAND BASED	0,2[1]	0,44	0,26[2]	0,57	0,51	0,3	1,0

[1] Additional area 1990 - 1995
[2] Additional area 1990 – 1998

a_I Area (M ha) in 1995 involved in the Article 3.4 activity since 1990. For forest management the same gross area is assumed in operation throughout the period 1990 – 2012 (including the first commitment period 2008-2012).

$CO_{2,I}$ Net CO_2 removals by sinks related to the Article 3.4 activity, accumulated estimate 1990 – 1995. A ton C amount multiplied by 44/12 is converted to ton CO_2.

a_{II} Area (M ha) in 1998 involved in Article 3.4 activity since 1990.

$CO_{2,II}$ Net CO_2 removals by sinks related to the Article 3.4 activity, accumulated estimate 1990 – 1998.

a_{cp} Projected area (M ha) in 2012 involved in Article 3.4 activity since 1990.

$_{\Delta}C_{cp}$ Projected carbon stock changes (Tg C) over the first commitment period related to the Article 3.4 activity since 1990. During the first commitment period (2008 – 2012) the annual carbon stock increase is estimated to 4,5 Mt C due to expected slight increase in forest harvesting during the first commitment period compared to the current forest carbon stock increase of about 9 Mt C/year (increase in total forest biomass above and below ground).

$CO_{2,cp}$ Projected net CO_2 emissions/removals related contribution (Mt CO_2) of the Article 3.4 activity to the first commitment period assigned amount of the Party.

Methods and approaches

The activity Forest management as defined in Table III is considered as a broad activity. The managed forest area (23 Mha) is averaged to be constant over the years 1990 – 2012. Productive forest land differs from other landtypes, marginal lands, etc which also may contain slow growing forests or tree cover, by storing certain amount of carbon every year provided that the biomass increment is bigger than removals by harvesting or any other circumstance like fires, storms, etc.

The activity Forest conservation as defined in Table III is considered as a narrow activity. Areas are well-defined and protected by legal means without time limits. Forests included in Table III are all well growing exceeding average annual increment of Swedish forests as no forest measures like thinning or any kind of cutting occur.

UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND

Table I Preliminary data and information provided by Annex I Party on carbon stock changes and areas related to article 3.3 activities

Article 3.3 Country specific data	Definitions	Accounting framework	a_I (kha)	$\triangle C_I$ (kt C)	a_{II} (kha)	$\triangle C_{II}$ (kt C)	a_{cp} (kha)	$\triangle C_{cp}$ kt C)	Methods and approaches	Data sources, data quality, and uncertainty (e.g. ranges)	Other information relevant to decision-making
Afforestation Reforestation	IPCC	*Activity based*									
		Land based	117	555	183	1537	401	3070	see below	see below	
Afforestation	FAO	*Activity based*									
		Land based	117	555	183	1537	401	3070	see below	see below	
Reforestation	FAO	*Activity based*	94	458	151	1296	334	2311	see below	see below	
		Land based I	94	-10286	151	-16386	334	-7107	see below	see below	
		Land based II	94	-368	151	-501	334	226	see below	see below	
Afforestation Reforestation	Other: Net approach	*Activity based*									
		Land based	111	526	173	1457	378	2918	see below	see below	
Deforestation	IPCC/FAO	*Activity based*									
		Land based	6	-315	10	-525	23	-263	see below	see below	
	Other: Net approach	*Activity based*									
		Land based		0		0		0	see below	see below	

a_I: Area (ha) afforested and reforested, or deforested since 1990 up to 1995 or possibly an earlier specific year.
$\triangle C_I$: Carbon stock change (t C) since 1990 up to the same year as used in a_I on land afforested, reforested, and deforested.
a_{II}: Area (ha) afforested and reforested, or deforested since 1990 up to 1999 or an earlier specific year.
$\triangle C_{II}$: Carbon stock change (t C) since 1990 up to the same year as used in a_{II} on land afforested, reforested, and deforested.
a_{cp}: Projected area (ha) afforested and reforested, or deforested since 1990 up to 2012.
$\triangle C_{cp}$: Projected carbon stock change (t C) over the first commitment period on land afforested, reforested, and deforested since 1990 up to 2012.

Methods and approaches
Specify:
a) Forest definition used;
b) Definitions for afforestation, reforestation and deforestation used;
c) Applied accounting approaches;
d) Included carbon pools;
e) Other.

EXPLANATORY TEXT (table I)
Parties should submit information under all headings listed below where the information is relevant to the approach taken in their submission and to the extent that data and methodologies exist.

1. Definitions and accounting:
   a) Forest,
   b) Afforestation, reforestation, and deforestation,
   c) Accounting approaches.
2. Carbon pools included (e.g. above-ground biomass, litter and woody debris, below-ground biomass, soil carbon, and harvested materials);
3. Stratification (e.g. biomes and regions);
4. Methodologies and data:
   a) Data sources,
   b) Sampling techniques,
   c) Models and key parameters,
   d) Uncertainties.
5. Treatment of non-CO_2 greenhouse gases.
6. Methods and key assumptions in projections for the first commitment period (2008–2012) and discussion, if possible, of trends beyond the first commitment period.

Table II - Preliminary data and information provided by Annex I Party on carbon stocks and area estimates (First sentence of Article 3.4)

Land system	Area (Mha)	Vegetation Carbon stock in 1990 (Mt C)	Soil Carbon stock in 1990 (Mt C)	Total Carbon stock in 1990 (Mt C)
Woodlands	2.6	94.8	591.1	685.8
Arable	4.8	4.8	969.3	974.1
Pasture	7.2	7.1	1718.3	1725.3
Semi-natural	6.9	11.5	6913.7	6925.2
Other	2.2	0.1	31.9	32.0
Total (as listed above)	**23.8**	**118.2**	**10224.2**	**10342.4**

EXPLANATORY TEXT (table II)

Parties should submit information under all headings listed below where the information is relevant to the approach taken in their submission and to the extent that data and methodologies exist.

1.Description of land categories, including any land categories not covered.
2.Carbon pools - distinctions and assumptions.
3.Data sources.
4.Methods.
5.Possible changes in carbon stocks.
6.Uncertainties.

Table III - Preliminary data and information provided by Annex I Party on Article 3.4 activities, related net GHG emissions, involved areas, and projected carbon stock changes (additional activities under Article 3.4)

Article 3.4 Country specific data	Accounting framework	a_I (1000 ha)	$CO_{2,I}$ (kt CO_2)*	$CH_{4,I}$ (t CO_2 equiv.)* §	$N_2O_{,I}$ (t CO_2 equiv.)* §	a_{II} (1000 ha)	$CO_{2,II}$ (kt CO_2)*	$CH_{4,II}$ (t CO_2 equiv.)* §	$N_2O_{,II}$ (t CO_2 equiv.)* §	a_{cp} (1000 ha)	ΔC_{cp} (kt C) + = uptake; - = release	$CO_{2,cp}$ (kt CO_2)* + = uptake; - = release	$CH_{4,cp}$ (kt CO_2 equiv.)* § + = uptake; - = release	$N_2O_{,cp}$ (kt CO_2 equiv.)* § + = uptake; - = release	Methods and approaches	Data sources, data quality, and uncertainties (e.g. ranges)	Other information relevant to decision-making
Forest management	*Land based*	1400	57000			1400	100000			1400	12250	45000	No data	No data	See explanatory text		
	Activity based																
Bioenergy crops	*Land based*	0.084	15	0	0	0.423	80	0	0	125	1250	4600	No data	No data	See explanatopry text		
	Activity based																
Other activities	*Land based*	Estimates for some other activities can be found in Smith et al (see reference list) but the UK does not advocate including these activities or any others under the provisions of															
	Activity based	Art 3.4 of the Kyoto Protocol for the first commitment period															
	Land based																
	Activity based																
	Land based																
	Activity based																

***** These columns would contain the sum over the years concerned of net annual emissions by sources and removals by sinks for the Article 3.4 activities proposed.
A negative sign indicates either emissions by sources or a decrease in carbon stocks. A positive sign indicates either removals by sinks or an increase in carbon stocks.
To convert a carbon amount to CO_2 multiply it by 3.67.

§ CH_4 and N_2O emissions are converted to CO_2 equivalent emissions by using the global warming potential (GWP) values of 21 for CH_4 and 310 for N_2O (Source: Second Assessment Report of the IPCC, 1995)

a_I: Area (ha) in 1995 or possibly an earlier specific year involved in the Article 3.4 activity since 1990.

$CO_{2,\ I}$: Net CO_2 emissions (t CO_2) by sources and removals by sinks related to the Article 3.4 activity, accumulated from 1990 to the same year as used in a_I.

$CH_{4,\ I}$: CH_4 emissions (t CO_2 equivalent) by sources related to the Article 3.4 activity, accumulated from 1990 to the same year as used in a_I.

$N_2O_{,\ I}$: N_2O emissions (t CO_2 equivalent) by sources related to the Article 3.4 activity, accumulated from 1990 to the same year as used in a_I.

a_{II}: Area (ha) in 1999 or possibly an earlier specific year involved in the Article 3.4 activity since 1990.

$CO_{2,\ II}$: Net CO_2 emissions (t CO_2) by sources and removals by sinks related to the Article 3.4 activity,accumulated from 1990 to the same year as used in a_{II}.

$CH_{4,\ II}$: CH_4 emissions (t CO_2 equivalent) by sources related to the Article 3.4 activity, accumulated from 1990 to the same year as used in a_{II}.

$N_2O_{,\ II}$: N_2O emissions (t CO_2 equivalent) by sources related to the Article 3.4 activity, accumulated from 1990 to the same year as used in a_{II}.

a_{cp}: Projected area (ha) in 2012 involved in the Article 3.4 activity since 1990.

$\triangle C_{cp}$: Projected carbon stock changes (t C) over the first commitment period related to the Article 3.4 activity since 1990.

$CO_{2,\ cp}$: Projected net CO_2 emissions related contribution (t CO_2) of the Article 3.4 activity to the first commitment period assigned amount of the Party.

$CH_{4,\ cp}$: Projected CH_4 emissions related contribution (t CO_2 equivalent) of the Article 3.4 activity to the first commitment period assigne amount of the Party.

$N_2O_{,\ cp}$: Projected N_2O emissions related contribution (t CO_2 equivalent) of the Article 3.4 activity to the first commitment period assigned amount of the Party.

EXPLANATORY TEXT (table III)

Parties should submit information under all headings listed below where the information is relevant to the approach taken in their submissions and to the extent that data and methodologies exist.

1.Activities and accounting:
  a) Definitions and descriptions of all activities proposed,
  b) Scope of activities and how they fit into broader managed land categories,
  c) Accounting approaches,
  d) Proposals for key accounting features, e.g. assumptions on baselines, basis for the area estimates covered by activity.
2.Carbon pools included (e.g. above ground biomass, litter and woody debris, below-ground biomass, soil carbon, and harvested materials).
3.Methodologies and data:
  a) Data sources,
  b) Sampling techniques,
  c) Models and key parameters,
  d) Uncertainties.
4.Treatment of non CO_2 greenhouse gases.
5.Methods and key assumptions in projections for the first commitment period (2008–2012) and discussion, if possible, of trends beyond the first commitment period.

COUNTRY SPECIFIC DATA FOR THE UK RELATING TO ARTICLES 3.3 & 3.4 OF THE KYOTO PROTOCOL

TABLE I

Explanatory text

1. Definitions and accounting

a) Forest is that planted land recorded in national surveys, the state forest sub-compartment database and private land receiving planting grants. This may include access roads and tracks but excludes nursery areas, land with buildings etc.

b) Afforestation & Reforestation in IPCC approach: For Great Britain (GB - England, Scotland and Wales) is the area each year published by the Forestry Commission (FC) to have been approved for planting grant plus the new area actually planted by Forest Enterprise (FE - state forest organisation). For Northern Ireland, both state and private new planting is published by the Dept. of Agriculture for Northern Ireland (DANI).

c) Afforestation for FAO approach is same as for IPCC.

d) Reforestation for FAO approach: The area of land recorded by the FC (GB - private) and FE (GB - state) and DANI (NI – state & private) as being restocked after recent clear felling for production purposes and includes natural regeneration.

e) Deforestation: Change in land use from forest to non-forest.

f) Other (net approach) uses same model as IPCC approach (see below) but areas of Afforestation plus Reforestation are reduced each year by the amount of Deforestation for broadleaf or conifer before changes in carbon pools are estimated.

g) Within the FAO approach for Reforestation the following processes are included: FAO Land Based I includes (loss of old forest carbon due to felling + loss of slash/litter carbon from old forest + gain of carbon in new forest) ; FAO Land Based II includes (loss of slash/litter carbon from old forest + gain of carbon in new forest) and FAO Activity I includes (gain of carbon in new forest)

2. Carbon pools included

For afforestation and reforestation, above-ground biomass, litter and woody debris, below-ground biomass, soil carbon. Deforestation includes the removal of above and below ground biomass and decay of litter and woody debris as appropriate.

3. Stratification

Forestry data is stratified by broadleaf and conifer forests for state and private sectors in each of the 4 devolved administrative regions of the UK i.e. England, Scotland, Wales & Northern Ireland.

4. Methodologies and data

a) Data sources: Forest areas from annual reports of Forestry Commission, Forest Enterprise and Forest Service of Northern Ireland. Tree physiological and carbon data from Dewar & Cannell (1992) and references therein.

b) Sampling techniques: Estimates are based on geographically specific data on forest status recorded by local forest managers.

c) Models and key parameters: Estimates of changes in carbon pools due to afforestation and reforestation use the C-Flow model of Dewar & Cannell (1992) (see also Cannell *et al* (1996), Milne *et al* (1998), Cannell *et al* (1999)). All conifers are assumed to Sitka spruce Yield Class 12 or 14 (NI) and broadleaves beech Yield Class 6. For Deforestation the lost tree carbon pool is

assumed to be the long run time-averaged equilibrium values in the C-Flow for Sitka Spruce and beech forests (60 tC ha^{-1} & 50 tC ha^{-1} respectively). Within the FAO approaches to Reforestation the clear felled forest is assumed to contain twice the carbon as these equilibrium values (since they would be at maturity) and decay of litter and woody debris from the felled forest occurs at the rates estimated by the C-Flow model. Deforestation rates are not well known, hence a representative conversion rate to non-forest of 1000 ha y^{-1} in total for the UK is used for all years. This is under review.

d) The estimates in the table have uncertainties of around ±15% see Milne *et al* (1998), DETR (2000).

5. Treatment of other GHG

Non-CO2 greenhouse gases are not estimated.

6. Methods and Key assumptions in projections

Afforestation and Reforestation are assumed to continue until the first commitment period at the rates recorded in 1998. Deforestation rate is assumed constant for all years from 1990 until the end of the first commitment period.

TABLE II

Explanatory text

1. Land Categories

The land categories used are those used in the UK national assessments of carbon stock and are fully described in Milne and Brown (1997) and Cruickshank *et al* (1998) as are methods and data sources.

2. Carbon Pools

Vegetation carbon contains estimates of above and below ground biomass for all plant types, woody and non-woody. Soil carbon to a depth of 1m (or less where appropriate) for mineral soils and to bedrock for peat soils.

3. Data sources

See Milne and Brown (1997) and Cruickshank *et al* (1998)

4. Methods

See Milne and Brown (1997) and Cruickshank *et al* (1998)

5. Possible changes in carbon stocks

Carbon stocks in forests are increasing due to programmes of afforestation. Stocks of soil carbon, particularly in carbon rich soils of Scotland, may be decreasing due to past expansion of agricultural use but this trend is slowing due to a range of agri-environment policies which have expanded conservation areas and tended to extensify agricultural practices – see Cannell *et al.* (1999) and DETR (2000).

6. Uncertainties

The uncertainty in the sizes of the carbon pools is about ±25% (Milne & Brown 1997)

TABLE III

Explanatory text

The estimates provided in this Table are for information only and do not imply that the UK seeks to include any activities under Art. 3.4 of the Kyoto Protocol for the first commitment period.

1 Forest management

All but some 300 kha of the UK's 2.3 Mha forest estate is managed and is accumulating carbon. Some 1.4 Mha of this estate has been planted since 1920 and the increase in carbon stock in this area is accounted in the UK submission to the UNFCCC Greenhouse Gas Inventory. The increase in carbon stock in forests planted since 1990 is reported here in Table I under Article 3.3 of the Kyoto Protocol and the difference between this amount and that in the GHG Inventory is entered here in Table III (under forest management). These values therefore refer to the accumulation in carbon on the standing forest area in 1990 for periods subsequent to that date up to the end of the first commitment period. Account has not been taken directly of those areas planted prior to 1920 (which are implicitly assumed to be in equilibrium) or of deforestation prior to 1990 except in checking consistency between accumulated areas of planting and the total forest area from periodic survey data. The methods used for calculating the uptake of carbon by the UK forest stock are described in Milne *et al* (1998) and Cannell *et al* (1999).

2 Bioenergy crop production

The data show only enhanced soil carbon uptake in arable land planted with short rotation coppice (SRC), assuming the same accumulation of SOC under short-rotation woody bioenergy crops as seen under natural woodland regeneration (1.17% y^{-1}; see Smith *et al* 2000). Bioenergy is a renewable energy source and its direct emissions mitigation impact in displacing fossil fuel emissions would of course be reflected in the UK inventory, as would any associated emissions in producing and using the SRC.

REFERENCES

Anon (1997), *Climate Change: The United Kingdom's Second Report under the Framework Convention on Climate Change* , The Stationery Office, London .

DETR (2000), *Climate Change: Draft UK Programme*. The Department of the Environment, Transport and the Regions, London.

R.C.Dewar and M.G.R.Cannell (1992), Carbon sequestration in the trees, products and soils of forest plantations: an analysis using UK examples. *Tree Physiology*, **11**, 49-71

M.G.R. Cannell, M.M. Cruickshank and D.C. Mobbs (1996), Carbon storage and sequestration in the forests of Northern Ireland. *Forestry*, **69**, 155-165

M.G.R. Cannell, R. Milne, K.J. Hargreaves, T.A.W. Brown, M.M. Cruickshank, R.I. Bradley, T. Spencer, D. Hope, M.F. Billett, W.N. Adger and S. Subak (1999), National inventories of terrestrial carbon sources and sinks: the U.K. experience. *Climate Change*, **42**, 505-530

M.M. Cruickshank, R.W. Tomlinson, P.M. Devine & R. Milne (1998), Carbon in the Vegetation and Soils of Northern Ireland. *Proceedings of the Royal Irish Academy*, **98B**, 9-12

P.J.A. Howard, P.J. Loveland R.I. Bradley, F.T Dry, D.M Howard and D.C. Howard (1994) The carbon content of soil and its geographical distribution in Great Britain. *Soil Use and Management*, **11**, 9 - 15.

R. Milne & T.A. Brown (1997), Carbon in the Vegetation and Soils of Great Britain. *Journal of Environmental Management*, **49**, 413-433.

R. Milne, T.A.W. Brown and T.D. Murray (1998), The effect of geographical variation of planting rate on the uptake of carbon by new forests in Great Britain. *Forestry*, 71, 297-309

P. Smith, D.S. Powlson, J.U Smith., P.D. Falloon, & K. Coleman. (2000). Meeting the UK's Climate Change Commitments: Options for carbon mitigation on agricultural land. *Soil Use and Management* **16:** 1-11.

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