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METHODOLOGICAL ISSUES
LAND-USE, LAND-USE CHANGE AND FORESTRY

Submissions from Parties

Addendum

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. As stated in document FCCC/SBSTA/2000/MISC.6, the secretariat has received a total of 14 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 the present document containing the submissions of Iceland, Indonesia, Japan, New Zealand, Norway, Poland, 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.

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[*] 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.

FCCC/SBSTA/2000/MISC.6/Add.1

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PAPER NO. 1: ICELAND

LAND-USE, LAND-USE CHANGE AND FORESTRY

This submission is provided by the Government of Iceland in response to a request by SBSTA at its eleventh session (FCCC/SBSTA/1999/14 para. 46) taking note of further conclusions of SBSTA at its twelfth session (FCCC/SBSTA/2000/CRP.2).

Definitions of activities under Article 3.3.

The IPCC Special Report outlines many of the concerns associated with definitions of afforestation, reforestation and deforestation in the context of Article 3.3. of the Kyoto Protocol. This will not be repeated here. This is not purely a technical or scientific issue, however, and has significant policy implications.

Iceland suggest that following concerns should govern the consideration of definitions of ARD activities.

- The definition of ARD activities can not be considered in isolation from activities under Article 3.4. One example of such a linkage is the definition of afforestation. This definition in effect sets the boundary between afforestation on the one hand and revegetation on the other. A restrictive definition of afforestation, which would exclude the planting of trees or shrubs which will not meet a given height criteria, calls for a broader definition of revegetation.

- The issues surrounding the definition of afforestation and reforestation are different from issues surrounding the definition of deforestation due to differences in the way these activities relate to a Parties assigned amount. There is a strong incentive for Parties to report afforestation and reforestation activities as these activities will lead to increases in assigned amounts. This increase will have to be measured in a verifiable manner by Parties before addition to the assigned amounts. There is therefore no reason to restrict the definition of reforestation and afforestation in terms of canopy cover or potential tree height. The net removals are more important. A broad definition also removes the need for regional differences.

- The definition of deforestation is more problematic. Deforestation is more likely to be underreported. In this case it might be necessary to define a forest for monitoring and verification purposes. Multiple thresholds might be necessary in this case.

- For the purposes of the Kyoto Protocol, there is no need to distinguish reforestation from afforestation.

In light of the above, Iceland suggest that afforestation and reforestation should be defined as **direct human action to increase carbon stock on a site through the planting of trees**.

Activities to be included under Article 3.4.

At COP 3 in Kyoto, Iceland suggested the inclusion of revegetation of degraded land in the list of activities in Article 3.3 of the Kyoto Protocol. Iceland also suggested at the time that this could be defined as **direct action to increase carbon stocks in soil with low organic matter content**. This suggested addition was supported by some delegations. Iceland accepted the fact that consideration of sink enhancement activities could not be completed in Kyoto and withdrew its proposal on the assumption that the process set up in Article 3.4. would continue the consideration of sink enhancement activities.

In general terms, revegetation refers to human activity to increase both vegetative cover and soil organic matter (i.e. carbon stock) on a given site. This can be accomplished through a variety of means including: the seeding or planting of trees, shrubs, legumes, and grasses. Revegetation efforts commonly involve input of nutrients through the application of organic or inorganic fertilizers.

Revegetation stimulates natural successional processes and is more commonly undertaken on sites where natural vegetation succession is slow due to land degradation associated with past land uses and /or climatic conditions. Revegetation is commonly associated with land-use change. The timing of this land-use change does not necessarily coincide with the initiation of direct revegetation effort.

Revegetation tends to be undertaken on sites with reduced vegetative cover and low organic matter content compared to natural conditions. The low organic matter content reduces measurement problems associated with the fate of existing soil carbon stocks. Revegetation generally leads to a significant increase in soil carbon stocks. This carbon stock is relatively permanent.

In the Icelandic context, revegetation efforts have a long history. Iceland has lost 96% of its tree cover and 50 % of its vegetative cover during the 1100 years of settlement. Efforts are being made to reclaim lost vegetation and ecosystems. The fact that revegetation has significant climate benefits has already resulted in an increase in funding for this activity. The National Climate Change Action Program initiated in 1995 to stabilize GHG emissions at 1990 levels by the year 2000 includes a major revegetation and reforestation effort (see Iceland's 2nd National Communication and report of In-depth Review Team (FCCC/IDR.2/ICE)).

The choice of the most appropriate definition of revegetation under Article 3.4. is directly linked to the definition of afforestation under Article 3.3. These two activities are very similar and complementary. The main difference is that trees are not necessarily used in revegetation, at least not during the initial stages.

Revegetation does not lead to commercial forestry but can increase the value of the land for grazing or recreation. Revegetation has significant ancillary benefits in terms of erosion control, favorable impact on the hydrological characteristics of the site and increases in biodiversity.

The objective of the UNFCCC, as stated in Article 2, is the "stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system." Revegetation, as conducted in Iceland contributes directly to this objective. Direct action to increase carbon stocks on degraded sites, both below ground and above ground, results in permanent removal of carbon dioxide from the atmosphere.

Revegetation of degraded land is important in the context of the Convention to Combat Desertification. It would therefore be mutually supportive for the objectives of the two Conventions to include this activity in the list of human-induced activities to enhance carbon uptake by sinks.

Iceland proposes that **revegetation** be included as an activity under Article 3.4. This should be defined as direct human activity to increase carbon stocks in above- and below-ground biomass and in soils on sites with minimal vegetative cover and low organic matter content.

Preliminary data and information on carbon stock changes and areas related to Article 3.3 activities

Article 3.3. activity	Definitions	Accounting framework	Area in 1995 (ha)	ΔC (tC)	Area in 1999 (ha)	ΔC (tC)	Area in 1st CP	ΔC (tC)
Afforestation	IPCC	Land based	5,700	34,200	8,750	94,500	20,000	120,000
Deforestation	IPCC		0		0		0	

EXPLANATORY TEXT

1. Definitions and accounting:
a) Forest is defined here as land area with trees.

b) Afforestation is here used for the activity of planting trees on previously treeless areas.

c) Accounting approaches. All afforested land since 1990 is included in the sum.

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

The pools include soil carbon, above-ground biomass, litter and rootmat. Life roots below the rootmat are excluded as research shows that this fraction normally yields <1% of the total carbon.

3. Stratification (e. g. biomes and regions): No stratification was applied

4. Methodologies and data:
a) Data sources,

Based on information from the Icelandic Forest Service.

b) Sampling techniques,

Some of the areas are included in government funded planting of trees by farmers on abandoned land. These areas are mapped and closely monitored. Some the afforestation is undertaken by non-governmental organizations with government funding. Finally some of the areas are planted by the public.

c) Models and key parameters,

Sequestration rates are based on measurements on mature stands. Average growth rates are assumed for the rotation period.

d) Uncertainties.

5. Treatment of non- CO_2 greenhouse gases.

The data in this table does not include non-CO_2 gases. Possible changes in CH_4 and NO_2 emissions associated with these activities can be expected to be minor compared to sequestration rates.

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.

It is very difficult to predict the level of afforestation in the first commitment period. The numbers here are simple extrapolations.

Preliminary data and information on carbon stock changes and areas related to Article 3.4. activities

Article 3.4. activity	Accounting framework	Area in 1995 (ha)	CO_2 (t CO_2)	Area in 1999	CO_2 (t CO_2)	Area in 1st CP	CO_2 (t CO_2)
Revegetation	Land based	12,500	171,900	28,200	698,500	70,000	963,400

EXPLANATORY TEXT

1. Activities and accounting:
a) Definitions and descriptions of all activities proposed,

Revegetation is direct human activity to increase carbon stocks in above- and below-ground biomass and in soils on sites with minimal vegetative cover and low organic matter content.

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

The areas revegetated are generally managed by the Soil Conservation Service (a government agency) and are fenced off to protect them from grazing.

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

An important part of the *National Climate Change Action Program* is to verify the carbon sequestration which results from the revegetation/restoration activities. A special research project was established at the initial stages of the program to develop methods to measure the sequestration. The research program was divided into three components: sequestration in trees and by afforestation, sequestration in biomass other than trees, and sequestration in soils. The three groups worked closely together.

The research program, which was initiated in 1998, aims to formulate an Icelandic Sequestration Method (Ice-C-Method) which will be, after completion, used for determining carbon sequestration (see below). At this stage it is mostly designed for revegetation activities, but other similar methods are being developed for the forestry activities.

All areas with revegetation activities are measured (aerial photographs, GPS tracing etc) and stored in a GIS system at the Icelandic Soil Conservation Service (SCS). Sequestration rates are found by research throughout the country, representing a variety of environmental conditions. Sequestration is found by combining relatively detailed aerial information (ha), treatments, and sequestration rates provided by research. The methods do not rely on baseline measurements, if reliable numbers from regression equation for given conditions exist, but periodic field sampling and verification is required.

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

The pools include soil carbon, above-ground biomass, litter and rootmat. Life roots below the rootmat are excluded as research shows that this fraction normally yields <1% of the total carbon.

3. Methodologies and data:
a) Data sources,

All data is verifiable with aerial information stored in a GIS system, together with information on site conditions and revegetation treatment. Each area receives its carbon sequestration rate, based on research (Ice-C-Method), and samples are taken from each site for carbon measurement. The carbon sequestration for each of the sites is then adjusted according to results from measurements.

b) Sampling techniques,

Carbon sequestration is measured in soils and biomass. Soils are sampled by cores, 5 cores per sample, three samples per site, often three sites for each revegetation activity area. Samples are taken in 10 cm depth increments. Coarse fragments are determined at each site, and the bulk density of the finer materials in which C is determined by a separate sampling technique. Above ground biomass is sampled concurrently if possible to ensure that all carbon is included (and only counted once). All vegetation, including biomass, rootmat and litter is sampled, but initial research has shown that below ground life roots under the rootmat add little to the total carbon pool at these sites. Vegetation is harvested in randomly located subplots within larger plots, which are several at each site.

c) Models and key parameters,

Research results are used to formulate model for sequestration, both general and specific for areas and treatments. At this point (June 2000), about 70 sites have been sampled and carbon determined in the soils. Carbon stock in vegetation has been determined for fewer locations. These sites represent several treatments and age of treatment ranging from 1-50 years. Regression have been made for the dataset (kg C/m^2 vs. age to arrive at annual sequestration). The research shows that separate regressions are needed for North and South Iceland, and sandy vs. other desert soil types. At about 20 of these sites, comparison plots were available with untreated sites but same site conditions adjacent to treated plots, which generally yields similar or higher sequestration rates than the regression lines. All carbon sequestration activity areas should be measured for carbon at least once over each 10 yr. period. Research shows that carbon sequestration can slow considerably down or halt if vegetation succession “stops”, which it can for many reasons. It is therefore important to follow up the results in revegetation areas if they are designed as carbon sequestration areas.

Research is still going on to test the sequestration curve with time for these sites. General sequestration rates vary from 0.1 to > 1 tC/ha/yr (soils and biomass). Data indicate that soils sequester carbon at >0.2 tC/ha/yr for >100 yrs, and on average about 0.6 tC/ha/yr for the first 50 yrs. Sequestration is generally lower in North Iceland than in the South. Sequestration in biomass reaches a limit within 30-80 yrs, depending on initial rates and success in crossing ecosystem succession thresholds (and moving the system towards more fertile systems such as shrub or woodlands).

The research program is planned as a steadily on-going project, it is currently in its third year. Additional research results and monitoring data is used to formulate, and later to adjust the Ice-C-Method each year (regression lines for given site conditions). Separate indices are found for soils and biomass, and they are dependent upon such factors as site characteristics, revegetation treatments, climate and other factors as previously noted. Each site is assigned a bulk density factor, based on measurement at the site or comparison with similar area.

Research has been initiated on carbon fluxes in revegetation areas to compare with measured sequestration rates according to the Ice-C-Method. First results indicate similar sequestration as direct CO_2 flux measurements indicate, and that without revegetation, Icelandic deserts may act as a source of CO_2.

d) Uncertainties.

4. Treatment of non CO_2 greenhouse gases.

The data in this table does not include non-CO_2 gases. Possible changes in CH_4 and NO_2 emissions associated with these activities can be expected to be minor compared to sequestration rates.

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.

It is very difficult to predict the level of revegetation in the first commitment period. The numbers here are simple extrapolations.

Methodologies for measuring and reporting in relation to Article 3.3. and 3.4. activities

Activities which have been considered for inclusion under Article 3.4. fall into two very different categories.

1. **High intensity – small area.** Activities with high intensity of human intervention on a confined area.
2. **Low intensity – large area.** Activities with low intensity of human intervention covering large areas.

Revegetation is an example of the former while forest-, cropland- or grazingland management are examples of the latter. The former is generally associated with land-use change while the latter involves improves management without changes in land use.

This difference has important implications for quantification of the changes in net removals, attribution to human activity, separation of actions before and after 1990 and the need for the separation of direct and indirect human impact.

Activities with high intensity on small areas are essentially identical to the Article 3.3. activities of reforestation and afforestation in that there is no need to separate indirect from direct human impacts. Indirect growth enhancing or reducing effects only enhance the climate benefits of the activity. Neither would be realized without the activity.

For management activities the separation of indirect from direct human impact becomes critical to ensure that removals due to indirect human impacts independent of the management activities do not enter into the accounting system.

Methods used for quantifying net removals from revegetation in Iceland during the special effort for additional sequestration in 1995-2000 will form the basis for the approach taken for the first commitment period. Data collection will continue uninterrupted. The current approach is outlined in the explanatory text accompanying the table on Article 3.4. activities.

Rules for the implementation of sink enhancement activities should be the same for Article 3.3. and Article 3.4. activities to the extent possible. There is no inherent difference between Article 3.3. and Article 3.4. activities. The term “additional activities” in Article 3.4. refers to the fact that activities to be included under Article 3.4. are additional to those already included under Article 3.3. Under Article 3.4. there is a need to distinguish between high intensity activities and the low intensity management activities when methodologies are developed.

The fact that Article 3.3. refers to “net changes in greenhouse gas emissions from sources and removals by sinks…measured as verifiable changes in stocks” while Article 3.4. refers to “changes in greenhouse gas emissions and removals” has been overinterpreted. One example is the inference that for Article 3.3. activities, only carbon dioxide needs to be considered. This inference is based on the fact that this is the only gas which for technical reasons can be measured as changes in carbon stocks (IPCC SP SPM para 36). The first sentence of Article 3.3. clearly refers to greenhouse gas emission, not only carbon dioxide emissions.

Preliminary data and information on carbon stocks and area estimates
(First sentence of Article 3.4)

Land categories	Land system Area (ha)	Carbon stock in 1990 (million t C)
Forest lands	**150,000**	**62**
Agriculture lands	**130,000**	**52**
Rangelands/ grasslands	**4,097,000**	**1,229**
Wetland/ tundra	**860,000**	**774**
Other* (**deserts**)	**3,823,000**	**32**
Total (as listed above)	**9,060,000**	**2,149**

EXPLANATORY TEXT

1. Description of land categories, including any land categories not covered.

Forest lands are native birch woodland and planted forest using native species and introduced conifers and broadleafed trees. Agricultural land are permanent hay fields, potato fields and barley fields. Rangelands/grasslands are non-cultivated land used for grazing. Wetland are bogs and mires (no permafrost or tundra areas are found in Iceland). Deserts are areas with limited plant cover either due to erosion or sand encroachment (mainly on the central highlands). The total does not include about 10,000 km^2 of glaciers in Iceland.

2. Carbon pools - distinctions and assumptions.

Biomass and soil carbon

3. Data sources.

Area estimates are based on several sources, including soil maps, vegetation maps, satellite images, and land use statistics. Rangelands/grasslands are over-estimated because such areas often include desert patches too small to show up on small scale maps.

4. Methods.

5. Possible changes in carbon stocks.

Forest lands are expanding due to afforestation of approximately 1000 ha per year. Soil erosion is still ongoing and can be expected to increase the area classified as deserts.

6. Uncertainties.

Uncertainties are associated both with area estimates and determination of carbon stocks. The numbers reported here provide a good first-order estimate of the total carbon stocks in Iceland. These numbers can not be used to determine short-term (one to several decades) changes in carbon stocks.

PAPER NO. 2: INDONESIA

LAND-USE, LAND-USE CHANGE AND FORESTRY (LULUCF)

GENERAL

1. Government of Indonesia would like to thank to the Secretariat of UNFCCC for organising the recent workshop on LULUCF in Poznan, Poland, which provided parties a forum to exchange views and in depth discussions on the IPCC Special Report. We do hope that this session will smoothen the negotiation process towards COP6.
2. We are aware of the implications of Decision 9/CP.4 paragraph 7, and would like to express our assurance to continue participating in the work of SBSTA on LULUCF

DEFINITIONS

3. Considering the various definitions of forest, afforestation, reforestation, and deforestation used by parties for national purposes and various scenario suggested in IPCC Special Report on LULUCF, and their suitability for carbon accounting purposes under Article 3.3 of the Kyoto Protocol (KP), Indonesia views that:
   a. the adoption of certain accounting approach for reporting of changes in greenhouse gas emissions by sources and removal by sinks, should consider the above aspects
   b. before the outstanding issues in relation to various options on definitions of ARD mentioned in the IPCC Special Report on LULUCF and the corresponding accounting systems can be resolved , parties should be given the freedom to use their own definition on ARD with appropriate carboun accounting system, provided that there is assurance on transparency, comparability, accuracy, consistency, and completeness in reporting
   c. definitional scenarios of ARD and the corresponding carbon accounting systems on LULUCF should be seen as a dynamic process, which need to be reviewed and revised, as appropriate, and the necessary adjustment of methodology should be applied

ADDITIONAL ACTIVITIES

4. In response to SBSTA 12th session on how additional activities proposed by parties to be included in Article 3.4 of the KP relate to the objective and principle of the Convention and the Protocol, Indonesia considers human-induced activities, which aimed at reducing greenhouse gas emissions and enhancing sinks, should be included under Article 3.4 of the KP. Deforestation avoidance, forest fire prevention, sustainable forest management, sustainable agroforestry, and conservation of threatened protected areas are among activities that should be included under Article 3.4.
5. Indonesia believes that such project may provide socio-economic and environmental benefits especially within project boundaries. LULUCF projects in areas where local livelihood would significantly benefit would achieve dual goals of climate mitigation and sustaianble development.

LULUCF AND CLEAN DEVELOPMENT MECHANISMS (CDM)

6. As described in Article 12, CDM is meant to assist parties not included in Annex 1 in achieving sustainable development and in contributing to the ultimate objective of the Convention, and to assist Parties include in Annex 1 in achieving compliance with their quantified emission limitation and reduction commitments under Article 3 of the Protocol.
7. In this connection Indonesia wishes to emphasise the importance of linking Articles 3.3, 3.4 and Article 12. However, we realise that the modalities, rules, and guidelines in engaging such projects are not ready yet.

8. Can CDM be equitable? We views that in concrete terms such project should enhance poverty alleviation and job creation. CDM projects in LULUCF sector are not acceptable if it does not encourage people to participate or if it causes adverse impacts on the local environment or if it is too costly. Our government has a very strong commitment that local people will gain benefit from projects like this.
9. We view that LULUCF in CDM will only applicable if various issues such as uncertainties regarding definitions, methodologies and other technical problems like baseline and additionality, project boundary and leakage, and risks management are resolved.

PAPER NO. 3: JAPAN

LAND-USE, LAND-USE CHANGE, AND FORESTRY

Textual Proposal of the Government of Japan regarding Article 3.3 and 3.4

I. Basic position concerning the Land-Use, Land-Use Change, and Forestry activities under the Kyoto Protocol

1. Land-Use, Land-Use Change, and Forestry activities play an important role in GHG emissions and removals. They should be treated in as comprehensive a way as possible within the framework of the Kyoto Protocol to provide appropriate incentives for emissions reductions and enhancement of removals with continuous efforts to reduce uncertainties.

2. The Kyoto Protocol specifies that accounting under Article 3.3 be limited to ARD since 1990. The Government of Japan, therefore, believes an approach which addresses activities in a comprehensive manner to be taken under Article 3.3 and 3.4 is necessary for the reasons outlined in 1 above.

3. Further, it is necessary to define activities and design an accounting framework which make it possible to provide appropriate incentives in accordance with distinctive circumstances unique to each country. In the case of Japan, ongoing efforts to manage forests have resulted in two-thirds of the country's total land area being covered by forests. As population density is quite high and industrial activities are quite common all around the country, the land available for afforestation or reforestation is strictly limited. Thus, for a country like Japan, activities which contribute to carbon sequestration through appropriate management of existing forests are of the utmost importance and should be given full consideration when determining the accounting framework under Articles 3.3 and 3.4.

4. In establishing definitions and designing an appropriate accounting framework under Articles 3.3 and 3.4, the following points must be considered:

1) Making it possible to monitor the change of amount of carbon sequestered adequately and cost-effectively including via the use of existing statistics while reducing the degree of uncertainty as much as possible

2) Contributing to sustainable forest management

II. Proposal for definition and accounting framework of afforestation, reforestation and deforestation under Article 3.3

[Proposal]
Japan proposes that Parties adopt an FAO definition and an activity-based accounting framework for ARD activities.
This involves identifying the land where ARD has been occurring since 1990, and counting changes in carbon stocks during the period 2008 - 2012 as removals when the amount of carbon stock increases and as emissions when it decreases. Changes in carbon stock in soil and residual organic matter, however, are not counted.
In addition, for activities under Article 3.3, emissions and removals of GHGs other than CO_2 may be counted in case of activities such as forest nitrogen fertilization or planting on wetland.

[Explanation]
1. In selecting a definition and an accounting framework under Article 3.3, proper consideration should be given to the provision of incentives which are appropriate to the state of forestry activities in countries where forest management is highly important. Specifically, the harvesting-regeneration cycle is important among the forestry activities of above-mentioned countries, and thus a definition and accounting framework that contribute to increases in carbon sequestration considering this cycle should be adopted. Present circumstances show that various options of land use compete with each other in determining how a given piece of land is used, and economically advantageous options receive priority. It is true that many of the world's forests are used in forestry as an economic activity. Therefore, it is important that the lands currently used in forestry are not subject to changes in usage, or being deforested, and that this forestland be maintained as such and continue its role as carbon sequestration. Incentives in the area of accounting will be necessary should these lands be included as lands governed under Article 3.3.

2. From this point of view, among the various existing definitions, the FAO definition can provide incentives for increasing the amount of carbon removed should the appropriate accounting framework be selected, since it covers the harvesting-regeneration cycle. On the other hand, the IPCC definition provides no incentives for the harvesting-regeneration cycle, in that it covers only ARD accomplished via changes in land use and excludes the harvesting-regeneration cycle entirely.

3. Among the three accounting frameworks of FAO, activity-based accounting provides strong incentives for afforestation based on appropriate forestry management activities, as it accounts for increases of carbon stock by reforestation following harvesting. Through the management of man-made forests, the starting of new accumulations of carbon by harvesting in due course as well as the immediate reforestation of harvested land will increase the removal of carbon from the atmosphere and lead to sustainable forest management. In Japan we have man-made forests of ten million hectares which comprise 40% of all forest area. Such a figure is significant and to strengthen these forests as sinks and reservoirs of GHGs through appropriate forest management contributes positively to preventing global warming and, especially in Japan, environmental conservation and promotion of forestry.

4. Activity-based accounting incorporates only increases of amount of carbon sequestered in soil resulting from the growth of plant afforested. Since excluding soil carbon will underestimates credit accrued, it will be acceptable for not including soil carbon in the accounting.

5. On the other hand, land-based I accounting is inappropriate to promote sustainable forest management on the basis of the harvesting-regeneration cycle, as it works as a disincentive for harvest in normal forestry activities, because net debit will be accrued from accounting carbon stock loss on forest land resulting from harvest.

6. In land-based II accounting, changes in carbon stock in soil and residual organic matter play an important role in accounting, yet accurate measurement and estimation of these changes for all land under Article 3.3 is extremely difficult at present. In addition, this accounting framework currently brings exorbitant costs involved in attempting to estimate such changes to an appropriate degree of accuracy. Therefore, from the perspective of cost-effectiveness, land-based II accounting seems not to be practical accounting framework.

7. For the accounting of GHGs other than CO2, only accounting in special cases, such as those GHGs released from nitrogen fertilization and from planting on wetland, should be considered, though emissions of these gases in forest activities are negligible in Japan.

III How and which additional activities are to be included in Article 3.4 (including structures, rules, guidelines and accounting framework related to these activities)

[Proposal]
Japan holds the view that forest management and urban greening etc. should be included in activities under Article 3.4, and supports the broad definition and activity-based accounting for activities under Article 3.4.
With regard to the broad definition, the Government of Japan suggests that each country should identify practices constituting each activity in accordance with the situation unique to each country, and then identify land where these practices are carried out. For identified land, net removals of CO_2 should be accounted for by estimating changes in the amount of removals by subtracting the carbon stock reference figures for 2008 from those for 2012.
Changes in the amount of carbon in soils and residual organic matter should not figure into the accounting.
For forest management, emissions and removals of GHGs other than CO_2 should be included in the accounting, although they will only be adopted to the special cases such as nitrogen fertilization and planting on wetland.

[Explanation]
1. It is not appropriate to enumerate all the practices fitting within the narrow definition and then decide whether or not they should be classified as activities falling under Article 3.4, because the practices of forest and farmland management differ by country. Adoption of a broad definition is thus more practical.

2. In adopting the broad definition, it is practical to identify practices constituting the activities of forest management and so on in accordance with the circumstances existing in each country first. And then to identify the lands on which these practices are carried out as the lands for activities under Article 3.4.

3. It is appropriate to adopt activity-based accounting for Article 3.4 in order to have consistency with accounting framework under Article 3.3. Under the broad definition, different practices would be accounted as one incorporated activity; hence, the problem of double accounting when multiple practices on one section of land exist would not arise.

4. In accounting, a counterfactual baseline in order to separate natural changes and human-induced changes may increase uncertainty, and indeed, the setting of the baseline may have to be decided arbitrarily. While there is another way of setting up control areas not subject to human-induced activities, in terms of cost and its effectiveness, it is impractical to set up these control areas taking into account various factors such as species planted, landform, climate and so on. Also, in certain cases, it might take a long time until results become evident. For these reasons, estimating the change of carbon stock by subtracting the carbon stock reference figures for 2008 from those for 2012 seems to be the most practical way.

5. Changes in the amount of carbon in soils and residual organic matter should not figure into the accounting because it is extremely difficult to conduct highly accurate estimations of these changes cost-effectively.

6. For the accounting of GHGs other than CO_2, only accounting in special cases, such as those GHGs released from nitrogen fertilization and from planting on wetland, should be considered, though emissions of these gases in forest activities are negligible in Japan.

IV. Measuring and reporting methodologies under Articles 3.3 and 3.4 of the Kyoto Protocol

[Proposal]
1. Parties should account for emissions and removals of CO2 by measuring or estimating changes of carbon stock for both Articles 3.3 and 3.4.

2. Relating to changes of carbon stocks, Parties should measure or estimate changes of carbon stock between 2008 and 2012.

3. Each country should determine its most appropriate method of measuring and estimation in accordance with its own unique situation in to the view point of reducing uncertainty and enhancing verification, taking into account both the relationship between the accuracy of measurement and estimation and the costs involved. There would be several methods including one using basic units, one incorporating both remotely-sensed data and surface data, one using models and direct measurement, and so on.

4. In conducting practical accounting, it is essential to make good use of existing statistics to carry out national level accounting cost-effectively.

5. When reporting, in order to ensure transparency, it is necessary to clarify measuring and estimation methods used so as to make possible verification by third parties.

V. Overall accounting approaches corresponding to requirements of Article 3.3, 3.4 and 3.7 of the Kyoto Protocol (especially correlation between reversibility, natural effects and accounting inter-linkages)

[Proposal]
1. In accounting, commitment periods should set contiguously and account for both emissions and removals. By doing this, even for reversible activities, accurate calculation of emissions and removals at each time when the activities are conducted, will make it possible to demonstrate the exchange of GHGs between sources/sinks and the atmosphere precisely.

2. It is necessary to establish a counterfactual baseline in order to separate natural changes from human-induced changes, which may increase uncertainty, and the setting of baseline may have to be decided arbitrarily. There is another way of setting up control areas not subject to human-induced activities, but in terms of expense and effect it is impractical to set up these areas taking into account species, landform, climate and so on. Also, in certain cases, it might take a long time until effects become evident. Therefore, in terms of reducing uncertainty and excluding arbitrary estimation, accounting should be done by subtracting the carbon stock reference figures for 2008 from those for 2012, without separating out natural effects.

3. Activities under Articles 3.3 and 3.4 should be estimated in the same accounting framework to ensure consistency in accounting between Article 3.3 and 3.4.

4. It is appropriate to treat GHG emissions from agricultural soil under Article 3.1 on the basis of provisions under the Kyoto Protocol. Activities, however, that lead to increase amount of removals of GHGs should be treated under Article 3.4.

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	Relevant Definition	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							Estimated with the FAO activity-based accounting approach. Only above- and below-ground biomass accounted as carbon stock. Litter, humus and soil carbon not included as carbon stock.	Areas afforested an reforested based on historical data and forecasting. Estimated standing tree volume in each period using yield tables, then converted to carbon stock by applying coefficients.	Activity-based accounting approach recommended owing to high uncertainties in estimating soil carbon. Is rational to estimate carbon stock from standing tree volume.
		Land-based									
Afforestation	FAO	Activity-based	35,000	50,000	58,000	294,000	134,000	1,368,000			
		Land-based									
Reforestation	FAO	Activity-based	316,000	491,000	459,000	2,736,000	749,000	9,102,000			
		Land-based I									
		Land-based II									
"Afforestation & Reforestation"	Other	Activity-based									
		Land-based									
Deforestation	IPCC/FAO	Activity-based	-107,000	-5,956,000	-148,000	-8,461,000	-319,000	-5,104,000			
		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)

1. Definitions and accounting

a) Forest

"Land with trees and/or bamboo growing in a group, and/or land provided for collective vegetation of trees and/or bamboo (Article 2.1, the Japanese Forest Law).

b) Afforestation, reforestation, and deforestation

"Afforestation" : "Artificial establishment of forest on lands that were not historically forest"

"Reforestation": "Artificial establishment of forest on lands that had them previously (including regeneration post harvest)"

"Deforestation": "Conversion of forest to non-forest."

c) Accounting approaches

The activity-based accounting approach is applied for estimation, and carbon pools of above- and below-ground biomass are considered.

Carbon stock changes are estimated as follows, using yield tables to estimate stem volume as well as its change for a given period.

i) Total stem volume is estimated with afforested areas by planting years, and stem volumes per hectare for the corresponding forest ages derived from the yield table, which was applied to design Basic Plan on Forest Resources.

Ti = (Aij × Vj), where

Ti : total stem volume of the year "i" of the forest stand established since 1990.

Aij : area of the part of the forest at age "j" in the year "i".

Vj : stem volume of forest at age "j" according to the yield table.

ii) The following formula and coefficients to convert stem volume to carbon weight are used.

Carbon Weight Stem Volume × Expansion Coefficient × Wood Density × Carbon Content, where

Expansion Coefficient : 1.7 ; coefficient to convert stem volume to above- and below-ground biomass, including branches and roots

Wood Density : 0.4 ; coefficient to convert volume to weight

Carbon Content : 0.5 ; fraction of carbon content in a tree

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

In this estimation, above- and below-ground biomass are considered.

In estimating the carbon stock, it is considered efficient and pertinent to estimate it based on stem volume, readily available from conventional forest surveys which have been widely and routinely implemented.

As stem volume correlates closely with volumes of branches and roots, it was concluded that carbon stock covering above- and below-ground biomass can be derived from stem volume.

3. Stratification (e.g. biomes and regions)

Stem volume is derived from yield table prepared by regions, major tree species and site quality.

4. Methodologies and data

a) Data sources

"Forestry Statistics" and "Basic Plan on Forest Resources" are referred to as information on forest resources, and the "White Paper on Land Use" and "National Land Use Plan" as information on land use as source materials.

b) Sampling techniques

Complete enumeration has been implemented for the survey of the current status of forest resources, which forms the base of estimation for sequestration, .

c) Models and key parameters

As described above, stem volume with expansion coefficients, and above- and below-ground biomass are estimated.

d) Uncertainties

Uncertainty is considered relatively low since complete enumeration was implemented for the Survey of the Current Status of Forest Resources, which forms the base of estimation for sequestration.

5. Treatment of non-CO_2 greenhouse gases.

Emissions of greenhouse gases from forests, other than CO2, are not considered.

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.

of trends beyond the first commitment period.

Future areas for planting, i.e. afforestation and reforestation, are estimated on the basis of historical data, and stem volume is estimated with yield table.

Future conversion area of forest lands is estimated based on conversion area data in National Land Use Plan.

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 (t C)
Forest lands	25,212,000	1,420,917,000
Agriculture lands	5,243,000	258,064,000
Rangelands/grasslands	*cf. Note*	*cf. Note*
Wetland/tundra	NE	NE
Other	69,628	24,722
Total (as listed above)	30,524,628	1,679,005,722

N/E: Not Estimated
Note: Grasslands is included in agriculture lands.

EXPLANATORY TEXT (Table II)

. Forest lands

1. Description of land categories, including any land categories not covered

"Land with trees and/or bamboo growing in a group, and/or land provided for collective vegetation of trees and/or bamboo (Article 2.1, the Japanese Forest Law).

2. Carbon pools - distinctions and assumptions

Same as the explanatory note for Article 3.3, Table .2.

3. Data sources

Forestry Statistics used as forestry resource information.

4. Methods

Carbon stock is estimated as follows, using stem volume in all forests, referring to the Survey of Current Status of Forest Resources, 1990, along with expansion coefficient, wood density and carbon content.

Division	Area (1,000ha)	Volume (1,000m3)	Expansion Coefficient	Wood Density	Carbon Content	Carbon Stock in 1990 (1,000tC)
Man-made Forest	10,327	1,597,844	1.7	0.4	0.5	543,267
Natural Forest	14,885	1,539,737	1.9	0.6	0.5	877,650
Total	25,212	3,137,581				1,420,917

5. Possible changes in carbon stocks

As plantations established in postwar years are still in the growing stage, carbon stock is increasing even if felling volume is subtracted out.

6. Uncertainties

Uncertainty is considered relatively low since complete enumeration was implemented for the Survey of the Current Status of Forest Resources, which forms the base of estimation for sequestration.

. Agriculture lands

1. Description of land categories, including any land categories not covered
   Corresponding divisions: paddy fields, normal patches, fruit farms, grasslands, and facilities

2. Carbon pools - distinctions and assumptions
   1) For data for areas of each soil group over the entire country, a requirement for estimation, the synthesis report "Fundamental Survey Of Soil Fertility Conservation," surveyed until 1976, contains the most recent data. Lacking more recent information, the figures presented here use figures from 1990 and assume that the data for area component ratio by type of soils has not changed since 1990.
   2) The "Fundamental Survey of Environmental Quality for Soil", being surveyed by fixed-point observation including 20,000 data points of 250 ha each in various areas across the country, will take 5 years to complete. Lacking more recent information, data on carbon stocks in soils from 1989 to 1993 were used here, and the figures presented here assume that such data has not changed since 1990.

3. Data sources
   Statistics and Information Department / The Ministry of Agriculture, Forestry and Fisheries of Japan
   "Statistics of agricultural lands and acreage under cultivation"

4. Methods
   Carbon stocks in 1990 were estimated using the following data:
   - Total carbon stocks in cultivated soils from "Fundamental Survey of Environmental Quality for Soil (3rd, 1989 1993)"
   - Area of agricultural lands in 1990

5. Possible changes in carbon stocks
   It is necessary to keep in mind that even if total carbon stocks in agriculture lands decline as a result of the decline in the total area of such lands increased to carbon emissions do not necessarily result.

6. Uncertainties
   Uncertainty is low for carbon stocks in soils based on the "Fundamental Survey of Environmental Quality for Soil." However, because of the age of the references for the data of sections of each soil group, the general uncertainty is considered to be between M and L..

. Other (Urban green spaces)

1. Description of land categories, including any land categories not covered
   Corresponding divisions: Square parks, Neighborhood parks, Community parks, Comprehensive parks, Sport parks, Large scale parks, Specific parks, National government parks, Buffer greenbelts, Ornamental green spaces, Greenways, Specified community parks, and Green space conservation zones

2. Carbon pools - distinctions and assumptions
   Carbon pools include above- and below-ground biomass.

3. Data sources
   Surveyed by Ministry of Construction.

4. Methods
   Carbon Stock = A PW BI k, where
   A : area (ha)
   PW : percentage of planted tree area vis-a-vis park area
   : biomass increase in a year
   k : 0.5 ; carbon content

5. Possible changes in carbon stocks
   Possible changes in carbon stocks depend on the definition of activities shown in Article 3.4 of the Kyoto Protocol.

6. Uncertainties
   In the Second National Communication of Japan, uncertainties of the estimate for the category "LUCF" was prescribed as "M (Middle)" and reported to UNFCCC.

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) (×1,000)	$CO_{2, I}$ (t CO_2)* Total over 6yrs('90-'95)	$CH_{4, I}$ (t CO_2 equiv.)* §	$N_2O_{, I}$ (t CO_2 equiv.)* §	a_{II} (ha) (×1,000)	$CO_{2, II}$ (t CO_2)* Total over 10 yrs('90-'99)	$CH_{4, II}$ (t CO_2 equiv.)*§	$N_2O_{, II}$ (t CO_2 equiv.)* §	a_{cp} (ha) (×1,000)	C_{cp} (t C) Total over 5 yrs (2008-2012)
Forest Management etc.: (All Forests)	*Activity based*	25,146,000	457,512,000	NE(See Text)	NE(See Text)	25,197,000	740,564,000	NE(See Text)	NE(See Text)	25,220,000	56,840,000
(Managed Forests)	*Activity based*	8,084,000	135,792,000	NE(See Text)	NE(See Text)	8,657,000	233,156,000	NE(See Text)	NE(See Text)	12,450,000	48,948,000
Urban Greening etc.	*Land based*										
	Activity based	15,050	165,701	NE	NE	38,050	698,218	NE	NE	83,050	377,750
….											
….											

Note 1) : All data are preliminary. NE: Not Estimated

2) : ai, aii, and acp for urban greening and other such activities shows the number of planted trees per year (1,000)

* 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)

$CH_{4,cp}$ (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
NE(See Text)	NE(See Text)	Broadly-defined activity. Estimated with the Activity-based accounting approach. Emissions from harvesting are accounted for in carbon stocks.	Estimated sequestration based on growth in Managed Forest where additional human-induced activities take place. Current status based on Forestry Statistics, and forecast based on Basic Plan on Forest Resources.	
NE(See Text)	NE(See Text)			
		Broadly-defined activity. Estimated with the Activity-based accounting approach. Estimated biomass weight data of the trees planted in the parks, etc. that were planted artificially.	Used historical data and future perspectives for planted trees based on the "Survey of Preparation for the 5 year Greenery Promotion Plan" and "Green Plan 2000."	
NE	NE			

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 CO2 emissions related contribution (t CO2) 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)

I. Forest Management etc.

1. Activities and accounting

a) Definitions and descriptions of all activities proposed.

Forest Management : Activities to establish healthy and vital forests, in order to develop and enhance various functions of forests comprehensively, and to assure national land conservation, prevent disasters and provide a comfortable environment.

More specifically, the activities include plantation, regeneration assisting practices such as surface scarification and brush cutting, weeding, clean-cutting among others.

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

Forest Management includes a broad range of forestry operations implemented in the forest area.

c) Accounting approaches

The activity-based accounting approach is applied for estimation and, as with Article 3.3, carbon pools of above- and below-ground biomass other than understory vegetation, litter, humus and soil carbon, are considered.

Sequestration is estimated based on growth of the Managed Forest in the assessment period and, as with carbon stocks from the activities under Article 3.3, above- and below-ground biomass is estimated with standing tree volume, and then sequestration under Article 3.3 and emissions due to harvest are subtracted.

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

Baseline has not been established.

For area and growth of the Managed Forest accounted for in the assessment period, present status is based on Japan's national "Forestry Statistics", and forecasting is based on Japan's "Basic Plan on Forest Resources."

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

Same as the explanatory note for Article 3.3, Table I.2.

3. Methodologies and data

a) Data sources

"Forestry Statistics" and "Basic Plan on Forest Resources" are referred to as information on forest resources.

b) Sampling techniques

Complete enumeration has been implemented for the Survey of the Current Status of Forest Resources, which forms the base of estimation for sequestration.

c) Models and key parameters

No models or key parameters are used in relation to forest accounting.

d) Uncertainties

Uncertainty is considered relatively low since complete enumeration was implemented for the Survey of the Current Status of Forest Resources, which forms the base of estimation for sequestration.

4. Treatment of non CO_2 greenhouse gases.

Emissions of greenhouse gases from forests, other than CO2, are not considered except in special cases.

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.

It would be possible to estimate carbon sequestration beyond the first commitment period, based on the "Basic Plan on Forest Resources", and use the same approach applied here to estimate carbon sequestration for the first commitment period.

. Urban Greening, etc.

1. Activities and accounting:

a) Definitions and descriptions of all activities proposed.

Activities in planting trees on the urban parks, roads, rivers, etc., sewage-disposal plants, facilities for government and other public offices, public housing, among others.

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

Accounted by the number of planted trees for this estimation. Therefore, it is also applicable in the case of other divisions of land.

c) Accounting approaches.

Use the annual average number of planted trees and the trends from 1991 to 1995 and project the activity data during the commitment period, assuming that trends will continue uniformly after 2000.

Estimate carbon stocks by multiplying this projected activity data: biomass increase in the wooded land under the IPCC definition (2.0 t/ha); carbon content coefficient (0.5); surveyed number of planted tree in the urban park (1,000 pieces/ha).

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

Since these activities develop areas of land, to plant trees artificially where there has been previously no greenery, no baseline is used.

This is because it can be regarded as the same activities as "afforestation" under Article.3.3.

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

Above- and below-ground biomass other than understory vegetation, litter, humus and soil carbon are included in carbon pools.

3. Methodologies and data

a) Data sources

Historical data and established goals for planted trees based on the "Survey for Preparation of 5 Year Greenery Promotion Plan" and "Green Plan 2000."

b) Sampling techniques

Surveys of current status of urban parks which form green zones in urban planning, that are the basis of the activity data, have been implemented.

c) Models and key parameters

No models or key parameters are used.

d) Uncertainties

Uncertainty is low for the surveys of the current status of urban parks which form the basis of the activity data since complete enumeration has been implemented.

4. Treatment of non CO_2 greenhouse gases.

No corresponding section.

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.

Can estimate area and carbon stocks at times subsequent to those of the first commitment period with the trend of historical data used in this estimation.

PAPER NO. 4: NEW ZEALAND

IMPLEMENTATION OF ARTICLE 3(3) OF THE KYOTO PROTOCOL

New Zealand considers that a practical and simple approach should be taken to resolve the outstanding issues under Article 3.3, consistent with the environmental integrity of the Protocol. We believe this would be consistent with the approach that was in the minds of sinks negotiators in Kyoto. If it is possible to resolve Article 3.3 issues quickly in the remaining time before COP6, this would maximise the amount of time that can be spent on the more complex LULUCF issues associated with Article 3.4 and Article 12.

Regarding Article 3.3, we believe we can first be guided by two key 'foundation' facts relating to the sinks negotiations in Kyoto:

- The "since 1990" constraint on including LULUCF activities was the manner by which sinks were included into what otherwise was a Protocol addressing 'gross' emissions such that there would not be an "emission loophole"[1].
- The reason a fourth activity "harvesting" was not included in the list of activities was the recognition that, because of the "since 1990" constraint, countries with managed production forests in carbon balance (where annual reductions in carbon stock in harvested stands are matched by increases in carbon stock in the balance of the forest) would be unreasonably penalised[2].

In New Zealand's view, these facts, taken together, make it clear that the activities of "*afforestation, reforestation and deforestation*" should be interpreted on the basis of land-use changes that have occurred since 1 January 1990, i.e. conversion from non-forest land to forest and vice versa. These interpretations are consistent with the 'definitions' in the Revised 1996 IPCC Inventory Guidelines.

Another fact that stems from the above points is that the coverage of LULUCF activities will necessarily be constrained in the first commitment period. Seeking full carbon accounting of human-induced LULUCF activities, while being a science-based and logical goal that we fully support for the second and subsequent commitment periods (when emissions targets can be based accordingly), is impracticable for the first commitment period.

In our view other factors that can help us guide decisions in this area are:

- what is practical for both Parties to implement and Article 8 teams to review – in reality this means seeking what is 'simple' and can flexibly cater to the very different forest circumstances

[1] Because Annex I targets were set on the basis of just 'gross' emissions (of gases listed in Annex A from source categories listed in Annex A) the possibility existed of unintended increases of net emissions by Annex I Parties during the commitment period by comparison with 1990 if all human-induced LULUCF activities were included. In 1990 these 'sinks' in Annex I countries contributed over 1 billion tonnes of net removals of CO_2. It can be expected that removals of CO_2 by these same sinks may be at similar levels during the commitment period. If they were rewarded with increases of assigned amount the possibility would exist that rather than achieving a 5% reduction in emissions to the atmosphere from Annex I countries on average over the commitment period by comparison with 1990, emissions in fact could increase. This circumstance was known in the sinks negotiations in Kyoto as the "gross-net **emissions loophole**".

[2] Because the loss of carbon from harvesting would be all "since 1990", whereas only a portion of the growing forest would be "since 1990" trees.

that exist in countries (mindful, however, of the need to maintain the environmental integrity of the Protocol)?

- how can we avoid outcomes that most would agree are obviously unfair?
- how can we avoid outcomes that most would agree establish perverse incentives inconsistent with the objectives of the Convention?

In this context we believe that a common definition of "forest" across all parties is not required to satisfactorily maintain environmental integrity in the implementation of Article 3.3. Annex B parties have existing international commitments and obligations to report against a broad range of forest statistics, including systems developed to support the principles of sustainable forest management (in New Zealand's case the Montreal Process). We would expect that Parties practice in respect of reporting Article 3.3 activities should not be inconsistent with their practice in reporting against these existing commitments and obligations.

A practical and flexible approach for the purposes of Article 3.3 is to allow Parties to take into account their national circumstances in defining "forest" while maintaining consistency with their current practice in international sustainable forest management reporting.

It is with these thoughts in mind that we put forward the following textural proposals in respect of the definitions that should apply to the implementation of Article 3.3.

(What is a forest? – ref IPCC LULUCF SR SPM paragraphs 13-18,21)

For the purpose of increases to the assigned amount of Annex B Parties for verifiable increases in carbon stock over 2008-2012 from afforestation or reforestation since 1990, each Annex B Party may take national circumstances into account when defining a "forest". Methods for verifying changes in carbon stocks on any such forested land shall be those included in the 1996 Revised IPCC Guidelines, as elaborated through good practice guidance approved by the [COP][COP/MOP].

For the purpose of decreases to the assigned amount of Annex B Parties resulting from decreases in carbon stock over 2008-2012 from deforestation since 1990, the definition of a "forest" shall be based on land cover and carbon density characteristics detectable at the spatial resolution by which the conversion from forest to some other land use is able to be ascertained for each Annex B Party. Methods for verifying changes in carbon stocks on any such land shall be those included in the 1996 Revised IPCC Guidelines, as elaborated through good practice guidance approved by the [COP][COP/MOP].

(Regarding definitions of A,R,D – ref IPCC LULUCF SR SPM paragraphs 19-20,22-24)

Afforestation, reforestation and deforestation activities shall be defined in terms of conversion from non-forest land to forest and vice versa, namely

- **afforestation – the establishment of forests on lands which, historically, have not contained forests**
- **reforestation – the establishment of forests on lands which, historically, have previously contained forests but which have been converted to some other use**
- **deforestation – the conversion of forest land to some other use**

(Regarding "direct human induced" – ref IPCC LULUCF SR SPM paragraphs 26)

Given the land conversion basis of the definitions of afforestation, reforestation and deforestation, these activities, by their nature, are direct human induced.

In addition to these proposals a draft COP decision for Article 3.3 is also provided as Annex 1 to this submission. This draft COP decision is provided to provide the broader context for the definitional proposals included above. In some instances, where we do not yet have fully developed suggestions on particular issues, we have provided place markers. We look forward to seeing others views in respect of these matters.

Tables presenting Preliminary data and information on carbon stock changes and areas related to Article 3.3 activities and the first sentence of Article 3.4 are also annexed to this submission.

Annex 1:
PROPOSAL FOR AN ARTICLE 3.3 DECISION TO BE TAKEN AT COP6

THE CONFERENCE OF THE PARTIES

recalling Articles 3.3, 3.4 and 3.7 of the Kyoto Protocol and Decision 9/ CP.4;

bearing in mind Article 2 of the UNFCCC and the role of land-use, land-use change and forestry;

bearing in mind that quantified emission limitation and reduction commitments for Annex I Parties for the first commitment period, other than for agricultural soils, did not include the emissions from sources or removals by sinks of greenhouse gases listed in Annex A from the land-use, land-use change and forestry (LULUCF) sector;

bearing in mind, therefore, that to avoid the possibility of unintended increases of net emissions by Annex I Parties in the first commitment period by comparison with 1990, the inclusion of LULUCF sink activities in the first commitment period must be restricted, and that the “since 1990” constraint was the means by which this restriction was affected; and

bearing in mind, that countries for whom the last sentence of Article 3.7 applies have quantified emission limitation and reduction commitments that additionally include their 1990 net emissions from land-use change

decides that

(What is a forest – ref IPCC LULUCF SR SPM paragraphs 13-18,21)

1. For the purpose of increases to the assigned amount of Annex B Parties for verifiable increases in carbon stock over 2008-2012 from afforestation or reforestation since 1990, each Annex B Party may take national circumstances into account when defining a “forest”. Methods for verifying changes in carbon stocks on any such forested land shall be those included in the 1996 Revised IPCC Guidelines, as elaborated through good practice guidance approved by the [COP][COP/MOP].

2. For the purpose of decreases to the assigned amount of Annex B Parties resulting from decreases in carbon stock over 2008-2012 from deforestation since 1990, the definition of a “forest” shall be based on land cover and carbon density characteristics detectable at the spatial resolution by which the conversion from forest to some other land use is able to be ascertained for each Annex B Party. Methods for verifying changes in carbon stocks on any such land shall be those included in the 1996 Revised IPCC Guidelines, as elaborated through good practice guidance approved by the [COP][COP/MOP].

(Regarding definitions of A,R,D – ref IPCC LULUCF SR SPM paragraphs 19-20,22-24)

3. Afforestation, reforestation and deforestation activities shall be defined in terms of conversion from non-forest land to forest and vice versa, namely

- **afforestation** – the establishment of forests on lands which, historically, have not contained forests
- **reforestation** – the establishment of forests on lands which, historically, have previously contained forests but which have been converted to some other use
- **deforestation** – the conversion of forest land to some other use

4. Annex B Parties shall report on the means by which harvesting or some other forest disturbance intended to be immediately followed by the reestablishment of the forest, has been distinguished from *deforestation* when, during 2008-2012 by comparison with 1990, it may otherwise appear that *deforestation* has occurred.

(Regarding "direct human induced" – ref IPCC LULUCF SR SPM paragraphs 26)

5. Given the land conversion basis of the definitions of afforestation, reforestation and deforestation, these activities, by their nature, are direct human induced.

(Accounting rules to address specific issues)

6. Once units of land are ascertained to have been subject to afforestation, reforestation and deforestation activities carried out since 1990 by Annex B Parties, changes of carbon stocks on such land units shall be accounted for from the time the activity started or 2008, which ever is later, and shall be accounted for in all subsequent commitment periods.

7. In satisfying the intent of Decision 9/CP.4 to account for <u>net</u> emissions or removals over the commitment period from increases in carbon stock from since 1990 afforestation and reforestation and decreases in carbon stock from since 1990 deforestation, Annex B Parties may account for increases and decreases in carbon stock during the commitment period as soon as data is reported and reviewed pursuant to Articles 7 and 8.

8. *[something about the accounting coverage issues of above and below ground carbon and non-CO_2 gases from Article 3.3 activities??]*

9. *Reforestation* will not be considered to have occurred in the circumstance where units of land that are forested in 2008-2012 were also forested in 1990, even where a temporary conversion of land use may have occurred between 1990 and 2008. *(ref IPCC LULUCF SR SPM paragraph 25, first 'dash' point)*

10. During the first commitment period, Annex B Parties who report a net decrease in carbon stock due to afforestation, reforestation and deforestation activities carried out since 1990 shall not have their assigned amount reduced pursuant to Decision 9/CP.4 in the circumstance where, by comparison with 1990, such Parties' forest area has increased and where during 2008-2012, if the emissions and removals from pre-1990 forests are also considered, overall carbon stocks have not decreased. Where this situation occurs such Parties' assigned amount shall be neither increased or decreased.

11. During the first and subsequent commitment periods, in the circumstance where there are reductions in carbon stock on units of land that have been subject to afforestation or reforestation activities carried out since 1990, the amount of the reduction in assigned amount shall be limited to the amount of any previous increase in assigned amount for these same land units. *(ref IPCC LULUCF SR SPM paragraph 25, second 'dash' point)*

12. *[something about balanced accounting re Article 3.7 – for example to address the issue of emissions in 1990 from land-use change related to releases of below ground carbon from prior land-use change activities??]*

Related methodological work

<u>and requests that</u>

13. the SBSTA invite the IPCC to elaborate good practice guidance for estimating changes in carbon stocks and emissions and removals of greenhouse gases, based *inter alia* on the framework provided by the IPCC guidelines. Such good practice guidance could include the elaboration of ‘Tier 2’ methods, which currently do not exist for LULUCF, for application to Article 3.3.

Table I – Preliminary data and information provided by New Zealand on carbon stock changes and areas related to Article 3.3 activities.

Activity	**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, Approaches Data Sources**
Afforestation, Reforestation Grasslands to planted forest	IPCC	Land Based	194,200	130,000	458,000	6,300,000	875,200	25,440,000	See note 1
Afforestation, Reforestation Shrublands to planted forest	IPCC	Land Based	46,900	29,800	78,800	1,100,000	141,200	4,140,000	See note 2
Afforestation, Reforestation Grassland to shrublands/forest	IPCC	Land Based	n/a	n/a	n/a	n/a	n/a	approx. 9,000,000	See note 3
Deforestation	IPCC	Land Based	n/a	n/a	n/a	n/a	n/a	n/a	See note 4

a_I Area (ha) afforested and reforested, or deforested since 1990 up to 1995.
ΔC_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 1999.
ΔC_{II} Carbon stock change (t C) since 1990 up to 1999 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.

Note 1: The data presented for **Afforestation, Reforestation – Grasslands to Planted Forests** provides current estimates relating to the conversion of grasslands to planted forests. This data represents a subset of data prepared through New Zealand's national modelling methodology for estimating emissions and carbon uptake by planted forests that is reported in the National Greenhouse Gas Inventory 1990 – 1998. The modelling is completed with three scenario's for future planting rates, low (20,000ha pa), medium (40,000ha pa), and high (60,000ha pa). The medium new planting scenario is reported here – the low and high new planting scenarios range approximately 20 % on either side of these estimates. The methodology is elaborated further in the explanatory text below.

Note 2: The data presented for **Afforestation, Reforestation, Shrublands to Planted Forest** is derived in the same manner as outlined in Note 1 above. The National Exotic Forest Description, which provides the new planting area input data for the national modelling methodology, categorises new planting into only 2 broad land cover classes – pasture and predominantly scrubland (shrublands). The category "predominantly scrublands" represents a continuum from grazing lands with scattered agricultural woody weeds through to denser shrublands, which can be regarded to be forests for these purposes, that have been cleared and replanted. Hence only a proportion of this reported new planting can be regarded as being compatible with the requirements of Article 3.3, however the historic data does not allow this separation to be made with any degree of certainty. The forward estimates assume levels that are expected to be higher than those that will actually occur. The data is presented separately to ensure transparency.

Note 3: Substantial areas of marginally economic grasslands are no longer managed for pastoral production. This land use change has accelerated following economic restructuring and the removal of agricultural subsidies in the mid and late 1990's. Much of this land area is regenerating to natural shrublands and successional forests. Little work has been completed to date to quantify the carbon sequestration on these lands. One recent study indicates that, in terms of Article 3.3, some 1.8 million tons of carbon per year is likely during the first commitment period. Substantive work is underway that will allow sequestration on such lands to be fully accounted for prior to the commitment period. This approximate figure is include here for completeness.

Note 4: No data is available to quantify deforestation in the period since 1990. The rate of deforesation is known to have been low in the beginning of the period and has subsequently reduced substantially. This reduction is result of a combination of the poor economic return from converting shrublands and forests to grasslands and strict controls through legislation - the Forest Act 1993 eliminates unsustainable logging in natural forests, while the Resource Management Act 1991 provides for sustainable resource management and the avoidance or mitigation of adverse environmental effects.

Explanatory Text for Table I – Preliminary data and information provided by New Zealand on carbon stock changes and areas related to Article 3.3 activities.

This text elaborates the data and information provided in the Table, particularly in respect of the methodology associated with the **Afforestation, Reforestation Grasslands to planted forest** and **Afforestation, Reforestation Shrublands to planted forest areas.**

Definitions:

a) **Forest:** forest is not defined in legislation in New Zealand, nor is there a single agreed definition that is applied in practice or in other international forestry reporting . Rather "forest" is commonly regarded to involve three broad constructs;

- natural, or indigenous, forests with substantially closed canopy and often dense understory. This forest is substantially in public ownership managed for conservation and watershed protection.
- planted forests established for timber and wood products purposes,
- regenerating natural shrublands and successional forests.

b) **Afforestation, Reforestation and Deforestation** are defined as;

- afforestation – the establishment of forests on lands which, historically, have not contained forests
- reforestation – the establishment of forests on lands which, historically, have previously contained forests but which have been converted to some other use
- deforestation – the conversion of forest land to some other use

In a practical sense afforestation and reforestation in New Zealand conditions may be considered to be largely synonymous.

c) **Accounting approaches:** The National Forest Estate Description provides the basis for these estimates. This provides a precursor for the development of a land based accounting system.

Carbon Pools: These estimates include above and below ground carbon pools and litter, but exclude soil carbon.

Stratification: The modelling method is intended to provide national estimates Accordingly simplifications are included. Firstly, the wood density factors for the different age classes assume that all trees grow in a medium density region of New Zealand. Secondly, the model takes the weighted national crop-type as being wholly *Pinus radiata*, when in fact around 10% of the estate is made up of Douglas fir (5%) and other species. Regional growth and yield data will be applied to provide more precise estimates in an operational situation.

Methodologies and Data: These estimates are based on New Zealands national LUCF inventory methodology and includes above and below ground carbon pools and litter (but exclude soil carbon). Sources and methods are fully described in New Zealands National Inventory Report (2000). Uncertainties are assessed in the order of 25%

Table II Preliminary date and information provided by New Zealand on carbon stocks and area estimates (first sentence of Article 3.4)

Land system	*Area (000 ha)*	Carbon stock circa. 1990 (MtC)
Forest Lands		
Planted forests	1581.8	115.5
Indigenous forests	6250.6	933
Shrublands	2642.9	527
Mangrove	22.2	-
Agriculture lands		
Pastoral	10339	
Horticultural	45.2	
Rangelands/Grasslands (Tussock)	3639.5	
Wetland/Tundra	114.5	
Other		
Bare Ground	1454.1	
Urban areas etc	189.2	
Total	**26688.8**	

1. Land categories

Land categories and areas are based on the New Zealand Land Cover Database (LCDB). The LCDB is based on SPOT satellite imagery acquired during 1996/97 and has a map unit of 1ha (Ministry of Agriculture and Forestry: 2000).

2, 3 & 4. Carbon pools, data sources and methods

For planted forests, the estimate is based on New Zealands national LUCF inventory methodology and includes above and below ground carbon pools and litter (but exclude soil carbon). Sources and methods are fully described in New Zealands National Inventory Report (2000).

For indigenous forest and scrub, available carbon stock estimates are based on the Vegetative Cover Map (1987). The areas of these classes is different from the LCDB, mainly due to the mapping methods used and the map unit size of 500ha. Carbon stock estimates have not yet been updated to the LCDB class areas (which were released in June 2000).

The carbon pools for indigenous forest and shrub relate to above and below ground biomass only (but exclude litter and soil carbon). An estimate for litter in indigenous forest is 570MtC. Methods and data sources are described in Hall and Beets et al *Estimate of the carbon stored in New Zealand's indigenous forest and scrub vegetation for 1990* (a contract report by Landcare Research and Forest Research for the Ministry for the Environment: September 1998).

Preliminary estimates from the Carbon Monitoring Project of soil carbon for all land classes (excluding urban areas) are 1208 +/- 66 Mt for 0 to 0.1m depth, 1532 +/- 107 Mt for 0.1 to 0.3m depth and 1944 +/- 278 Mt for 0.3 to 1.0m depth. Thes estaimets are based on the Vegetative Cover Map areas and are provisional. Methods and data sources are described in Tate et al *Contribution of soil carbon to New Zealand's CO2 emissions: revision of data layers and overlays* (a contract report by Landcare Research and Forest Research for the Ministry for the Environment: March 1998).

5. Possible changes in carbon stocks

New Zealand has made a significant investment in research to develop a carbon monitoring system for indigenous forest, and shrublands and (all) soils. The carbon stock estimates presented in the table are based on preliminary results from this work. The carbon monitoring system is not yet operational and it is not possible to report on actual changes in carbon stocks for most of the classes given above. Changes in carbon stocks in planted forests are reported annual in New Zealand LUCF inventory.

There is some evidence to suggest that there may be considerable changes in land use occurring with the withdrawal of pastoral grazing on marginal agricultural land and is subsequent reversion to shrubland and ultimately indigenous forest.

6. Uncertainties

Uncertainties for planted forest are in the order of 25%. For indigenous forest the standard error of the estimate is +/- 25Mt.

PAPER NO. 5: NORWAY

VIEWS AND PROPOSALS FOR DEFINITIONS AND ACCOUNTING FRAMEWORK FOR ACTIVITIES UNDER ARTICLES 3.3 AND 3.4 OF THE KYOTO PROTOCOL

The SBSTA at its eleventh session requested Parties to provide submissions by 1 August 2000 with views, or proposals for definitions, on activities under Article 3.3. The submissions from Annex I Parties should include information on methodologies to measure and report on net changes in greenhouse gas emissions by sources and removals by sinks for these activities. The SBSTA also requested Parties to make submissions as to how and which human-induced activities will be included under Article 3.4, including a list of additional activities that each Party is proposing for inclusion under Article 3.4.

We hereby submit the Norwegian views and proposals on these issues. The submission is divided in four parts. First we give some general views on how and which Land-Use, Land-Use Change and Forestry (LULUCF) activities should be included under the Kyoto Protocol. Then we present our views and proposals on activities under Articles 3.3 and 3.4, respectively. Finally we present preliminary data and information according to the reporting format agreed on by the SBSTA at its twelfth session.

In general our submission is guided by the IPCC Special Report on LULUCF (IPCC SR). We have particularly tried to give views and proposals on some of the questions listed in IPCC SR tables 3-2, 3-3, and 4-2. We would like to emphasise that our views and proposals, as well as data and information, are preliminary.

1. General views

Reduction in greenhouse gas emissions from fossil fuel consumption and from industrial processes is essential to fulfil the commitments under the Kyoto Protocol. In addition, measures to enhance the removals by sinks and reduce emission from sources of CO_2 and other greenhouse gases resulting from LULUCF activities can be effective in limiting global warming. In fulfilling the commitments under the Kyoto Protocol such activities should be promoted under the condition that the sequestration is permanent and not in conflict with other international environmental agreements, such as the Convention on Biological Diversity.

Article 3.3 of the Kyoto Protocol requires Annex B Parties to meet their commitments by including in their assigned amounts verifiable stock changes due to direct human-induced activities limited to afforestation, reforestation and deforestation taken place after 1990. Article 3.4 opens for the implementation of other activities in the first commitment period, provided that such additional activities have been implemented after 1990. As far as we understand, the agreed text on sinks in the Kyoto Protocol was a compromise between a comprehensive inclusion of removals by sinks on one side and exclusion of sinks for the first commitment period on the other. Seeking full carbon stock accounting for the first commitment period would therefore not be our understanding of Articles 3.3 and 3.4 under the Kyoto Protocol.

For the second and subsequent commitment periods it is Norway's general view that a full carbon stock accounting is a better scientific and logical approach, given that sufficient and verifiable estimation methodology has been developed. An inclusion of full carbon stock accounting would probably necessitate more differentiated commitments for the Parties.

It is important that definitions, modalities and rules etc. related to Articles 3.3 and 3.4 should give credit to promotion of sustainable forest management practices, included maintenance of forest biodiversity, when such activities lead to sink enhancements. Furthermore, it is crucial that none of the activities to be included under Articles 3.3 and 3.4 should be in disagreement with any of the articles of the Convention or the Kyoto Protocol. They should also be in conformity with the Convention on

Biological Diversity, the United Nations Forum on Forests, as well as other relevant international agreements. The work on criteria and indicators for sustainable forest management by regional processes, for example the Pan-European Process (The Ministerial Conference on the Protection of Forests in Europe) should be taken into account. In our view, one should for instance aim for a definition of "human-induced" that prevents Parties from obtaining credits for converting natural forest to plantations, defining this as reforestation under Article 3.3. Furthermore, afforestation of non-forest land should not lead to reduced biodiversity or destroy valuable types of natural resources. In fact, and as pointed out by the IPCC SR, consideration would need to be given to synergies and tradeoffs related to many LULUCF activities under the UNFCCC and its Kyoto Protocol in the context of sustainable development including a broad range of environmental, social, and economic impacts.

For the first commitment period, all relevant carbon pools should be considered under both Articles 3.3 and 3.4, as long as the stock change can be measured in a verifiable way. In this respect, both stem wood, branches, tops, stumps and roots, as well as slash and carbon in soil, should be considered. The IPCC Special Report underlines the importance of the soil as a carbon reservoir.

Article 3.4 should be understood in such a way that the selection of additional activities should cover both activities leading to net emissions and activities leading to net removals of greenhouse gases.

In principle we support the inclusion of changes in carbon stock in harvested wood products and landfills etc. Inclusion of harvested wood products would necessitate an estimation methodology that separates wood products originating from Articles 3.3 and 3.4 activities from wood due to harvesting in other parts of the forest system. The Parties should also decide which of IPCCs three different accounting approaches should be used to verify the carbon stock changes in wood products. However, it seems that sequestration in wood products and landfills etc may be less important than sequestration in the living biomass and in soil. In a Norwegian study the net annual accumulation of CO_2 in wood products in Norway has been estimated to constitute not more than about 3 % of the total net annual CO_2 sink in the forests. Furthermore we would like to recall that the SBSTA at its eleventh session invited Parties to submit views on approaches for accounting emissions of CO_2 from harvesting and wood products by 15 March 2001, for consideration by the SBSTA at its fourteenth session.

The level of uncertainty related to the estimation of effects of some LULUCF activities and to the magnitude of some carbon pools may be very high. The effect of activities on carbon stock changes in soil may for instance involve considerable uncertainty. In our view, uncertainty should be a criterion for selection of activities and inclusion of carbon pools.

The impacts on all greenhouse gases, including non-CO_2 greenhouse gas emissions, should be included under Articles 3.3 and 3.4, provided the net emissions could be measured in a verifiable way. Methane is e.g. produced during decomposition of waste wood in forests, and from waste wood disposed of at landfills. According to estimates in Norway, about 30% of the carbon of the original tree is left in the forest after harvesting, and may produce methane during the decay process under certain conditions. Furthermore, methane is produced in peatland, and land-use activities involving peatland could affect the methane emissions.

2. Views and proposals for definitions on activities under Article 3.3

Norway uses as a key foundation for our views and proposals that Article 3.3 of the Kyoto Protocol limits LULUCF activities to afforestation, reforestation and deforestation (ARD) and to stock changes due to such direct human-induced activities taken place after 1990. We believe this constraint should be interpreted on the basis of <u>land-use changes that have occurred since 1990</u>, that means conversion from non-forest to forest and vice versa.

The forest activities related to Article 3.3 are relevant only to a minor part of the managed forests in many Annex B countries for the first commitment period. In boreal forests the rotation cycle would typically be 70-120 years because of climatic conditions. Hence, the calculated carbon balance for the first commitment period from afforestation, reforestation and deforestation after 1990 could be negative for countries in such areas. At the same time the forest area as a whole could be a major net carbon sink in such countries, due to active and continued forest management. This paradox should be addressed in the further discussions of definitions and rules for calculation related to ARD-activities under Article 3.3.

2.1. How should a forest be defined

The definition of a forest should take into account the differences between countries and regions, and between different forest management practices. Hence each country should be allowed to use their national definition of forests, provided such definitions are well documented and accepted by the Parties. The definition must enable the Parties to detect carbon stock changes due to land-use change. Amendments might be required to ensure this, following any methods included in the Revised IPCC Guidelines, as elaborated through good practice guidance approved by the Parties.

Forest regulations and practices assure that there are small risks of permanent reductions in canopy cover, forest degradation, etc in Norway. The objective of the Norwegian Forest Act is to promote forest production, afforestation and forest protection. The Act is also stating that harvesting in younger forests must be conducive to the further favourable development of the forests with regard to production and quality. The historical increases in both standing stocks and annual increments in Norwegian forests, and future projections for the development of forest resources, also show that the chances of reductions in stocks and increments in the future are small (see further comments on longer-term changes in Norwegian forests).

2.2. Definitions of afforestation, reforestation and deforestation

<u>Afforestation</u> in Norway will normally be defined as establishment of forests by planting, seeding or other changes in human land-use practises on areas not defined as forests in the National Forest Inventory. This could be establishment of forests on areas which, historically, have not contained forests. From our existing data, however, it might be difficult to separate such areas. In practice, areas defined as afforested in Norway have been non-forest land for about 50 years or more.

<u>Reforestation</u> will normally be defined as re-establishment of forests by planting, seeding or other revegetation on previously forested land or other wooded land. After harvesting, all forests in Norway will be regenerated either by planting or by natural regeneration (e.g. seed tree- and shelterwood systems) as part of the normal forest management system. Approximately half of the harvested area is assumed to be planted, while the other half is assumed to be regenerated naturally through different forest practices.

The most critical question with regard to the definition of reforestation is whether re-establishment of trees after clear-cut harvesting should be included or not. The IPCC Special Report on LULUCF has described four different definitional scenarios[1]. Three of them are following the FAO definition of

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[1] The IPCC Special Report on LULUCF describes the following accounting frameworks for reforestation:

<u>FAO – land based I</u>: All carbon stock changes are accounted on all lands reforested (including regeneration after harvesting) between 1990 and 2012. Accounting is beginning on 1~~st~~ January 2008. On lands reforested between 2008 and 2012 harvest will be accounted as carbon emission.

<u>FAO – land based II</u>: Like land based I, except that accounting is beginning with the start of the activity. This means that emissions from harvesting before reforestation are not included. However carbon changes in soil, slash and roots after harvesting are accounted.

<u>FAO – activity based</u>: Only carbon changes directly related to the reforestation activity are accounted. Hence emissions from harvesting and carbon changes in soil, slash and roots due to harvesting are not accounted.

reforestation, which includes re-establishment of trees after clear-cut harvesting. One scenario follows the definition in the Revised 1996 IPCC Inventory Guideline, which assumes that reforestation entails a land-use change. The three FAO definitional scenarios give quite different ranges of accounted carbon stock, depending on whether emissions from harvesting before re-establishment are counted for or not. Countries in the boreal region, like Norway, would benefit most by following the third FAO definitional scenario, activity-based, which does not include harvesting before re-establishment of the trees. However, according to the IPCC Special Report on LULUCF, for a forest estate managed on a sustainable-yield basis none of the FAO definitions of reforestation reflect the actual net exchange of carbon between the forest estate and the atmosphere during a commitment period.

In Norway's view, the IPCC definition and accounting approach is most in line with the intention of Article 3.3. As already stated, we believe Article 3.3 should be interpreted as limited to land-use change activities. In this context that means conversion from non-forest to forest and from forest to non-forest. Following the reforestation definition in the Revised 1996 IPCC Guideline would prevent Parties from obtaining credits for converting natural forest to plantations, and would also be consistent with the requirement laid down in Article 5.2 of the Kyoto Protocol.

Deforestation should be defined as converting forest lands to other land. For Norway such a definition would include conversion of forests to agriculture land, roads, housing and other urban areas. All carbon stock changes due to the defined deforestation activities should be included. Normal harvesting as part of a forest management system should not be defined as deforestation.

2.3. Definition of direct human-induced activities

Related to afforestation and reforestation, direct human-induced activities should include all practises that are implemented with the purpose of establishing forests. This includes planting, seeding and other practices, which will accelerate the establishment of the forests. In Norway this would include natural revegetation through different practices, such as seed tree- and shelterwood systems. Such natural revegetation should be defined as a direct human-induced activity, since this practise in many countries is a deliberate policy as part of their forest management. Natural revegetation and regeneration could also be an integrated part of a policy to increase the biodiversity in forests.

2.4. Which carbon stocks should be included

All carbon biotic stocks should be included under afforestation, reforestation and deforestation, provided they could be measured in a verifiable way. This means that changes in the whole tree biomass should be considered, including the stem wood, branches, tops, stumps and roots. In addition we find it particularly important to include verifiable changes in carbon stocks in forest soils linked to the activities included under Article 3.3. Forest establishment on carbon rich soil, e.g. peatland, could involve a carbon loss to the atmosphere rather than a carbon sink. On the other hand afforestation on previous agricultural land would normally increase the carbon stock in soil.

In principle we also support the inclusion of changes in carbon stock related to harvested wood products, provided that it is possible to separate wood products originating from activities under Article 3.3, and that a satisfactory accounting approach to verify the carbon stock changes has been defined and approved.

IPCC – activity based: Only changes in carbon stock on lands that previously have been used for other purposes and then converted back to forests are accounted.

2.5. Non-CO2 greenhouse gases

In principal impacts on all greenhouse gases, in practice CO_2, CH_4 and N_2O, should be included under Article 3.3, provided the net emissions could be measured in a verifiable way. Normally the effects on CH_4 and N_2O are small with regard to ARD-activities. However, some specific activities could result in increased CH_4 and N_2O net emissions, such as afforestation on wetland and peatland, and nitrogen fertilisation. Such effects should be included, if measurable within a given level of significance.

2.6. Accounting framework for afforestation, reforestation and deforestation under Article 3.3.

It is Norway's view that an accounting framework for Article 3.3 should be founded on an understanding that the ARD-activities include only land-use changes that have occurred since 1990. This entails that afforestation, reforestation and deforestation should only include conversion from non-forest to forest and vice versa. Hence, reestablishment of tree cover after clear-cut harvesting should not be included. Consequently Norway would support the following definitions (accounting framework based on IPCC Definitional Scenario – activity based):

> *Afforestation: the establishment of forests due to planting, seeding or other changes in human land-use practises on areas which, historically, have not contained forests.*
>
> *Reforestation: the establishment of forests due to planting, seeding or other human-induced activities on areas which, historically, have previously contained forests but which have been converted to some other use.*
>
> *Deforestation: the conversion of forest land to other land. Harvesting as part of a forest management system should not be defined as deforestation.*

The ARD-activities since 1990 are relevant only to a minor part of the managed forests in many Annex B countries for the first commitment period. For many countries, due to slow growth rates, the calculated carbon balance for the first commitment period from afforestation, reforestation and deforestation after 1990 could be negative. At the same time the forest area as a whole could be a major net carbon sink in such countries due to active and continued forest management. This paradox is mainly due to the slow growth rates of forests in the boreal regions, where the effects of any human-induced activities to stimulate afforestation and reforestation will be minor or negligible within a time frame of 20 years. At the same time deforestation often will involve cutting of full-grown trees with relatively high carbon volume. Thus the emission increase due to deforestation related to the first commitment period could exceed the sink increase due to afforestation and reforestation, even though the area of deforestation is a magnitude of order less than the area of afforestation and reforestation. It is important that this problem is taken into account in further discussions on definitions and rules for calculation related to ARD-activities under Article 3.3. A decision along the following lines could avoid unintended punishment of Parties with a slow growth rate in their forest stocks, but which actively contribute to the enhancement of their forest carbon stocks during the first commitment period through their forest management policy:

> *Parties which report a decrease in carbon stocks resulting from the sum of ARD-activities since 1990 under Article 3.3 should not have their assigned amount reduced, if they can verify that their total forest carbon stock has increased since 1990 and during the first commitment period.*

With regard to forest definition countries should be allowed to use their national definitions, provided such definitions are well documented and accepted by the Parties. The definition must enable the Parties to detect carbon stock changes due to land-use change.

Related to afforestation and reforestation, direct human-induced activities should include all practises that are implemented with the purpose to establish forests. This includes planting, seeding and other practices which will accelerate the establishment of the forests. Natural revegetation through different practices, e.g. seed tree- and shelterwood systems, should also be defined as direct human-induced.

All carbon stocks should be included under afforestation, reforestation and deforestation, provided they could be measured in a verifiable way. This includes the stem wood, branches, tops, stumps, roots as well as verifiable changes in carbon stocks in forest soils linked to the activities included under Article 3.3.

In principle Norway also supports the inclusion of changes in carbon stock in harvested wood products, provided that it is possible to separate wood products originating from activities under Article 3.3, and that a satisfactory accounting approach to verify the carbon stock changes has been defined and approved.

Effects on CH_4 and N_2O emissions should be accounted, provided the net emissions could be measured in a verifiable way and within a given level of significance.

To promote permanence with regard to sequestration of CO_2, the land accounted for in the first commitment period must remain within the accounting system for the second and subsequent commitment periods.

3. How and which activities should be included under Article 3.4

Article 3.4 of the Kyoto Protocol opens for Annex 1 Parties to add to, or subtract from their assigned amount, changes in greenhouse gas emissions by sources or removals by sinks from additional activities related to agricultural soil, land-use change and forestry. The COP/MOP shall decide upon modalities, rules and guidelines on how and which additional activities can be included. Such a decision shall apply in the second and subsequent commitment periods. However, Article 3.4 opens for inclusion of such additional activities in the first commitment period, provided that these activities have taken place since 1990.

In our view the intention of Article 3.4 was mainly to focus on commitments in the second and subsequent commitment periods. It is therefore our understanding that Parties should anticipate a clearly limited credit from additional activities under Article 3.4 for the first commitment period. Seeking full carbon stock accounting for the first commitment period would therefore not be our understanding of Article 3.4 under the Kyoto Protocol.

However, for the second and subsequent commitment periods it is Norway’s general view that a full carbon stock accounting is a better scientific and logical approach, given that sufficient and verifiable estimation methodology has been developed. An inclusion of full carbon stock accounting for the second and subsequent commitment periods would probably necessitate more differentiated commitments for the Parties.

We find it particularly important to ensure that inclusion of new activities under Article 3.4 are not in conflict with any of the articles of the Convention or the Kyoto Protocol, the Convention on Biological Diversity and other relevant international agreements. In addition, we find that definitions and rules related to Article 3.4 activities should promote sustainable forest management. Furthermore it is important that all carbon stocks related to the Article 3.4 activities are accounted, including carbon in soils. The effects on CH_4 and N_2O should be accounted as well, provided the net emissions could be measured in a verifiable way and within a given level of significance.

Article 3.4 should be understood in such a way that the selection of additional activities should cover both activities leading to net emissions and activities leading to net removals. For instance, if wetland restoration is included as an additional activity under Article 3.4, the effects of drainage of wetland should also be included.

If additional activities are accepted for inclusion under Article 3.4 for the first commitment period, Norway may support inclusion of additional activities, analogous to the ARD-activities under Article 3.3, such as land-use changes related to other biomes than forests. For instance revegetation of degraded non-forest lands after 1990 could be included under Article 3.4 and applied for the first commitment period, provided these activities are additional and direct human-induced and the greenhouse gas emissions by sources and removals by sinks can be measured in a verifiable way.

Furthermore, the consequence of a constricted interpretation of Article 3.4 activities with regard to the first commitment period would be to apply for instance a baseline or a threshold accounting approach to factor out the effects of natural variability, business-as-usual activities and activities undertaken prior to 1990. The IPCC Special Report on LULUCF describes several options to employ a baseline concept in national accounting for Article 3.4 activities, which include: a) continuation of BAU, b) continuation of 1990 activities, c) absence of active management, d) performance benchmarks and standard management, and e) rate of stock change in 1990. Norway has no strong position on which approach would be most appropriate to factor out the carbon stock changes that would have occurred without additional Article 3.4 activities. It is, however, important to choose a baseline/threshold approach that ensures an accounting framework which is transparent, comparable, consistent, well documented and verifiable.

Improved forest management may be included under Article 3.4, provided only the effects additional to normal forest management are accounted, see our views on baselines. Due to the slow growth rate, the effects of improved forest management in Norwegian forests will be minor in the short term. Introduction of longer rotation periods could increase the carbon stock in the Norwegian forests. However, Norway does not intend to include introduction of longer rotation periods as a new activity under article 3.4, because the age of trees at harvest already is high in Norway. In the longer term, increased rotation time would most likely lead to reduced growth rates and reduced carbon sequestration in the forests, as well as production of less wood for bioenergy or replacement of energy-intensive products as steel, aluminium, plaster board and concrete (see IPCC Special Report on LULUCF, page 273).

In the longer run, there is a higher potential for increased carbon sequestration and stock enhancements through improved forest management in Norway. The future potential is however difficult to quantify, and it will heavily depend on environmental, social and economic developments and considerations. Active policies and new economic incentives would be needed to stimulate increased sequestration.

4. Preliminary data and information on Article 3.3 and 3.4 activities

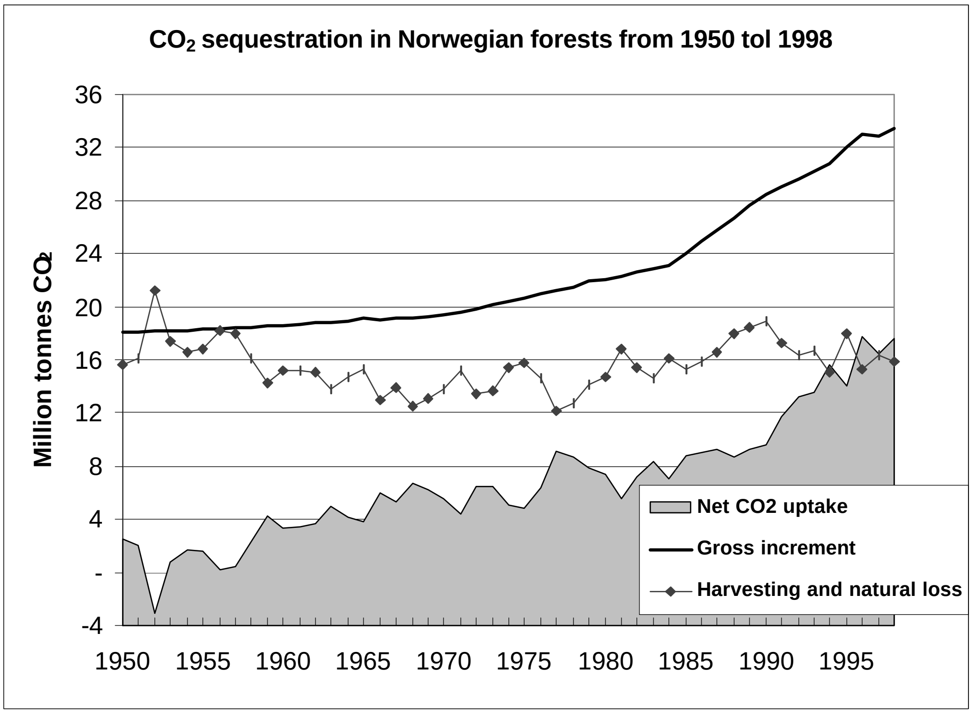
The SBSTA at its eleventh session requested Parties to provide national data and information on net changes in greenhouse gas emissions by sources and removals by sinks resulting from activities under Articles 3.3 and 3.4 as well as preliminary data and information as specified in the first sentence of Article 3.4. The SBSTA at its twelfth session agreed to a format for submissions of data and information. According to the conclusions at SBSTA 12, Annex I Parties should complete those portions of the agreed tables I and III that directly relate to their preferred proposals. In addition, Parties could provide data and information in relation to other options using tables I and III.

The requested preliminary data and information for Norway reported according to the agreed formats can be found in annex 1 to this submission. As required, we have provided data according to our preferred solutions on Article 3.3. In addition, we have included data on other possible options to illustrate the differences between them for Norway. Regarding Article 3.4, we have included information on one additional activity in Table III. This should, however, primarily be regarded as an illustration of our accounting approach etc., since we do not necessarily intend to claim the potential credits resulting from this activity for the first commitment period. Furthermore, we have included data on the total carbon stock in 1990 in the agreed Table II, as well as data on the total carbon stock in 1995 and 2000.

The methodology and information used on data sources, uncertainties etc. are included in the annex to this submission. In the following, we have summarised the results and some main findings. We have also given some data describing carbon sequestration in the total Norwegian forests due to the overall forest management.

The total carbon budget of Norwegian forests

Forests have been an important resource for wood products as well as hunting, grazing, wild berry picking and recreation for many hundred years. Since 1900 there has been an active policy to promote sustainable forest management and increase the standing volume of Norwegian forests. Since 1925 the total volume has almost doubled, while the harvest over the period has been quite stable at about 10 million m^3 per year. This has resulted in a considerable net increment and hence an accumulation of carbon in Norwegian forests, see figure 1. The gross increment of carbon was estimated to be equivalent to 33.5 million tonnes CO_2 in 1998. A total of 15.9 million tonnes of CO_2 was depleted by felling and natural losses, resulting in a net forest sink of 17.6 million tonnes of CO_2. This net sink was equivalent to 35% of the total emissions of CO_2 in Norway in 1998. The estimate includes bark, stumps, branches and roots, and is calculated according to the Revised 1996 IPCC Inventory Guideline (including the assumption of total emissions of wood carbon at the time of harvest). The carbon change in soils and wood products has undergone similar changes, however at a lower rate than for the forest biomass, see our comments with regard to Article 3.4, first sentence.



4.1 Summary

Article 3.3
We propose that the methods for verifying changes in carbon stocks from afforestation, reforestation and deforestation should be those included in the 1996 Revised IPCC Guidelines, as mentioned in Chapter 2. This method would probably yield a small net carbon emission source for Norway in the first commitment period, if only above and below ground biomass is included. If the sequestration of carbon in soil is included, this source is likely to turn into a small net sink. However, the uncertainty in the data on carbon changes in soils is large, so that the net change in total carbon stocks on ARD lands may well be negative.

Data for the three FAO definitional scenarios applied on Norway are presented. Regarding the FAO land based I and II approaches, the projected changes in carbon stocks over the first commitment period are net carbon emissions of around 9 million tonnes and 3 million tonnes, respectively. The FAO activity based approach would on the other hand likely result in a carbon uptake of about 0.4 million tonnes of carbon in the first commitment period. However, none of the FAO definitions will generally reflect the actual net exchange of carbon between the forest estate and the atmosphere during a commitment period. In our view the IPCC definition and accounting approach is most in line with the intention of Article 3.3, and should be preferred.

<u>The first sentence of Article 3.4</u>

The total Norwegian carbon stock is estimated at about 2 billion tonnes in 1990. The main part of the total carbon stock, about 52 %, is contained in forest soil, while about 24 % and 9 % of the carbon is contained in soils of other wooded lands and agriculture lands, respectively. Only around 10 % of the total carbon stock is contained in aboveground woody biomass of forests and other wooded lands. The carbon stock in wood products and waste is estimated to be less than 1% of the total carbon stock.

The numbers for carbon stock in forest biomass (above and below ground) and for carbon stock in wood products are rather accurate. There are larger uncertainties related to the estimates for carbon in soils. Furthermore the calculations cover about 1/3 of the total Norwegian land area. Hence, some carbon pools in e.g. mountain areas and in lakes are not covered.

<u>Article 3.4</u>

With our understanding of the agreement reached on sinks in Kyoto, inclusion of additional activities under Article 3.4 applicable for the first commitment period should be limited. If additional activities accepted for inclusion under Article 3.4 should also be made applicable for the first commitment period, such activities should be analogous to the ARD-activities under Article 3.3, such as land-use changes related to other biomes than forests. Revegetation of degraded non-forest land included under Article 3.4 could, as an example, be made applicable for the first commitment period, provided such activities can be proved additional and human induced, and emission changes measured in a verifiable way.

4.2 Article 3.3

Table I in Annex 1 provides preliminary data and information on carbon stock changes and areas related to Article 3.3 activities. We have chosen to include data related to the different definitions on afforestation, reforestation and deforestation given in the IPCC SR to illustrate the differences between them for Norway. We propose to use the IPCC definition for accounting carbon changes from ARD activities, since Article 3.3 in our view should be interpreted as land-use change; conversion from non-forest to forest and from forest to non-forest. Following the reforestation definition in the Revised 1996 IPCC Inventory Guidelines would also be consistent with the requirement in Article 5.2 of the Kyoto Protocol. In addition, it is stated in the IPCC Special Report on LULUCF that the IPCC method better reflects the changes in CO_2 that the atmosphere sees from ARD activities.

Our accounting approach regarding the IPCC method can be interpreted as activity based, where the impact on carbon stocks is determined per unit area where the activity takes place. The changes in carbon stocks are calculated from formulas developed on the basis of estimated productivity rates in the type of area where the activity occurs, as well as the size of the land areas in question. We have not included carbon in trees lower than 1.3 meters. The carbon stock figures consist of above ground biomass, below ground biomass and soil carbon. Above ground biomass includes stem wood, tops and branches, while below ground biomass includes stumps and coarse roots. The carbon in soils is counted as median values for carbon stocks in the O horizon plus the mineral soils for the different soil types.

According to our projections, the FAO Activity based method for calculations of changes in carbon stocks would generate a net uptake of about 0.4 million tonnes of carbon in the first commitment period. The IPCC method would give a net carbon uptake of 0.09 million tonnes, or about one fifth of the FAO Activity based approach. We would like to emphasise that the estimated uptake based on the IPCC definition is very sensitive to changes in soil carbon, since the level of uncertainty of the soil figures is as high as about 100 %. If soil carbon was not included in the calculations, the estimated outcome would be slightly negative. Regarding the FAO definitional scenario Land based I and II, the projected changes in carbon stocks on ARD-land over the first commitment period are estimated to net carbon emissions of around 9 and 3 million tonnes, respectively.

We have included some qualitative descriptions of changes in the emissions of non-CO_2 greenhouse gases related to ARD activities. Forest soils are usually viewed as sinks for atmospheric methane (CH_4) and as sources for atmospheric nitrous oxide (N_2O). The conversion of arable lands to forests (afforestation) may result in decreased emissions of N_2O and an increased sink of CH_4. Deforestation may have the opposite effect. Harvesting of trees and revegetation of forests may also have effects on net N_2O and CH_4 emissions in soils in as much as soil moisture, soil temperature, gas-diffusion rates between soil and atmosphere and N-availability are affected. However, such interactions are complex and evaluation of the magnitude and time-span of possible changes is highly uncertain. We regret that there was not enough time to provide quantitative estimates of such effects for this submission.

4.3 First sentence of Article 3.4

Data and information for Norway as required by the first sentence of Article 3.4 are contained in Table II. In addition to the table format agreed on at SBSTA 12, we have included two columns with the distribution of the total carbon figure on aboveground, below ground and soil carbon, which in our view makes the data more transparent. The first sentence of Article 3.4 says that data should also be provided to enable an estimate to be made of changes in carbon stocks in subsequent years to 1990. Norway has submitted information on the total carbon stocks in 1995 and 2000 in addition to the 1990-data. The figures are presented in the same way as for 1990.

The figures of the total carbon stock in 1990, 1995 and 2000 include carbon on forest lands, on agricultural lands and on other wooded lands, as well as carbon in products and waste. In the calculation of carbon reservoir in products and waste four main carbon storage sources have been considered: 1) paper and paper products, 2) buildings, 3) furniture and 4) paper and wood products in landfills. We emphasise that there are carbon reservoirs that are not covered in the table or in the total figure, e.g. carbon stocks in mountain areas and in lakes are not included. The area covered by the different types of land listed in Table II represents about 1/3 of the total Norwegian land area.

The total Norwegian carbon stock was estimated at about 2 billion tonnes in 1990. The main part of the total carbon stock, about 52 %, is contained in forest soil, while about 24 % of the carbon is contained in soils of other wooded lands. Around 10 % of the total carbon stock is contained in aboveground woody biomass of forest lands and other wooded lands, and ca. 9 % in agricultural soils. The carbon reservoir in wood products and waste was estimated to less than 1 % of the total carbon stock. The area of forest lands, agricultural lands and other wooded lands added together was about 13 mill. hectare in 1990. In 1995 the total carbon stock, including soil carbon, had increased slightly since 1990, and in 2000 the estimations gave an increase of about 5 % since 1990. We would like to point out that the uncertainties connected to these estimates are high.

The increasing trend in the total carbon figures between 1990 and 2000 can mainly be explained by increased forest land area and thus increased carbon content on forest lands. The carbon stock on forest lands grew with about 7 % in this period. During the same period the carbon stock on other wooded lands decreased. The distinction between forest land and other wooded lands in Norway is primarily related to the percentage crown cover, which is minimum 10 % and 5 %, respectively. The main reason for the carbon content on other wooded lands going down while the reservoir on forest land has had an upward trend, is that there has been an increase in tree coverage on other wooded lands which has resulted in some of these areas being converted to forest land.

The area, and hence the carbon sink, in agricultural soils remained about the same in the period from 1990 to 2000. There may have been a slight decrease in the carbon content of cultivated boggy land because of loss of peat. We have estimated this loss to be very small and within the level of uncertainty, and it is therefore not presented in the tables.

The total carbon reservoir in products and waste was estimated to about 20 million tonnes in 1990. The reservoir of carbon in products and waste increased slightly between 1990 and 1998. Waste in landfills and wood materials in buildings are the main reservoir, contributing to 43 and 50 percent respectively in 1998.

4.4 Activities under Article 3.4

The possibility in Article 3.4 to include greenhouse gas credits for additional activities should be limited in the first commitment period, as expressed in earlier chapters. In Table III in the annex we have, however, included an example of a narrowly based activity for Norway that could yield a net carbon uptake during the first commitment period. This should only be regarded as an illustration of our accounting approach, since we do not necessarily intend to claim the potential credits evolving from this activity.

Table III provides preliminary data and information on this activity, increased fertilisation in older forests. This illustrates a baseline approach applied on a possible 3.4 activity, and the effects of such an activity, if this was to be accepted also for the first commitment period.

However, in chapter 3 we emphasise the importance of activities not being in conflict with any of the articles of the Convention, the Kyoto Protocol, the Convention on Biological Diversity, the United Nations Forum on Forests or other relevant international agreements. We realise that an activity like the one we have used as an example in Table III may have adverse effects and be in conflict with some of the elements in these agreements.

The business-as-usual (BAU)-baseline on the basis of average fertilised area in the period 1989-1997, was about 2000 ha per year. It has been estimated that the area to be fertilised may be increased to 35,000 hectares per year. The change in carbon from the activity would hence be the change in carbon content on 33,000 hectares yearly. This is estimated to give an increased uptake of nearly 0.7 million tonnes of CO_2 over the first commitment period.
The data on emissions of CH_4 and N_2O resulting from the activity can also be found in Table III, expressed in terms of CO_2-equivalents. We have estimated that about 300 tonnes of nitrogen are added in the baseline scenario. If the N_2O emissions amount to 0.1 %, this equals 300 kg per year. Increasing the fertilised area involves more nitrogen, and the N_2O emissions related to such increase is estimated to 5250 kg per year, or about 1.5 k tonnes of CO_2-equivalents over the first commitment period. Methane turnover is difficult to estimate – for well-growing forests we have estimated it to be negligible.

Annex I

(According to format for submissions of data and information agreed upon at SBSTA 12)

Table I - Preliminary data and information on carbon stock changes and areas related to Article 3.3 activities

	Definitions	Accounting framework	a_I (ha)	ΔC_I (t C)	a_{II} (ha)	ΔC_{II} (t C)	a_{cp} (ha)	ΔC_{cp} (t C)
Afforestation reforestation	**IPCC**	**Activity based**	**186,500**	**0.052×10^6**	**311,000**	**0.12×10^6**	**715,000**	**0.25×10^6**
Afforestation	FAO	Activity based	186,000	0.05×10^6	310,000	0.12×10^6	713,000	0.25×10^6
Reforestation	FAO	Land based I	153,000	-9.4×10^6	237,000	-16×10^6	507,000	-8.9×10^6
		Land based II	153,000	-1.6×10^6	237,000	-3.6×10^6	507,000	-3.5×10^6
		Activity based	153,000	0	237,000	0.001×10^6	507,000	0.3×10^6
Deforestation	**IPCC**/FAO	**Activity based**	**15,000**	**-0.14×10^6**	**25,000**	**-0.25×10^6**	**57,500**	**-0.16×10^6**

a_I Area (ha) afforested or reforested, or deforested since 1990 up to 1995 (including 1995)
ΔC_I Carbon stock change (t C) since 1990 up to 1995 on land afforested, reforested or deforested
a_{II} Area afforested or reforested, or deforested since 1990 up to 1999 (including 1999)
ΔC_{II} Carbon stock change (t C) since 1990 up to 1999 on land afforested, reforested or deforested
a_{cp} Projected area afforested or 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 or deforested since 1990 up to 2012

Table I.add specifies the data presented in Table I with regard to above and below ground biomass and carbon in soil.

Table I.add - Preliminary data on carbon stock changes above and below ground and in soils related to afforestation, reforestation and deforestation from 2008 to 2012. All numbers in million tonnes of carbon.

	Above ground biomass	Below ground biomass	Soil carbon	Total change in carbon stocks
IPCC-Activity based:				
Afforestation	0.07	0.015	0.16	0.25
Reforestation	-	-	-	-
Deforestation	- 0.08	- 0.017	- 0.06	- 0.16
Total ARD	- 0.1	- 0.002	0.10	0.09
FAO-Land based I:				
Afforestation	0.07	0.015	0.16	0.25
Reforestation	- 6.6	- 1.6	- 0.7	- 8.9
Deforestation	- 0.08	- 0.017	- 0.06	- 0.16
Total ARD	- 6.6	- 1.6	- 0.6	- 8.8
FAO-Land based II:				
Afforestation	0.07	0.015	0.16	0.25
Reforestation	- 1.2	- 1.6	- 0.7	- 3.5
Deforestation	- 0.08	- 0.017	- 0.06	- 0.16
Total ARD	- 1.2	- 1.6	- 0.6	- 3.4
FAO-Activity based:				
Afforestation	0.07	0.015	0.16	0.25
Reforestation	0.26	0.05	0.00	0.31
Deforestation	- 0.08	- 0.017	- 0.06	- 0.16
Total ARD	0.25	0.05	0.11	0.4

Explanatory text (Table I)

1. Definitions and accounting, Table I

a) Forest

Norway follows the FAO definition where forest land is defined as an area with a minimum of 10 % crown coverage. The trees should be able to reach a minimum height of 5 meters at maturity. The area can be temporarily without crown coverage due to harvesting.

Forest regulations and practices assure that there are small risks of permanent reductions in canopy cover, forest degradation, etc. in Norway. The objective of the Norwegian Forest Act is to promote forest production, afforestation and forest protection. The Act is also stating that harvesting in younger forests must be conducive to the further favourable development of the forest with regard to production and quality. The historical increases in both standing stocks and annual increments in Norwegian forests, and future projections for development of forest resources, also show that the chances of reductions in stocks and increments in the future are small. See figure 1 in the main part of the submission, and comments on trends beyond the first commitment period in the explanatory text to tables I and III in this annex.

b) Afforestation, reforestation, and deforestation

Figures for afforestation, reforestation and deforestation have been reported according to all the different definitional scenarios from the IPCC Special Report on LULUCF. Our understanding of the definitional scenarios is cited in the following.

<u>Afforestation</u>
Afforestation in Norway will normally be defined as establishment of forests by planting, seeding or other changes in human land-use practises on areas not defined as forests in the National Forest Inventory. Areas defined as afforested in Norway have been non-forest land for about 50 years or more.

<u>Reforestation</u>
Reforestation will normally be defined as re-establishment of forests by planting, seeding or natural revegetation on previously forested land or other wooded land. After harvesting all forests in Norway will be regenerated either by planting or by natural regeneration as part of the normal forest management system. Approximately half of the harvested area is assumed to be planted, while the other half is assumed naturally regenerated through different forest practices.

In the following we have presented our understanding of the different definitions of reforestation from the IPCC Special Report on LULUCF.

FAO – land based I: Carbon stock changes are accounted on all lands reforested (regeneration after harvesting) between 1990 and 2012. Accounting is beginning on 1st January 2008. On lands reforested between 2008 and 2012 (the commitment period) harvesting will be accounted as a carbon emission. The wood removed from the forest (timber) will be accounted as emissions at harvest time. Slash and roots are accounted as emissions at a given rate of decay.

Carbon changes in soil, slash and roots on the reforested area after harvesting are accounted. Slash and roots will be accounted as emissions at a given rate of decay. Accumulation of slash C in soil on reforestation areas is not accounted for, as it is difficult to predict how quickly the slash C will be incorporated in the soil C pool.

FAO – land based II: Like land based I, except for emissions from harvesting, which is not included in the carbon change accounting. All other carbon changes on the reforestation area are accounted.

FAO – activity based: Only carbon changes directly related to the reforestation activities are accounted. This means that we have estimated the carbon sinks due to the growth of the new forest, and the expected carbon changes in soil that occur as a result of the development of young forest stands. The changes that would take place if the area was not replanted, for example decaying slash and changes in carbon soil, are excluded.

For the soil C, Activity based includes only C from litterfall, which will be negligible during the first 22 years after planting (1990-2012).

IPCC: Only changes in carbon stock on lands that previously have been used for other purposes and then converted back to forest are accounted.

Deforestation

Deforestation should be defined as converting forest lands to other land. For Norway such a definition would include conversion of forests to agriculture land and roads, housing and other urban areas. Normal harvesting as part of a forest management system should not be defined as deforestation. All carbon stock changes, also carbon in soils, due to the defined deforestation activities are included. All standing biomass is accounted as emissions at conversion time. Carbon loss from soil is supposed to be increasing.

c) Accounting approaches

Norway’s view at this point is that the IPCC definitional scenario should be used for afforestation, deforestation and deforestation, see the main part of the report, hence these figures are in bold in Table I. Our accounting approach regarding the IPCC method can be interpreted as activity based, where the impact on carbon stocks is determined per unit area where the activity takes place. The changes in carbon stocks are calculated from formulas developed on the basis of estimated productivity rates in the type of area where the activity occurs as well as the size of the land areas in question. In other words, we have not calculated the carbon stock change in all pools on each land area where an activity takes place (land-based approach).

Approximately half of the harvested area in Norway is regenerated through planting, while the other half is regenerated naturally through different forest practices, e.g. seed tree- and shelterwood systems. Natural regeneration is defined as a direct human induced activity, since this is deliberate policy as part of forest management in Norway. Natural regeneration could also be an integrated part of a policy to increase the biodiversity in forests.

Our results would not change significantly if credits available for reforestation between 2008-12 were to be limited if deforestation occurred on the same land prior to the commitment period, as suggested by the IPCC (question in Table 3-3 of the IPCC SR). We reach the same conclusion if afforestation/reforestation between 1990 and 2008 should limit carbon debits resulting from subsequent deforestation in the commitment period. The reason for this is the slow growth rate of Norwegian forests. Regarding faster growing forests, however, these approaches should be employed.

2. Carbon pools included, Table I

The carbon stock figures consist of above ground biomass, below ground biomass and soil carbon. Above ground biomass includes stem wood, tops and branches, while below ground biomass includes stumps and coarse roots. Litter and woody debris are also included. The carbon in soils is counted as median values for carbon stocks in the O horizon plus the mineral soil for the different soil types.

3. Stratification, Table I

In Norway mean values for carbon density, growth rates etc. are estimated on the basis of field observations and calculations of the annual growth increment (see below). Of the increments, 51 % is found to be spruce, 26 % pine and 23 % deciduous wood. We do not need to distinguish between different types of biomes and regions, since this is taken into account when calculating the mean values. How these average values are calculated is further explained in chapter 4.c.

4. Methodologies and data, Table I

a) Data sources

A national forest inventory is performed every year by the Norwegian Institute of Land Inventory (NIJOS). Field observations are collected from all counties in Norway every year. These observations are the basis for the calculations of the annual growth increment. Permanent observation fields have been established and all plots are visited within the course of a five-year cycle.

b) Sampling techniques

The National Forest Inventory is carried out as a sample survey. In the period 1986-1993 permanent sample plots were established in forests in a 3 x 3 km grid. This includes most of the forest area in Norway, except the county of Finnmark and the mountain birch forests.
Totally, approximately 10,500 permanent sample plots are located on productive forest and other wooded land below the coniferous forest limit. On the average, each sampled area comprises about 3×10^{-5} of the surveyable area. The plots are re-measured every 5th year.

Measurements on trees are carried out on an area of 250 m^2. Stand parameters are based on a plot size of 0,1 ha.

An extensive number of attributes concerning forest conditions are being recorded at the plots. Some of these describe the area. Parameters which characterise the level of development and species composition of the vegetation, certain aspects on biodiversity, utilisation and yield capacity of the land, forest treatment, relations concerning forest operations, etc., are being measured or estimated.

c) Models and key parameters

Calculation of total biomass

To include total above ground biomass, tops and branches, the roundwood cut volume is multiplied with a factor of 1.5. To include below ground biomass, stumps and coarse roots, the volume of stems, tops and branches is multiplied with a factor of 1.2. Thus total biomass is calculated by using a factor of 1.8 on roundwood cut volume. Trees lower than 1.3 meters are not taken into account.

Carbon and CO2 contents in the wood

An amount of 200 kg C / m^3 wood is used in the estimates.
A factor of 3.67 is used to arrive at carbon dioxide equivalents.

Removals from the forest (Emissions due to harvesting)

Roundwood cut volume is expected to be 6% less than total stem volume including bark, due to harvest residuals.

Decay rates of harvest residuals

Above ground residuals, tops and branches are expected to have a decay rate of 3.4 % (Næsset 1999). Below ground residuals, stumps and course roots are expected to have a decay rate of 18.9 % (Aalstad 1990).

Growth of young trees

Using the H40 site index system (Tveite 1977) the heights on young trees (age 10 year at breast height) can be found. Assuming a linear growth 10 years after reaching breast height, the diameters at breast height are found using the formula: d1.3= 1.4 x h – 1,8
The stem volume is then found by Jonson's volume expression for small trees: $V=0.2\ (1+d^2)$
Growth and volume on trees lower than 1.3 meters are not taken into account.

Forest soil carbon stock

Median C contents were taken from de Wit and Kvindesland (1999), based on data from Tomter (1996) and the NIJOS database. The equation used to calculate C-stocks in a soil horizon was (de Wit and Kvindesland 1999):

$$\text{C-stock} = d \times BD \times \text{C-content} \times CF_{st}$$

With the following units and definitions:

C-stock (kg/m^2)
d: depth of horizon (m)
BD: bulk density (kg/m^3)
C-content ($g\ g^{-1}$)
CF_{st}: correction factor for stoniness and gravel content

The C values in de Wit (op.cit.) were the median values for C stocks in the O horizon plus the mineral soil for the different soil types. According to this reference, the median soil C content is 13.2 kg/m^2 for productive forest land.

Afforestation area

Based on figures from the National Forest Inventory and Statistics Norway, the yearly afforested area is estimated to 31,000 ha. This area is assumed to mostly convert from other wooded land due to changes in land use.

The afforestation is assumed to take place on lands with low or medium production capacity.

Site index (H40)	6	8	11	14
Production capacity m^3 / ha / year	1.2	2.0	3.5	5.5
% of afforestation area	25	25	25	25

Stands of 1200 plants / ha are assumed to be established immediately at the afforestation area.

Afforestation, carbon in soils:

Data from Norway have not been found. Billett et al. (1990) measured carbon contents in the soil O horizon in a Scottish forest of Sitka spruce, Norway spruce and Scots pine established mainly between 1930 and 1960, partly on moorland and partly after clearfelling of a plantation. The average annual increase in C contents in the period between 1949/50 and 1987 was 350 kg/ha. This was due to increased thickness of the organic layer, partly because of increasing litter inputs and partly because of decreased decomposition rates. The values did, however, vary from 12 to 1151 kg/ha. The conditions in this investigation are supposed to be rather similar to the conditions in the main areas for afforestation in Norway (mainly western and northern Norway). For our purpose, the average annual increase in C contents during the first 22 years of planting is assumed to be 20% of the above-mentioned average value, which is 70 kg/ha. The calculation is as follows for the period 1988-1992:

31 000 ha x (1+2+3)yrs x 350 kg C/ha/yr x 3.67 kg CO_2/kg C x 0.2 = 48 x 10^6 kg CO_2

31 000 ha is the average annual afforestation area. The figures (1+2+3) arise from the fact that the area planted in 1992 accumulates C for one year in this period (1992), the area afforested in 1991 accumulates C for two years (1991 and 1992), and the area afforested in 1990 accumulates C for three years (1990, 1991, 1992).

The calculation for the period 1993-1997 is as follows:

(93 000 ha x 5 yrs x 350 kg C/ha/yr x 3.67 kg CO_2/kg C x 0.2) + (31 000 ha x (1+2+3+4+5)yrs x 350 kg/ha/yr x 3.67 kg CO_2/kg C x 0.2) = 239 x 10^6 kg CO_2

Reforestation area

Reforestation area is based on figures of replanted areas from the Ministry of Agriculture. Distribution on site quality is taken from the National Forest Inventory.

Plants / ha are given as average figures of young planted stands, taken from the National Forest Inventory.

Site index	6	8	11	14	17	20	20-
Production capacity m^3/ha/yr	1.2	2.0	3.5	5.5	7.5	9.5	12.5
% of re-forestation area	1	10	29	37	15	6	2
Plants / ha	900	900	1150	1300	1500	1500	1500

For the period 1999-2012, the average of the annual reforestation areas of 1995-1999 is used as an estimate for the yearly reforestated area.

Standing volume at harvest, ‘FAO reforestation’

For reforestation with the FAO definitional scenarios, average figures of standing volume distributed on site index classes on areas that are harvested and replanted between the 6th and the 7th National Forest Inventory (baseline 1990 and 1996), are used to estimate the standing volume at harvest time on reforestation areas.

Site index	6	8	11	14	17	20	20-
m^3 / ha o.b. in mature forest	107	114	175	228	331	368	368

Reforestation, carbon in soils

For reforestation with the FAO definitional scenarios, the following assumptions have been made:

Clear-cutting will affect the C stock in the O horizon only.

The C stock in the O layer of productive forest is 5 kg C/m^2 on mineral soil and 14 kg C/m^2 on organic soil (de Wit and Kvindesland 1999, Fig. 2). With organic soil in 12 % of the area, the average value will be 6.1 kg C/m^2.

In a boreal ecosystem in Canada, Kurz et al. (1992) simulated effects of clear-cutting and replanting on soil carbon dynamics. According to their results, during the first 32 years there was an annual and close to linear decrease in the fast and medium C turnover pool. A simulated clear-cutting of a boreal forest in Finland (Liski et al. 1998) caused a decrease of 5 – 10% in soil C over 20 years. For our purpose, we have assumed an annual linear decrease of 0.5 % of the original C (the decrease is probably somewhat lower on mineral soil and somewhat higher on organic soil). Starting with a stock of 6.1 kg C/m^2, this means an annual decrease of 0.0305 kg C/m^2 or 305 kg C/ha.

The principles for calculations of change in C stocks are the same as used for Afforestation.

Deforestation area and standing volume

In lack of data an estimate of a yearly deforestation area of 2,500 ha has been used. Standing volume is assumed to be like the average standing volume for forest land, 89 m^3/ha above bark.

Deforestation, carbon in soils:

The same type of calculations as in Reforestation, FAO land Based I have been used. Note that a loss of 305 kg C/ha annually has been estimated. This reflects that not all soil C is assumed to be lost the same year as deforestation takes place.

d) Uncertainties

The random errors connected to the sample survey of the forest areas should not exceed 4% of total volume and increment. Smaller subsamples will have larger errors. The reforestation area is based on area statistics, with total measurements of the replanted area.

Removals from the forest will differ due to methods of harvesting, and market value of timber. With lower prices on timber, combined with higher processing costs, the residuals after harvesting will probably increase. A roundwood cut volume 6% less than stem volume is used as an estimate according to earlier practice, while in many cases the removed volume could probably be 15% less than the stem volume.

The rate of decay on harvest residuals will necessarily differ a lot due to different conditions on the harvest sites. The rates used are average numbers taken partly from findings in standing forest and therefore represent a high level of uncertainty.

The high level of uncertainty in the soil C stock change calculations should be noted. The uncertainty is supposed to be at least ± 100 %, due to the great differences between maximum and minimum values and the long time spans that lie behind the average values taken from the literature.

5. Treatment of non-CO_2 greenhouse gases, Table I

CH_4 consumption and N_2O production in soils

Forest soils are usually viewed as sinks for atmospheric methane (CH_4) and as sources for atmospheric nitrous oxide (N_2O) (Schlesinger, 1991). Aerated soils are considered to be sinks for atmospheric methane, as opposed to wetlands that are a source of methane (Goulding et al., 1996). In aerated soils, methane is degraded by microbial oxidation. Important factors that determine the rate of this process are soil moisture and temperature. Long-term cultivation of arable lands was found to decline the soil potential for oxidation of methane (Goulding et al., 1996). Willison et al. (1995)

showed that soils in woodlands had a larger potential to oxidise methane than grasslands and arable lands. Forest soils produce N_2O as a by-product during denitrification and nitrification. Production of N_2O is positively correlated with soil moisture content, and is thus inversely correlated with methane oxidation. Additionally, N availability affects production of N_2O (Sitaula et al., 1995). Emissions of N_2O from agricultural soils are usually much higher than from forest soils due to the high N-availability in fertilised arable lands.

Norway's general view is that effects of ARD activities on non-CO_2 greenhouse gases also should be taken into account. We regret that our understanding of the complex processes and variations with sites is limited. We see a need for further research to improve the knowledge of the total effects of the different activities.

For aerated soils, the conversion of arable lands to forests (afforestation) may result in decreased emissions of N_2O and increased sink of CH_4. Deforestation may have the opposite effect. Harvesting of trees and revegetation of forest may have effects on net N_2O and CH_4 emissions in soils in as much as soil moisture, soil temperature, gas-diffusion rates between soil and atmosphere and N-availability are affected. Such interactions are complex, and evaluation of the magnitude and time-span of possible changes is highly uncertain. Estimates for such changes have not been included here.

6. Methods and key assumptions in projections for the first commitment period (2008-2012) and discussion of trends beyond the first commitment period, Table I

An assumption of "business as usual" is used in the projections for the defined ARD activities for the first commitment period. The number of plants and reforestation area is supposed to stay at the same level as the average for the last 5 years. Land-use changes are supposed to continue at the same level as reported between 1990 and 1996.

Linear projections are made based on total growing stock from 1990 and 1996 (6^{th} and 7^{th} National Forest Inventory).

Climate warming might give a decrease in soil organic carbon sequestration due to faster mineralisation at higher temperatures. However, since CO_2 is the plant nutrient number one, increased amount in the atmosphere would increase plant production, including roots, stolons, and above surface plant residues to such an extent that the accumulation in the soil might increase. The doubling of Norwegian forest biomass during the last 70 years (HYDRA Final Report 2000, Arne Grønlund et al. 1999) indicates that residues in the forest areas might have increased, thereby increasing the sequestration of soil organic carbon. The response of soil organic carbon to increasing CO_2 in the atmosphere is included in present day organic C in the soil, but we do not have possibilities for experimental comparisons between present and pre-industrial atmosphere, except at laboratory scale. It is also found difficult to separate the effect of increasing CO_2 in the atmosphere on C sequestration during the period 1850 to 2000 from other changes during those 150 years.

Trends beyond the first commitment period

Because of the slow growth rate in boreal forests, the forest increment on ARD lands in Norway in the first commitment period will only be minor. The production early in a stand's life is less well known than in young production forests. By using existing production tables, we can predict the annual increment on ARD areas, as defined in the first commitment period, better beyond the first commitment period.

Development of the forest resources in the longer run will, of course, depend on management and possibly also factors outside the forest sector. Changes in policies as well as economic factors are most likely to alter forest management. Possible changes are difficult to predict and their effects impossible to forecast. The annual increment is already well above the annual harvest, and the difference between the two is increasing (see figure 1 in the main part of the submission). Thus there is a potential for increased harvesting without decreases in standing stocks in the Norwegian forests. With increased management intensity, a higher growth potential in the Norwegian forests can be obtained. Estimates have shown (NIJOS 1997) that higher investments in regeneration can increase the long-term production capacity with more than a million cubic meters, and at the same time increase the total production with 48-67 million cubic meters over a period of 100 years. The same estimates show that regardless of future regeneration intensity, both the standing stocks and the annual increment will continue to rise due to the age class structure and the long-term results of earlier management strategies.

Table II – Preliminary data and information on carbon stocks and area estimates (First sentence of Article 3.4). Year 1990

	Area (ha)	Total carbon stock in 1990 (t C)	Aboveground woody biomass (t C)	Below ground woody biomass (t C)	Soil carbon stock (t C)
Forest lands	8.6×10^6	$1,400 \times 10^6$	200×10^6	40×10^6	$1,100 \times 10^6$
Agricultural lands	1.0×10^6	200×10^6	Negligible	Negligible	200×10^6
Rangelands/ grasslands	Not occurring	-	-	-	-
Wetland/tundra	Covered under other wooded lands	-	-	-	-
Other: Other wooded lands	3.4×10^6	500×10^6	10×10^6	2×10^6	500×10^6
Other: Carbon in products and waste	-	20×10^6	-	-	-
Total	13.0×10^6	$2,100 \times 10^6$	200×10^6	40×10^6	$1,800 \times 10^6$

Explanatory text (Table II)

1. Description of land categories, Table II

The total area in Table II covers about one third of the total land area in Norway. This means that not all carbon stocks are included in the total figure. For example, carbon pools in mountain areas and in lakes have not been included.

Forest lands

Norway follows the FAO definition where forest land is defined as an area with a minimum of 10 % crown coverage. The trees should be able to reach a minimum height of 5 meters at maturity. The area can be temporarily without crown coverage due to harvesting without following land use change.

Agricultural lands

The area of grain crops corresponds quite closely with the annually cultivated land. Areas of other annually cultivated crops are very small. The remainder 2/3 is mainly grass lay of varying age, e.g. from 4 to 7 years. In the eastern and central areas of Norway the renewal of grass lays is mainly done as an undersowing in a grain crop, while in the western and northern areas ploughing and immediate sowing of grass seeds is quite common. Cultivated areas in different counties are provided from agricultural statistics.

Other wooded lands

In Norway the category “Other wooded lands” defines areas with a minimum of 5 % crown coverage and tree heights over 5 meters at maturity, or a crown coverage of more than 10% and tree heights under 5 meters at maturity, which is the FAO definition.

Carbon in products and waste

In the calculation of carbon reservoir, four main carbon storage sources are considered: 1) paper and paper products, 2) buildings, 3) furniture and 4) paper and wood products in landfills. We have mainly used the same estimation methods as in earlier estimations in Gjesdal et al. (1996).

2. Carbon pools – distinctions and assumptions, Table II

Forest lands

The carbon stock figures consist of above ground biomass, below ground biomass and soil carbon. Above ground biomass includes stem wood, tops and branches, while below ground biomass includes stumps and coarse roots. Litter and woody debris are also included. The carbon in soils is counted as median values for carbon stocks in the O horizon plus the mineral soil for the different soil types.

Agricultural soils

The agricultural land of Norway amounts to 3.1 % of the total land area. The development with time in the 20th century is given in the following table.

Norwegian agricultural area in km^2 1900-1997.

Area	**1900**	**1939**	**1969**	**1997**
Total	9900	11200	9600	10400
Grain crops	1650	1840	2520	3400
Grain crops, % of agric. land	16.7	16.4	26.3	32.7

The table shows that the total area has been rather constant around 10 000 km^2 during the last 100 years, while the area of grain crops has increased from about 1/6 to 1/3 of the total agricultural area.

3. Data sources, Table II

Forest lands

As mentioned in the explanatory text to Table I, the Norwegian Institute of Land Inventory (NIJOS) carries out a national forest inventory is performed every year. These observations are the basis of the calculations of the annual growth increment.

Carbon in products and waste

The storage sources included are paper and paper products, furniture, buildings, and wood and paper disposed of in landfills (Gjesdal et al. 1996**)**.

The carbon stored in paper is calculated from consumption of paper, lifetimes and carbon content in the paper products. Consumption of paper is calculated from data on production, import and export of paper and paper products. Production data is obtained from Statistics Norway's annual industry survey, while the annual External trade statistics gives data on import and export. Lifetime data for paper products were found in Pingoud et al. (1996). The mean carbon content is assumed to be 37 per cent (Gjesdal et al. 1996).

The amount of wood in buildings and furniture is calculated from i.a. the number of dwellings, the average utility of floor space, the fraction of dwellings built with wood, the amount of wood per m^2 in wood buildings and the C-content. The number of dwellings is based on data from the Building census for 1990 and supplied with data for 1999 from the Norwegian Building Research Institute (NBI). Estimations of the fraction of houses built with wood are based on data from the Building census for 1990 and Building statistics.

The calculation of carbon stored in waste is based on background data used in estimation of methane emissions from landfills (Frøiland Jensen et al. 1999). Three categories of waste are considered: household and industrial waste included in municipal waste, and industrial waste treated outside the municipal refuse disposal service. For a close description of the data sources and estimations we refer to the documentation of the methane emission model (Frøiland Jensen et al. 1999).

There are good data on municipal waste from 1992 given by the Waste statistics. There are also statistics on amounts of industrial waste in municipal refuse disposal systems from 1991 and for some years earlier on. Factors for the composition of household and industrial waste in municipal waste are based on examinations for single years. However, especially for the industrial waste, the factors are uncertain. The waste products included in this analysis are paper and wood.

For industrial waste treated outside the municipal waste system, only the organic fraction of waste disposed of are considered. The data are based on statistics on industrial waste for 1993 and 1996. It is assumed that the organic fraction mainly consists of treated wood, as bark, splinter, wood fibres, paper etc.

4. Methods, Table II

Information related to carbon on forest land can be found in the explanatory text to Table I.

Soil carbon stock

Additional information on the methods to estimate the carbon content in soil is included in the explanatory text to Table I. The median soil C content is 13.2 kg/m^2 for productive forest land according to the reference we have employed (de Wit and Kvindesland 1999). This value is used to calculate soil C stocks in ”Forest land”. The median soil C content is assumed to be 12.5 kg/m^2 for non-productive forest land and 24 kg/m^2 for wooded mire. According to Tomter (1996), wooded mire makes up 27 % of the area covered by wooded mire and non-productive forest land. Thus, the average soil C content has been estimated to 15.6 kg/m^2 for ”Other wooded lands”.

Agricultural soils

The thickness of the organic layer in organic soil is estimated to 50 cm and in mixed mineral-organic soil to 25 cm.

The carbon stocks in vegetation on cultivated land can be estimated on basis of the annual yield. For grass, which constitutes more than 50 % of the Norwegian cultivated land, the mean annual yield is between 5 and 6 tonnes dry matter and between 2 and 2.5 tonnes C per ha. The annual mean can be estimated to about 3 tonnes per ha, which corresponds well with the global carbon stocks in vegetation croplands (IPCC 2000).

Soil organic contents in topsoils are calculated on basis of a database containing analysis of 350,000 soil samples from cultivated soils. The following soil characteristics are used:

- Soil class (sand, silt, clay, organic soil and mixed mineral-organic soil)
- Organic matter in topsoils
- Bulk density in topsoils

The carbon content of the soil organic matter has been assumed to be 58 %.
The thickness of the topsoil in mineral soils has been assumed to be 23 cm.
The thickness of the organic horizon has been assumed to be 25 cm in mixed mineral-organic soil and 50 cm in organic soil.

The organic matter content of subsoil has been calculated on the basis of descriptions and carbon analysis from different horizons in 358 soil profiles in cultivated soil.

Carbon in products and waste

<u>Paper</u>
The paper storage is calculated based on consumption and lifetime data. Consumption of paper is given by the formula:

Consumption = Import - Export + Production - Feedstock

To avoid double counting of production, only production of primary paper is counted. For import and export all paper and paper products are counted.

A simplified estimation of paper storage is given by:

Accumulated = Consumption · Average lifetime

The lifetime for different paper products is based on data from Pingoud et al. (1996). The distribution of primary products as feedstock for secondary products is uncertain, and an average lifetime of 1.2 years for all years has been chosen.

Production data is obtained from Statistics Norway's annual industry survey, while the annual external trade statistics gives data on import and export. For a few products in the industry survey the production is given by value only and not by weight. In those cases the production volume is estimated from the production value and the relationship between export and value for the same products given in the external trade statistics.

<u>Buildings</u>
The method for estimating the amount of carbon in the stock of buildings was developed by Gjesdal *et al*. (1996). The method has been revised to include dwellings with no inhabitants. The method is based on *stock* data, using direct estimates of the total building pool. The data for *fluxes* have been improved since 1996, especially with the new demolition statistics (Rønningen 2000). However, due to uncertainty in the fluxes and the very long lifetimes of buildings, we still find the stock approach more reliable for the present purpose.

The stocks in residential and non-residential buildings are estimated separately. The basic method for estimation is:

$C\ stock = Total\ utility\ floor\ space,\ m^2\ \ x\ \ tonnes\ wood/m^2\ \ x\ \ C\ content\ in\ wood$

Furniture
Gjesdal *et al.* (1996) have estimated the carbon stock in furniture by the expression

C stock = Total utility floor space x furniture, kg/m^2 x C content in wood

A factor of 10 kg furniture per m^2 was used. Non-residential buildings were excluded from the calculation.
Waste
Yearly accumulation of carbon in waste is found through an inflow-outflow analysis:
Yearly accumulation of C = C in waste disposed of - C in emissions from decomposition (CO_2 + CH_4)

The amount of waste disposed of in landfills for a specific year is given by:

Waste disposed of = Waste production - Waste recycled - Waste burned

The total carbon stored in waste is found by adding yearly accumulation from the year 1945. Only paper and wood products are considered.

Emissions of methane and carbon dioxide from decomposition are calculated by assuming half-lifetimes ($t_{1/2}$). Total emissions of both gases (Q) in tonnes methane equivalents for a given year T from waste disposed of in year x are given by the formula:

$$Q_{T,x} = k \;x\; M_x \;x\; L_0 \;x\; e^{-k\,x\,(T-x)} \;x\; v/1000$$

Here L_0 (m^3/tonne) is the gas potential calculated from the carbon content and proportion of carbon decomposed. The proportion of carbon decomposed is estimated to 0.7, based on the assumption of a mean temperature of 30 ^{o}C in the anaerobe zone (Frøiland Jensen et al. 1999). Further, M_x (tonnes) is the amount of waste disposed in year x, and v is the weight of methane (0,7168 kg/m^3). The factor k is given by: $k = ln(2)/t_{1/2}$

Emissions in year T from all waste disposed of in preceding years are then given by:
$Q_T = S\ Q_{T,x}$

The Norwegian methane emissions model does not consider waste used as filling, because it is assumed that the organic fraction is small and under aerobic decomposition. This fraction is hence not included in this work. The methane model's figures on wood waste disposed are similar to the figures found by the waste accounts for wood (SSB 2000). This might indicate that the volume of wood products stored as filling is insignificant or that the methane model overestimates the figures. In either of the cases, we do not find it reasonable to make any additions to the figures from the methane emissions model.

5. Possible changes in carbon stocks, Table II

In the first sentence of Article 3.4 of the Kyoto Protocol, it is written that data should be provided to establish the level of carbon stocks both in 1990 and to enable an estimate to be made of changes in carbon stocks in subsequent years. To answer to this, we have included information on the total carbon stock in 1995 and 2000 in Table II, add 1 and Table II, add 2 respectively. The data are presented in the same way as data for 1990 in Table II.

Table II, add 1: Carbon Stocks in 1995

	Area (ha)	Total carbon stock in 1995 (t C)	Aboveground woody biomass (t C)	Below ground woody biomass (t C)	Soil carbon stocks (t C)[1]	Change in C stock since 1990 (t C)
Forest lands	8.7×10^6	$1{,}400 \times 10^6$	200×10^6	40×10^6	$1{,}100 \times 10^6$	50×10^6
Agricultural lands	1.0×10^6	200×10^6	Negligible	Negligible	200×10^6	0
Rangelands/ grasslands	Not occurring	-	-	-	-	-
Wetland/tundra	Covered under other wooded lands	-	-	-	-	-
Other wooded lands	3.3×10^6	500×10^6	10×10^6	3×10^6	500×10^6	-20×10^6
Carbon in products *		20×10^6	-	-		1×10^6
Total	13.0×10^6	$2{,}100 \times 10^6$	200×10^6	50×10^6	$1{,}800 \times 10^6$	30×10^6

- * In 1998

Table II, add 2: Carbon Stocks in 2000

	Area (ha)	Total carbon stock in 2000 (t C)	*Aboveground woody biomass* (t C)	Below ground woody biomass (t C)	Soil carbon stocks (t C)	Change in C stock since 1990 (t C)
Forest lands	8.9×10^6	$1{,}500 \times 10^6$	200×10^6	50×10^6	$1{,}200 \times 10^6$	100×10^6
Agricultural lands	1.0×10^6	200×10^6	Negligible	Negligible	200×10^6	0
Rangelands/ grasslands	Not occurring	-	-	-	-	-
Wetland/tundra	Covered under other wooded lands	-	-	-	-	-
Other wooded lands	3.1×10^6	500×10^6	10×10^6	3×10^6	500×10^6	-50×10^6
Carbon in products	-	20×10^6	-	-	-	1×10^6
Total	13.0×10^6	$2{,}200 \times 10^6$	200×10^6	50×10^6	$1{,}900 \times 10^6$	50×10^6

6. Uncertainties, Table II

Forest land

See our comments on uncertainty with regard to Table I.

Soil carbon

The uncertainty in soil carbon was estimated to 17 - 22% (de Wit and Kvindesland 1999). There is also uncertainty connected to the estimated area, which means that the uncertainty in the figures on forest soil may be higher.

Agricultural soils

The main source of error is assumed to be the estimates of the thickness of the organic layer in organic soil (50 cm) and mixed mineral-organic soil (25) cm. If these layers are assumed to be 80 cm and 40 cm thick, which most certainly are too high values, the calculated carbon stocks will increase with 10 %. Equivalent, if the organic layers of organic and mixed mineral-organic soils are assumed to be respectively 40 and 20 cm, which should be considered as minimum values, the decrease in the calculated value will be 3 %.

Carbon in products and waste

The known outflow of carbon in the form of accumulation, exports and emissions is considerably lower than the inflow in the form of harvest and imports. The unaccounted difference, which might be either emissions or storage, is over 3 times larger than the yearly accumulation of carbon in products. However, the unaccounted carbon only constitutes about 3 per cent of the 1990 total carbon storage in products and waste. This imbalance between outflow and inflow illustrate the high level of uncertainty in these data.

Storage of carbon in buildings and waste disposed of in landfills are the major storage sources. For waste, both the data on amount of organic waste disposed of and the estimated decomposition are uncertain. For the estimation of carbon in buildings, the uncertainty of total storage is in the order of 50 per cent (Gjesdal et al. 1996). The main source of uncertainty is the amount of wood per m^2 of utility floor space.

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

Possible activities	Accounting framework	a_1 (ha)	$CO_{2,1}$ (tCO_2)	CH_4, $_1$ (t CO_2-equiv.)	N_2O, $_1$ (t CO_2-equiv.)	a_{1I} (ha)	$CO_{2,1I}$ (tCO_2)	CH_4, $_{1I}$ (t CO_2-equiv.)	N_2O, $_{1I}$ (t CO_2-equiv.)	a_{cp} (ha)	ΔC_{cp} (t C)	$CO_{2,cp}$ (tCO_2)	CH_4, $_{cp}$ (t CO_2-equiv.)	N_2O, $_{cp}$ (t CO_2-equiv.)
Fertilisation	Activity based	2033	50,556	0	558	2033	84,260	0	930	35,000	724,825	682,620	0	1,535

a_I Area in 1995 involved in the Article 3.4 activity since 1990 (area in 1995)
$CO_{2,1}$ Net CO_2 emissions by sources and removals by sinks related to the Article 3.4 activity, accumulated from 1990 to 1995 (including 1995)
CH_4, $_1$ CH_4 emissions by sources related to the Article 3.4 activity, accumulated from 1990 to 1995 (including 1995)
N_2O, $_1$ N_2O emissions by sources related to the Article 3.4 activity, accumulated from 1990 to 1995 (including 1995)
a_{II} Area in 1999 involved in the Article 3.4 activity since 1990 (area in 1999)
$CO_{2,1I}$ Net CO_2 emissions by sources and removals by sinks related to the Article 3.4 activity, accumulated from 1990 to 1999 (including 1999)
CH_4, $_{1I}$ CH_4 emissions by sources related to the Article 3.4 activity, accumulated from 1990 to 1999 (including 1999)
N_2O, $_{1I}$ N_2O emissions by sources related to the Article 3.4 activity, accumulated from 1990 to 1999 (including 1999)
a_{cp} Projected area in 2012 involved in the Article 3.4 activity since 1990 (area in 2012)
ΔC_{cp} Projected carbon stock changes over the first commitment period related to the Article 3.4 activity since 1990
$CO_{2,cp}$ Projected net CO_2 emissions related contribution of the Article 3.4 activity to the first commitment period assigned amount of Norway
CH_4, $_{cp}$ Projected net CH_4 emissions related contribution of the Article 3.4 activity to the first commitment period assigned amount of Norway
N_2O, $_{cp}$ Projected net N_2O emissions related contribution of the Article 3.4 activity to the first commitment period assigned amount of Norway

Explanatory text (Table III)

1. Activities and accounting, Table III

As a general approach, we think that the possibility in Article 3.4 to include greenhouse gas credits for additional activities should be limited until the second and subsequent commitment periods. We have, however, included an example of an activity that yields a net carbon uptake during the first commitment period. This should only be regarded an illustration on our accounting approach, since we do not necessarily intend to claim the potential credits evolving from this activity. We also see that an activity like increased fertilisation may have negative environmental effects by eutrophication of terrestrial and aquatic ecosystems.

a) Definitions and descriptions of all activities proposed

Increased fertilisation
We have included data on the activity "increased fertilisation" in Table III as an example of an additional activity that may yield credits for Norway. In Norway the fertilised area on mineral soil the last years accounts to about 2000 ha per year. We have estimated that it would be technically possible to increase the fertilised area to about 35,000 ha per year, and this is described further in the following. The increased nitrogen fertilisation described is implemented only in older forests (cutting class IV and V), where the effects on carbon stocks are highest. Fertilisation in younger forest (cutting class II and III) can give increased increment, but this activity is excluded because of the controversy with regard to possible environmental effects and the long period of economic return.

Other assessed activities
We have also assessed some other narrowly interpreted Article 3.4 activities, and in the following we have explained why we do not propose them for inclusion.

Longer rotation periods
In the short run, longer rotation periods would increase the carbon stock in the forests, but Norway does not intend to include this as an activity. The reasons for not including increased rotation time are:
- difficulties in developing a baseline
- the age of forest harvested today is already on average well above 10 years older than the 'technical optimal rotation age', defined as the point where mean annual increment is the highest.
- increasing the rotation time further would most likely lead to reduced growth rates and reduced carbon sequestration in the forest, as well as producing less wood for bioenergy or for replacing energy-intensive products as steel, aluminium, plaster board, and concrete (see Special report on LULUCF, page 273).

Species changes - afforestation
According to NIJOS data, about 30,000 ha is the annual increase in forested land, mostly in western and northern Norway. About 20 % are planted forest and only a minor part in non-forested areas. If we use the UK estimate (Billett et al 1990) with an annual accumulation of 35 g C/m^2 for the cultivated conifer forest, about 60,000,000 m^2 x 35 g C/m^2 = 2100 t C are added to the stock in soil after forest has been established. Only a minor increase in C in soil are expected the first 10 years after planting (estimated to 10 %, 210 t). Both the above and below ground biomass could almost be neglected the first 10-20 years after planting. If all the afforested land is cultivated with conifer forest, annual addition is 10,500 t C or about 1000 t the first years. These figures give small values for the short-term effect on the C-stock. In a longer perspective these figures could be considerably higher (but negligible in 2008-12).

Different harvesting systems
According to Forest Statistics about 90 % of the harvested cubic volume is harvested with clear cutting or the seed tree method. Less than 2 % is harvested with selected cutting systems or shelter tree method, and 8 % in thinning. Transformed to area scale this means that about 4-5 % of the harvested area is harvested by alternative methods (selection systems, shelterwood), the rest by open cuttings.

Whole tree removal is not practised in the country. Unless the cutting might cause risk for dramatic changes in the water level, the cutting regime seems to have minor influence on the C-stock (de Wit & Kvindesland 1999). What might be the case – and not treated much in the literature - is that the clear-cutting method is the most time effective way to accumulate C in the biomass – if the harvested stand has a low density or a low vitality. We still don't know whether different harvesting systems will contribute more or less to the C-stock in Norwegian forests – and especially the long term effect of the C-stock in the soil. Only general aspects could be described.

Cultivation of peatland
Drainage and cultivation of peatland lead to an increased microbial activity, a more rapid decay of the peat and an increase of the CO_2 emissions. Drainage will in general reduce the emissions of CH_4 as the gas diffused from the deeper layers is consumed in the aerated zone during methane oxidation. The N_2O fluxes have been reported to increase 5-15 times following cultivation of peatland (Martikainen 1993). The effect of peatland cultivation on greenhouse gas emission depends on the difference between the increase of CO_2 and N_2O and the decrease of CH_4. Observations in Norway show a 2-4 cm annual subsidence of cultivated peatland (Hovde 1996). Provided that the peat density is 0.1 and about the half of the subsidence is due to decay, the loss can be estimated to 20-40 tonnes CO_2 per ha and year.

Drainage of agricultural lands
Sullivan et al. (1998) reported clear positive effects of subsurface drainage on crop yields, but insignificant decreases of soil organic C after 37 years. In one of the experimental sets of plots there was a slightly higher organic C content for undrained, with the total carbon stock being 59.9 Mg C per ha for undrained and 57.1 Mg C per ha for drained in 0-24 cm depth. Another set of plots had slightly higher soil organic C in the drained treatment for the 0-8 cm layer, but higher soil organic C in the undrained treatments for all deeper layers. Strangely enough the ratio of undrained to drained for soil organic C was highest for the deepest layer, 30-34 cm depth, in both plot sets. Although the tendency was for slightly higher soil organic C in undrained soil, these results after 37 years were not significant.

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

The scope of the activity we use as an example, addition of N-fertiliser to older forests, is to increase the increment on the areas of concern.

Implemented on the right areas, the activity may be an example of improved forest management. However, the share of forest lands suitable for increased fertilisation is most likely to be very limited also in the future.

c) Accounting approaches

The assessed activity can be interpreted to be narrow-based, and we have calculated the outcome in increased carbon uptake from estimations of area of practice and increased increment following the fertilisation. Our assessment also includes estimates of emissions of nitrous oxide resulting from the activity.

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

The current annual area for increased nitrogen fertilisation in older forests is approximately 2000 ha, which is thus considered the baseline. The potential area for the activity is, by expert judgements, estimated to be 35 000 ha annually. From this information, a possible increased area for fertilisation in older forest of 33 000 ha is used as an example of an additional activity in Norway.

2. Carbon pools included, Table III

When calculating the outcome of the increased fertilisation in older forests, we have included carbon in above ground biomass, below ground biomass and soil carbon. Above ground biomass includes stem wood, tops and branches, while below ground biomass include stumps and coarse roots. The carbon in soils is counted as median values for carbon stocks in the O horizon plus the mineral soil. Carbon stocks in harvested materials are not included.

3. Methodologies and data, Table III

a) Data sources
The data are based on the Official Statistics of Norway (SSB 1999) and Norwegian Institute of Land Inventory (Tomter 1998).

b) Sampling techniques
No sampling is done, since the area for fertilisation is based on expert judgements and the potential effects are estimated based on general assumptions of growth responses.

c) Models and key parameters

<u>Fertilisation in older forest (cutting class IV and V).</u>
Most of the Norwegian experiments show that a N-fertiliser addition (150 kg ha) has given a increment of 1-2 m^3/ha/year over a period of 6-9 years (Tveite 1994, Nilsen 1999). For the calculation of effects we have used 1.5 m^3/ha/year.
Potential areas: Site index medium (H40= 11, 14 and 17) Coniferous forest.
c.cl. V = 1 000 000 ha
c.cl. IV = 770 000 ha

On mineral soil baseline alternative, 2033 ha:
Effect on the above ground biomass today: 2033 ha, 1,5 kbm/ha/year = 3050 kbm/ha/year x 1,9 = 5794 t w m x 0.41 = 2375 t d.m. or 1188 t C. About 1:3 are the relationship between above and below ground biomass = 396 t C.

The presumptive increase in soil carbon stock due to the fertilisation are a doubling in the humus layer content, and an increased C-level with increasing N-adding to the B-horizons. Here we have simplified and calculated (a conservative) increase in C-content of 35 g C/m^2/year = 712 t. The mean value of the soil is estimated to be about 13 kg C/m^2, O-horizon + mineral soil).

Steep terrain, long extraction distances, a non thinning regime, nitrate leaching etc. resulted in that we have used a factor of 2 % as a qualified estimate of areas that might be of interest for potential measures, which then amounts to 35,000 ha. This fertilisation scenario with 35,000 ha per year is 5-6 times the level that was reached on mineral soil in the 1960'ies. However, technically such a measure could be possible to reach with certain economic incentives. Since new areas are included every year, the accumulated effect could be summarised. Repeated fertilisation is presupposed every 5th year.

d) Uncertainties

Most of the calculations that are performed are based on expert judgement – and the uncertainties of the estimates must be strictly underlined. We have not estimated the uncertainty connected to the provided figures.

4. Treatment of non-CO_2 greenhouse gases, Table III

The data on emissions of CH_4 and N_2O resulting from the activity can be found in Table III, as CO_2-equivalents. We have estimated that about 300 tonnes of nitrogen is added in the baseline scenario. If the N_2O emissions amount to 0.1 % this equals 300 kg per year. Increasing the fertilised area involves using more nitrogen, and the N_2O emissions related to this increase is estimated at 5250 kg per year. Methane turnover is difficult to estimate – for well-growing forest we have estimated it to be negligible.

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

Information on methods and key assumptions in projections for the first commitment period can be found under chapter 3. Methodologies and data.

Trends beyond the first commitment period

As briefly mentioned in the main part of the submission, the potential for increased carbon sequestration and enlarged carbon stocks in forests and wood products with improved forest management in Norway, could be significant in the longer run. The potential is difficult to quantify, as it will depend on environmental, social and economic factors in the future. Materialisation would depend on active policies and economic incentives. Both decisions on the Kyoto Protocol’s second and subsequent commitment periods as well as developments in many other areas are likely to influence changes in policies and the economic situation.

The example activity, increased fertilisation in older forests, could probably be maintained at a higher level for many years on new areas as the first ones are harvested. The same would probably be true for other potential activities. What is common for most of the potential activities in Norway, is that the effects are minor in the short run while more substantial in the longer run.

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PAPER NO. 6: POLAND

ART. 3.3 AND 3.4 OF THE KYOTO PROTOCOL

Art. 3.3 - DEFINITIONS

Definition of forest

Up to now over 200 definitions of forest exist all over the world and not even one of them fully respects the geographical differentiation of natural conditions. That is the reason that we should ask the following question: do we really need the definition of forest under the Kyoto Protocol to implement properly the provisions related to LULUCF contained there? Poland is of the opinion that the definition of forest will be extremely difficult to agree among the Parties and as a result it can obstruct the work under LULUCF issues as a whole. Thus, it can be said that not only forests can be considered as a potential carbon sinks. Such ecosystems as wetlands, steeps, bush, and tundra have also the potential to accumulate carbon in a long-term meaning. So the definition should not determine the certain type of ecosystem, but must reflect the potential for long-term carbon sequestration. Poland hereby proposes to concentrate the work on definitions of terms, which has the real importance when implementing the Kyoto provisions.
What is really important in the light of Art. 3.3. is to define "forestry activities" instead of "forest" itself.

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Afforestation cannot be limited to planting new trees only (in the meaning of artificial afforestation described under FAO. The natural succession leading to natural establishment of tree cover and creation of a forest ecosystem should also be considered as "afforestation". Where afforestation as such is going on to restore post agriculture lands, it also has important environmental benefits like increasing of biodiversity, reducing erosion, protection of watershed and controlling water management, creating a potential new areas for recreation etc.
The problem associated with inclusion of natural succession under afforestation is as follows: how to determine "human factor" in this process? Is it "human induced" activity if we decide to stop agricultural activities and let the trees grow to create a new forest? Poland is of the opinion that such decision must always be taken by human and natural succession on post-agricultural areas should be considered as "human induced" activity and therefore should be included in definition of afforestation.

Usually, afforestation and **reforestation** are considered as having similar meaning but differentiated regarding the respective time slot within which the land is not covered by forest. In the light of Sustainable Forest Management it is not allowed to leave land after harvesting as such. New trees are being planted as soon as soil is prepared to do so. From our point of view, such operation should be called "regeneration" and divided into two meanings: artificial (tree planting after clear cutting) and natural (by natural ecological succession). Poland is of the opinion that it seems to very important to distinguish those two terms: reforestation and regeneration as far as different methods are being used for soil preparation, which can significantly increase or decrease the $CO2$ emission levels from the forest soil.

From our point of view, **deforestation** should not be considered as one of the "forestry activities", but as other type of human activity: land use change. The purpose of deforestation is mostly related to fulfil human needs resulting from development: create additional agricultural land, built-up areas or communication infrastructure.
Taking into account the above deforestation should not be considered as a forestry activity. In addition, Poland is of the opinion that clear-cutting cannot be considered as deforestation, because such practice belongs to the scope of forest management activities and does not create new, long-term deforested areas but is followed by planting new trees on this area.

ART. 3.4

Poland is of the opinion, that agreement on the complete list of additional human induced activities will be time-consuming process with not so good prognosis to reach consensus. Therefore we propose to use provisions contained in Sustainable Forest Management (SFM), existing under Pan-European Process on Forests, Montreal Process or Tarapoto Process, as a basis for further consideration under this issue. The approach contained in SFM will allow also including carbon stocks other than growing stocks in forests. It means that for example carbon stocks in forest soils could also be considered during calculations needed to assess total carbon removal by forest ecosystem. It should be also underlined, that application of SFM principles will secure prevention of potential loss of biodiversity, which could happen if forest management is focused only on wood production and creation of Kyoto forests not respecting the provisions of other international agreements, i.e. Convention on Biological Diversity. If Parties would agree to use SFM approach as a basis for further work, there will be no need to elaborate and to agree upon a detailed list of additional human induced activities in forestry.
In addition, Poland is of the opinion that issues related to management of wood and wood-based products should also be considered as additional human induced activity taking into account their potential to promote development of the wood-based products market in the meaning of a long-term sequestration of carbon.

Taking into account the above, Poland is of the opinion that Art. 3.3 and 3.4 need further comprehensive work on expert level, including scientific work regarding methodologies for proper estimation of carbon removal and storage by different ecosystems in different geographical regions, with the aim to elaborate the relevant rules, guidelines and modalities necessary for proper implementation of these articles. Thus, it seems to be quite difficult to apply the provisions contained in Art. 3.3 and 3.4 of the Kyoto Protocol during the first commitment period (2008-2012).

PAPER NO. 7: RUSSIAN FEDERATION

ACTIVITIES WITHIN ARTICLES 3.3 AND 3.4 OF KYOTO PROTOCOL: COUNTRY SUBMISSIONS IN RESPONSE TO SBSTA REQUEST

The forests of Russia are tremendous reservoir of carbon comprising living biomass of plants, plants residues of various stages of decomposition, soil humus, and peatlands. Sustainable management of Russian forests is a national priority. Conservation and refurbishment of forests are assigned by the country legislation, particularly by the Forest Code of Russian Federation.

State inventory of Russian Federation forest stock is performed once in 5 years. In 1988, the area of forests comprised 1182.6 mil ha. In 1993, it changed to 1180.9 mil ha, and in 1998 it became 1178.6 mil ha. The estimates of growing stock correspond to 81.6; 80.7, and 81.9 billion m^3 for subsequent inventory years: 1988, 1993, and 1998 respectively. The yearly carbon sequestration in the forests of Russia is estimated as 960 Mt CO_2. Total area of wood harvesting in 1989 and 1993 was 4.6 and 2.9 mil ha correspondingly. The removal of timber from cutting areas was 358 mil m^3 and 210 mil m^3 for the years 1989 and 1993 respectively. Consequently in 1990 and 1993, forest utilization activities resulted in atmospheric carbon dioxide emission being 400 and 270 Mt CO_2 respectively. The value of CO_2 emission from the same activities within the period from 1994 to 1997 vary from 220 to 240 Mt CO_2/yr. Forest fires cause the emission of 90 to 240 Mt. CO_2/yr. That is the mean value for the period from 1988 to 1994. Based on the above data, the estimates of total CO_2 net sink in the forests of Russia are as follows:

1990 – 392 Mt CO_2/y;
1994 – 568 Mt CO_2/y; and
1995 - 585 Mt CO_2/y.

The accuracy of these estimates is ± 30 %.

However, these value display general changes in carbon net sinks, whereas Kyoto Protocol is addressing only "…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…" (Article 3.3) and "…additional human-induced activities related to changes in greenhouse gas emissions by sources and removals by sinks in the agricultural soils and land-use change and forestry categories…" (Article 3.4). The definitions of afforestation, reforestation and deforestation are discussed in details in the IPCC Special Report on Land-Use, Land-Use Change and Forestry (LULUCF SR). In general Russian Federation agrees with the definition of forest proposed by FAO/IPCC in the LULUCF SR. However, we think that within the context of Kyoto Protocol, this definition should be extended so that it includes multipurpose forest shelter belts artificially planted on agricultural fields and other lands. Based on their structure on functions, forest belts sometimes are not completely consistent to IPCC/FAO definition of forest, but they constitute an important sink of CO_2 and therefore, should be included in national estimates of greenhouse gases emissions and sinks. Besides, in many countries planting forest shelters belts might become an important type of human activity within Articles 3.3 and 3.4 of the Protocol, whereas the LULUCF SR lacks of appropriate definition of forest shelter belts.

Russian Federation gives the following definitions to human-induced activities on afforestation, reforestation and deforestation within Article 3.3 of Kyoto Protocol:

Afforestation is artificial establishment of forest on land that was previously under different land use. The different types of land use are: agriculture, peat extraction, mining, and others. A special emphasis should be paid to development of artificial forests over degraded lands subject to soil erosion, weathering, and sand storms. Besides, significant conservation functions, these stands could be highly productive as atmospheric carbon sinks.

Reforestation is artificial establishment of forest on forested lands at present are not covered by forest or their forest cover is insufficient. These lands include sparsely forested territories (with low density forest cover), areas of former forest fires, dead (or declining) stands, harvesting areas, and large glades (or other open sites) in forests.

Deforestation is artificial conversion of forested lands to non-forest territories as a result of various human activities including unfavorable anthropogenic impacts (human-induced forest fires, industrial pollution, and etc.). In that case the deforestation might be associated to clear cutting or other activities aimed at removal of damaged wood, and consequently it becomes a source of CO_2 and other greenhouse gases emission to the atmosphere.

To our opinion, the above definitions are not in contradiction to those presented in the IPCC Special Report on Land-Use, Land-Use Change and Forestry and particularly in Table 3.1 of the LULUCF SR. They provide a more exact description of direct human activities stated in the Article 3.3 of the Kyoto Protocol.

Russian Federation believes that Articles 3.3 and 3.4 are closely interrelated and should be considered together. Therefore, the term of "**human-induced land-use change**" in the Article 3.3 of the Protocol should refer not only to afforestation, reforestation, and deforestation, but also should define various types of "**additional human-induced activities**"as stated in the Article 3.4 of the Protocol. Consequently **human-induced changes in land use** are defined as anthropogenic activities on land management within a given territory that modify its ability to emit greenhouse gases to the atmosphere or capture greenhouse gases from the atmosphere and store them or their components (e.g. C in case of CO_2, N in case of N_2O, and etc.).

Correspondigly Russian Federation believes that the list of additional human-induced activities should be flexible enough and take into consideration specific features of UNFCCC Parties and therefore, include all types of a country activities that result in absorption of greenhouse gases or may prevent their substantial emissions to the atmosphere. Based on the above said, the list of currently performed in the forest sector of Russia additional human-induced activities within Article 3.4 of Kyoto Protocol includes:

1. Control on forest fires and insect outbreaks that includes an opportune detection of areas of fires and insect outbreaks and appropriate arrangements aimed at struggle against them (fire extinguishing or pest treatment procedures);
2. Artificial arrangements on promotion to natural regeneration that enable reducing period of forest restoration and increase CO_2 sink from the atmosphere.

3. Artificial reconstruction of forest stands by planting young trees. It includes development of artificial younger stands beneath the growing forest cover.

4. Forest management activities (particularly management cuttings) in young stands aimed at increase of their production as well as carbon accumulation.

Tables I-II in the annex provide preliminary data on afforestation, reforestation, and deforestation activities according to Article 3.3. Each table has appropriate explanatory text.

Similar to forestry sector, the agricultural sector of Russian Federation also has a significant potential for carbon sequestration. Soils participate in globale carbon cycle. They form a major natural carbon pool. Therefore, conservation and improvement of fertility of cultivated soils contribute to increase of carbon sink from the atmosphere. In 1997, the total area of agricultural land of Russia was 699.9 mil. ha. According to estimates made by the Ministry of Agriculture of Russian Federation, about 1 bln t organic and 16.5 bln t mineral fertilizers in active matter should be applied annually to maintain non-deficient humus balance in agricultural lands of the country. In 1996, the President of Russian Federation approved Federal Target Program on Stabilization and Development of Agricultural Production in Russian Federation for 1996-2000. The priority tasks of the Program include struggle against soil degradation and improvement of fertility of agricultural lands. The Program foresees anti-erosion, agroforestry, and land reclamation arrangements that should contribute to carbon accumulation in agricultural soils. Besides, it is intended to introduce highly efficient landscape-based land use technologies that provide resource and energy saving together with environmental safety of cultivated lands.

Thus, national forestry and agricultural sectors have a substantial potential for accumulation of greenhouse gases. Sustainable forest management, reforestation and reconstruction of forests play an important role in national policy on mitigation of unfavorable consequences of climate change and following national commitments within the frames of Kyoto Protocol.

ANNEX

TO COUNTRY SUBMISSIONS ON THE ACTIVITIES WITHIN ARTICLES 3.3 & 3.4 OF KYOTO PROTOCOL PREPARED IN REPONSE TO SBSTA REQUEST

Table I.

The preliminary data and information related to activities within Article 3.3 of Kyoto Protocol

Article 3.3 country specific activity	Definitions used	Accounting framework according to [3]	a_I (10^3 ha)	a_{II} (10^3 ha)	a_{III} (10^3 ha)	Methods and approaches	Data sources, data quality, and uncertainty (e.g. ranges)	Other information relevant to decision-making
Forest restoration activities within inter-inventory period	other (see explanatory text)	Land-based	3199.8	2480.3	1547.9	See explanatory text		

Explanatory text:

Forest restoration activities within inter-inventory period include afforestation and reforestation according to State Forest Inventory data.

The definitions of forest, afforestation and reforestation are given in the main text.

a_I – total area of forest restoration within inter-inventory period by the year 1988.
a_{II} – total area of forest restoration within inter-inventory period by the year of 1993.
a_{III} – total area of forest restoration within inter-inventory period by the year 1998.

Table II.

Preliminary data and information on carbon stocks and area estimates (First sentence of Article 3.4 of Kyoto Protocol)

Land system	Total area (10^6 ha)	Carbon stock in 1990 (Mt C)
Forest lands[1]	1182.6	38600
Arable lands	131.8	NE
Grasslands and pastures	80.1	NE
Others	-	-
Total	1394.5	NE

Explanatory text:

[1] The data on area and carbon stock for forest lands are given for 1988 that is the closest to 1990 year of State Forest Inventory.
NE – not estimated
Areas of arable lands, grasslands, and pastures are given as totals used by different land users involved in agricultural activities.
The data on carbon stocks are taken from the Second National Communication.

PAPER NO. 8: SWITZERLAND

LAND-USE, LAND-USE CHANGE AND FORESTRY UNDER THE KYOTO PROTOCOL

In response to the call at the twelfth session of the SBSTA concerning the methodological issues related to land-use, land-use change and forestry under the Kyoto Protocol, Switzerland presents the following views.

1) Switzerland believes that LULUCF activities are of great importance for the implementation of an effective Kyoto Protocol serving the ultimate goal of the Climate Convention. This is of particular relevance on the way towards ratification of the Kyoto Protocol. In this context, a number of issues should be addressed.

2) The Convention calls for protection and enhancement of sinks (Article 4.1 (d)) given the role of LULUCF activities in the global carbon cycle. In fact, LULUCF activities are important contributions to both sources and sinks of greenhouse gases.

3) The amount of emissions and removals related to LULUCF sources and sinks clearly demonstrates the relevance of LULUCF activities for the climate system, an argument which becomes even more striking when these two domains are compared to the quantitatively smaller magnitude of the Kyoto Protocol commitments. The Special Report of the IPCC on LULUCF has provided evidence for this, not the least by pointing out the relatively large potentials to mitigate greenhouse gases emissions via the LULUCF sector.

4) The Climate Convention calls for making use of a number of appropriate measures to mitigate climate change. These include the protection and enhancement of sinks as well as the reduction of emissions from fossil fuel burning and cement production. On the basis of knowledge gained through the Special Report of the IPCC on LULUCF, the flexibility granted in the Kyoto Protocol by the LULUCF option is well justified as long as comparable standards with respect to quantification and verifiability of effects of measures apply as in other areas. Switzerland expects that any political agreement on sinks will also take into account equity issues.

5) Technical and scientific issues related to LULUCF activities are challenging. Switzerland considers it premature to expect science to deliver quickly robust and sound answers to all questions arising from LULUCF activities. In the long term, Switzerland does view a dominantly land-based full carbon accounting system as technically the most feasible and scientifically promising accounting system for LULUCF activities.

6) Yet, such an accounting system, to be fully acceptable by all Parties, may need some corrections to be agreed upon at the political level. Switzerland considers that some useful suggestions have been pointed out recently at the workshop in Poland. Further exploration of such possibilities will be necessary in the forthcoming negotiations.

7) LULUCF rules and guidelines must take into account concerns expressed with respect to uncertainties, perverse incentives and loopholes. This calls for a well-balanced agreement at COP 6 that does embrace all major human-induced LULUCF activities under Article 3.3 and 3.4. Activities of relevant potential to affect the climate system fall under both articles and may have implications for each other in order to serve the ultimate goal of the Convention.

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 (t C)	a_{II} (ha)	C_{II} (t C)	a_{cp} (ha)	C_{cp} (t C)	Methods and approaches	Data sources, data quality, and uncertainty (e.g. ranges)	Other information relevant to decision-making
Afforestation/ Reforestation	IPCC/ FAO	Activity based	875	7875	1090	1635	2200	16500	Deviated from the number of planted trees	medium to high	3000 planted trees per ha in the average
		Land based	?		?		?				
Deforestation	IPCC/ FAO	Activity based	804	-82812	1255	-129265	3112	-70000	Authorisations by forest agencies	high	Estimation of carbon stock by multiplying the area with the mean biomass stock of Swiss forests
		Land based	804	-82812	1255	-129265	3112	-70000	Authorisations by forest agencies	high	Estimation of carbon stock by multiplying the area with the mean biomass stock of Swiss forests
Afforestation/ Reforestation	Land Use/ Flexible	Activity based	?	?	?	?	?	?			
		Land based	23800	2600000	?	?	?	?	Abandonment of managed land mainly by natural regeneration		The new law on agriculture states that the area of agriculture shall be kept. Therefore no more agricultural land should be converted to forest unless other decisions will be taken
Deforestation	Land Use/ Flexible	Activity based	804	-82812	1255	-129265	3112	-70000	Authorisations by forest agencies	high	Estimation of carbon stock by multiplying the area with the mean biomass stock of Swiss forests
		Land based	804	-82812	1255	-129265	3112	-70000	Authorisations by forest agencies	high	Estimation of carbon stock by multiplying the area with the mean biomass stock of Swiss forests

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 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.
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.
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.

Definitions of forest:
National forest inventory: Crown cover at least 20 %, top height at minimal 3 m and width of the area at least 25 m.
Forest Law: Area at least 200 m^2, width at least 10 m and tress must be 10 years old.

Afforestation is the change from non-forest to forest.
Afforestation and reforestation are not differentiated in the Swiss forest law. Any other use of a forested area, even it is only for a limited time period needs a deforestation authorisation. It has to be cleared whether some deforestation according to the Swiss law are deforestations according to the KP definitions, because they are "reforested" within a few years.
Figures include biomass only.

Comment to the difference in afforestation between IPCC/FAO and Land Use/Flexible Scenario: The difference is due to the area with natural regeneration, which is a generally admitted principle of Swiss forest policy with the goal to get stands with site adapted species composition. The natural regeneration is partly also due to protection works like artificial windbreaks or avalanche protection and can be taken as human induced. The high removal under the flexible or the land use scenario could be interpreted as an argument against these scenarios. But it should be taken into account, that by including areas with natural regeneration the area under control of the Kyoto Protocol could be augmented. It means that emissions at a later stage would be counted as a debit to the assigned amount of a Party at least with a land based approach, which we support. Otherwise neither emissions nor removals would not controlled.
The influence of activity based and land based on deforestation figures seems to be negligible but is not yet assessed on afforestation figures.

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 (t C)***
Forest lands	1'210'000	Biomass:128'615'000 Soil: 110'000'000
Agriculture lands	40'3000	20'093'054
Rangelands/grasslands	1'194'600	108'044'805
Wetland/ tundra	26'000 247'000	? ?
Other stock of wood products (housing, paper ...)		21'500'000
Total (as listed above)	2'717'900	388'252'859

Explanation to forest lands:
Calculation of carbon stock in **forest lands** like in the greenhouse gas inventory:
Data from national forest inventory I (1985) and II (1995)
Expansion factor: 1.45
Weighted average of wood density (dry matter / m^3): 0.4313
Carbon content per dry matter: 0.5
The average change over the years 1990 to 1995 in biomass is +1300 t C per year; this increase may continue the next one or two decades.

Explanation to agriculture and grasslands:
1. Rangelands/Grasslands: permanent grasslands, including 560000 ha alpine grasslands; wetlands cover only a small area and are not included
2. Cropland and rangeland/grassland: only soil carbon stocks 0 to 20 cm; biomass stocks are not included
3. Swiss Federal Statistical Office (area); Federal and Cantonal soil survey programmes (SOC and bulk densities)
4. SOC contents and soil bulk density measured by Federal and Cantonal soil surveys
   Means of bulk densities and carbon contents were used to assess the C storage in each land system
   Agriculture and rangeland/grassland are partitioned into subunits, table II gives the weighted means of these subunits
5. There is no estimate for changes in C stock available at the moment
6. For SOC and for bulk densities, only a limited data base is currently available

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)	$CO_{2, I}$ (1000 t CO_2)*	$CH_{4, I}$ (t CO_2 equiv.)*[ß]	$N_2O_{, I}$ (t CO_2 equiv.)*[ß]	a_{II} (1000 ha)	$CO_{2, II}$ (1000 t CO_2)*	$CH_{4, II}$ (t CO_2 equiv.)*[ß]	$N_2O_{, II}$ (t CO_2 equiv.)*[ß]	a_{cp} (1000 ha)	C_{cp} (1000 t C)	$CO_{2, cp}$ (1000 t CO_2)*	$CH_{4, cp}$ (t CO_2 equiv.)*[ß]	$N_2O_{, cp}$ (t CO_2 equiv.)*[ß]	Methods and approaches	Data sources, data quality, and uncertainties (e.g. ranges)	Other information relevant to decision-making
Activity 1: Establishment of carbon forests and forest reserves to increase carbon stock	Land based	12.4	790			12.4	1185			100	1450	5316			Estimation of possible area in CP multiplied by average growth of Swiss forests	medium	This is only an indicative figure on a possible action and its effect; no decision has been taken so far
	Activity based	12.4	?			12.4	?			100	?	?					Sequestration is assessed by measuring stock changes, activity based data have not yet been assessed
Activity 2: Cropland management	Land based	1.02	2.56			4.0	13.95			19	28.7	105.3			See Pt. 1c	See Pt. 3a-d	
	Activity based																
Activity 3: Cropland conversion to grassland	Land based	2.88	11.13			8.63	33.97			10.67	25.94	95.18			See Pt. 1c	See Pt. 3a-d	
	Activity based																
Activity 4: Grassland management	Land based	55.58	?			80.34	?			100	?	?			See Pt. 1c	See Pt. 3a-d	
	Activity based																

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.
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 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.
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); b) How the estimates were computed; c) Other.

Explanation to activities 2 to 4:

1. Activities and Accounting

Activities included here are realized in the framework of the Swiss Agricultural Policy 2002 (AP 2002). They form the main part of the programme on ecological compensation.
Since 1993, this programme is encouraged by financial incentives (direct payments to the provision of required standards).

1a. Activity 2: Key practice is conservation tillage; Activity 3: Key practice is conversion of cropland to grassland; Activity 4: Management change from intensive hay/pasture to extensively managed, low input grassland.
Area: Activity 2: Area data for 1999; Activities 3 and 4: area data for 1998 (data for 1999 not available yet)
1b. Activities belong to the broad categories cropland/grassland management and cropland conversion
1c. Changes in C-stocks were calculated using the area and rates of annual C-gain

2. Carbon pools included

For cropland and rangeland/grassland: calculated for soil organic carbon 0 to 20 cm. Above-ground biomass is not included.

3. Methodologies and Data

3a. Area data: Swiss Federal Statistical Office, Swiss Federal Office for Agriculture, Swiss No-till Association. Soil carbon data: Federal and Cantonal soil survey programmes
3b. Soil samples were taken either as intact soil cores with a soil augur or with soil drills

3c. Rates of C gain: 0.34 t C ha^{-1} a^{-1} for no-till; 0.5 t C ha^{-1} a^{-1} for cropland conversion (source: IPCC special report on LULUCF, 2000);
Activity 4: Values for set-aside programmes (see IPCC special report LULUCF, 2000) not applicable, and realistic values not available yet.
3d. Rates of C gain as proposed by IPCC (Special Report LULUCF, 2000) may not be applicable under Swiss conditions; own data are not available yet, but research is in progress.

4. Treatment of Non-CO_2 Greenhouse Gases

N_2O is expected to remain at the 1990 level (no-till), or to decrease for areas under Activities 2-3 proportional to the decrease in fertilizer application rate; quantification of these low rates is not possible.
CH_4: Grasslands and cropslands are generally rather sinks than sources. It is estimated, that effects of Activities 1 to 2 will be neglectable, and that Activity 3 will increase the sink strength.

5. Key assumption in projections

The increase in the areas corresponding to Activities 1 and 2 until the first commitment period are preliminary estimates with high uncertainty.
For no-till, an annual increase of 1000 ha until 2012 and for conversion of cropland to grassland an annual increase of 140 ha until 2012 is assumed.
Both estimates can be considered conservative and are below the current annual increase in area corresponding to each activity.
For Activity 4, the projection is made on the basis of an estimated total area of 110000 ha for Activity 3 plus Activity 4 .

Additional note

In addition to Activity 2 - 4, biological farming could be considered an Activity, but the effect on C sequestration is yet unknown and need further clarification.

PAPER NO. 9: UNITED STATES OF AMERICA

LAND-USE, LAND-USE CHANGE AND FORESTRY

Outline

I. Executive Summary

The United States believes carbon sinks can play an important role in meeting the challenge of climate change. The United States has long supported a comprehensive approach to emissions and removals of greenhouse gases related to land-use, land-use change and forestry (LULUCF) and proposes adoption of such an approach pursuant to Article 3.4. The United States believes that a comprehensive approach would best account for the full range of natural and human activities that could affect the global climate system.

The United States strongly believes that the COP-6 decision on LULUCF must be considered as a package. As the IPCC Special Report recognizes, Article 3.3 addresses only a very limited subset of LULUCF activities, and therefore inevitably leads to discrepancies between actual and accounted changes in carbon stocks. To remedy these inadequacies, the United States proposes that LULUCF activities be included in a comprehensive manner pursuant to Article 3.4. This will further the objective of the UNFCCC, namely to stabilize atmospheric concentrations of greenhouse gases at safe levels, by taking into account the entire contribution – both positive and negative – of LULUCF to climate change. It is also consistent with the nature of the agreement struck at Kyoto, which was intended to include LULUCF in a manner that would result in significant additions in the first commitment period to the assigned amount of countries that are sequestering large amounts of carbon (including the United States). Indeed, the United States agreed to the target set forth in Annex B of the Protocol, in part, on the expectation of significant credits from LULUCF.

The United States proposes the inclusion of three broad land management activities pursuant to Article 3.4:

- Forest management
- Cropland management
- Grazing land management.

These activities include the large majority of specific land management practices that store and release carbon in the United States.[1]

To account for greenhouse gas emissions and removals associated with these management activities, the United States proposes a land-based accounting system, focusing on the changes in carbon stocks on managed lands during the commitment period. The United States believes that it has the capability to provide high-quality data to implement a broad-activity/land-based accounting system, and that, prior to the beginning of the first commitment period, other Annex I Parties should also be able to do so. Parties should report other greenhouse gas emissions related to LULUCF in their inventories in accordance with agreed methodologies.

Benefits of the comprehensive approach proposed by the United States include the following:

- <u>Comprehensive accounting provides the greatest long-term incentive to protect existing carbon reservoirs, increase carbon removals, and reduce greenhouse gas emissions through better land management practices.</u> For example, the U.S. approach would discourage the conversion of primary or maturing secondary native forest to industrial timberland, since it would fully account for the emissions both at the time of the loss of native forest cover and thereafter (resulting from decaying

[1] It may be desirable to include other activities in order to account fully for anthropogenic emissions and removals associated with LULUCF in other Parties. These activities do not include urban lands.

harvest slash and soil disturbances). In this way, comprehensive accounting would provide new incentives to protect carbon reservoirs, particularly those in mature forests.

- Comprehensive accounting best reflects "what the atmosphere sees," that is, the actual exchanges of carbon between the atmosphere and terrestrial biosphere – in contrast to the limited scope of Article 3.3.

- Comprehensive accounting prevents Parties from picking and choosing only those activities that remove carbon and reduce greenhouse gas emissions, while ignoring other activities that emit carbon.

- Comprehensive, land-based carbon accounting is easier to monitor and verify than activity-based accounting, and allows Parties to use existing data bases and methods. For example, when multiple practices are used on the same land base during a commitment period, it may be impossible to separate out the effects of each practice. Moreover, existing data – especially for forests – may not identify lands by individual management practice, making it difficult to determine which lands would be included under a narrow practices-based approach.

- Inclusion of broadly-defined activities allows flexibility. Parties may use whatever practices or technologies are most appropriate for their particular circumstances, rather than focusing only on particular types of practices or technologies.

- The comprehensive approach provides incentives to develop new land management practices and technologies and apply them cost-effectively.

- Comprehensive accounting minimizes leakage and double counting.

- Comprehensive accounting addresses many of the accounting problems identified by the IPCC Special Report in connection with Article 3.3 activities. For example, the comprehensive approach accounts for aggradation and degradation of existing forests, and avoids the problems of determining exactly when deforestation occurs.

- LULUCF activities provide substantial "co-benefits," since practices that enhance carbon also tend to improve air, soil, and water quality, maintain biodiversity in forests, and provide socioeconomic benefits. These co-benefits are often larger than the climate benefits of improved land management practices.

In contrast, a narrow, practices-based approach would:

- Capture only selected activities and greenhouse gas fluxes.
- Not provide incentives with regard to excluded activities, some of which may be very important for those activities that remove carbon, reduce GHG emissions, or protect carbon reservoirs.
- Make monitoring and tracking individual activities more difficult and costly, since most land managers implement a suite of practices simultaneously.
- Introduce uncertainty into accounting.

Because the land management activities proposed by the United States are ongoing, and therefore have occurred since 1990, Parties could choose to count them in the first commitment period pursuant to Article 3.4. During the first commitment period, the United States projects that forest, cropland and grazing land management would result in average net removals of between 260 and 360 million metric tons of carbon equivalent (MMTCE) per year, with a central estimate of about 310 MMTCE per year.

Given concerns about the impact of additional LULUCF activities on the first commitment period targets of Annex I Parties, the United States is prepared to consider a phase-in for the first budget period, under which the positive net LULUCF removals of Annex I Parties would be reduced for purposes of first commitment period accounting. Possible approaches to the phase-in include allowing countries to count net removals above a pre-determined threshold, or discounting positive net removals by a certain percentage. The exact modalities of the phase-in will require further discussion and elaboration prior to COP-6.

With respect to Article 3.3, the United States proposes using the IPCC definitions of afforestation and deforestation, which focus on long-term changes in land use, into and out of forest use. In addition, within the context of the comprehensive approach described above, the United States is prepared to accept the IPCC definition of reforestation, which is essentially the same as the definition of afforestation. The United States notes that, under the IPCC definition of reforestation, the United States would likely experience a small net reduction in its assigned amount under Article 3.3, in contrast to other definitions and accounting approaches that would provide the United States with significant additions to its assigned amount. This result is at sharp variance with the basic Kyoto bargain, as the United States understood it, and with the fact that U.S. managed lands as a whole remove large amounts of carbon from the atmosphere. Accordingly, while the United States is prepared to accept the IPCC definition of reforestation, it is acceptable only if forest management is included in the Protocol in a comprehensive manner in the first commitment period pursuant to Article 3.4, so that emissions and removals from managed forests are counted in a comprehensive and symmetric manner, and so that Annex I Parties whose managed lands as a whole are sequestering carbon receive significant additions to their assigned amounts.

In connection with both Articles 3.3 and 3.4, the United States proposes using the FAO definition of “forest,” which is widely used internationally, while giving Parties some flexibility to adapt this definition to take account of their particular circumstances and existing data collection systems.

General accounting approaches proposed by the United States include the following:

- Carbon stock changes on lands under Articles 3.3 and 3.4 should be accounted for identically. Parties should use a single, coherent accounting system for both articles in order to prevent gaps or double counting.
- Land that comes into the system under Articles 3.3 and 3.4 should remain in the overall LULUCF accounting system as long as there is a chance of any significant changes in carbon stocks. Emissions and removals should be counted in the commitment period in which they occur.
- Accounting procedures should follow applicable IPCC Good Practice Guidance.
- Carbon pools should include: live biomass including roots; litter; organic soil carbon to a depth appropriate to the land use; logging residue; carbon in harvested biomass products and landfills; and carbon in dead wood.

In implementing Articles 3.3 and 3.4, Parties should, to the extent possible, take into account ancillary environmental effects, including effects on biodiversity; soil, air and water quality; the capacity of ecosystems to adapt to climate change; risks of land degradation; long-term vulnerability to disturbance by fire, pests and invasive species; and the protection of primary native and maturing secondary native forests.

Finally, the United States strongly supports the inclusion of LULUCF projects in the Clean Development Mechanism under Article 12. Such projects, properly designed and implemented, can both contribute to the sustainable development goals of their host countries and help Annex I Parties cost-effectively meet their commitments under the Kyoto Protocol.

II. Introduction

- The United States welcomes this opportunity to submit views, data, and textual proposals for elements of the COP-6 decision on land use, land use change and forestry (LULUCF). This submission addresses definitions and accounting for afforestation, reforestation, and deforestation under Article 3.3 and additional activities under Article 3.4, as well as accounting approaches under Article 3.7. It also examines inter-linkages between Articles 3.3, 3.4 and 3.7 and other relevant articles of the Kyoto Protocol.

- The submission contains data tables and accompanying explanatory text for preliminary U.S. country-specific data (see Section VII). The data and explanatory material are consistent with the formats developed by SBSTA at its twelfth session (FCCC/SBSTA/2000/CRP.2).

- The submission contains textual proposals for the elements of a COP-6 decision regarding LULUCF (see Section VIII). The structure of the proposed text is consistent with the structure for the synthesis of textual proposals developed by SBSTA at its twelfth session (FCCC/SBSTA/2000/CRP.2).

- In working toward the adoption of the COP-6 decision on LULUCF, Parties should give priority to the critical elements of the decision, including, inter alia, basic definitional approaches to afforestation, reforestation, and deforestation under Article 3.3 and the inclusion of additional activities under Article 3.4. The Parties should consider whether any of the more technical issues could appropriately be decided at a later time.

- The United States notes its support for the inclusion of LULUCF projects in the Clean Development Mechanism under Article 12. Such projects, properly designed and implemented, can both contribute to the sustainable development goals of their host countries and help Annex I Parties cost-effectively achieve their commitments under the Kyoto Protocol.

- The United States stresses the critical importance of considering the COP-6 decision on LULUCF as a unified package. As the IPCC Special Report on LULUCF recognizes, Article 3.3 addresses only a limited subset of the forest activities that affect carbon stocks, and therefore inevitably leads to discrepancies between actual and accounted changes in carbon stocks in managed forests during the commitment period. The United States strongly believes that Article 3.4 can and should be used to address these environmentally-unsound limitations in coverage by including LULUCF activities in a more comprehensive manner. This will further the ultimate objective of the UNFCCC, namely to stabilize atmospheric concentrations of greenhouse gases at safe levels, by taking into account the entire contribution – both positive and negative – of LULUCF to climate change.

A. Background

Land use trends in the United States

The total land area of the United States has remained constant since 1949 at about 900 million hectares. In 1992 the major uses of land in the entire United States were:

- Cropland, 186 million hectares (20 percent of the land area);
- Grassland pasture and range, 239 million hectares (26 percent);

- Forest-use land, 262 million hectares (29 percent) (excludes forested areas in parks, wilderness, wildlife reserves and other special uses)
    - Of the forest-use land, about 200 million hectares is managed forest, and the remainder is not suitable or available for timber production;
- Parks, recreation, wilderness, and wildlife areas (includes the forested areas in these special uses), 93 million hectares (10 percent);
- Urban land, 24 million hectares (3 percent); and
- Miscellaneous other land, 90 million hectares (10 percent) (includes deserts, wetlands, and barren land).

The various land uses in the United States have been relatively stable since 1949. For example:

- From 1949 to 1992, cropland has remained about 20 percent of the total U.S. land area.

- From 1960 to 1990, U.S. forest area declined slightly, but over the longer term the area of forest has been relatively stable. Losses of forest to urban development and other land uses have been offset by afforestation and natural reversion of abandoned crop and pastureland to forest.

- U.S. land area devoted to recreation and wildlife areas has increased over ten-fold since 1949.

- In response to U.S. population growth, urban land in 1992 was three percent of U.S. land area, up from 1 percent in 1949. As urbanization continues to spread into less developed areas, a greater proportion of natural resources will become part of urban ecosystems. For the foreseeable future, however, the vast majority of land in the United States will continue to be used for agricultural (i.e., crop and grazing) and forestry purposes.

- Of all land uses, grasslands have exhibited the largest decline over time, falling by about 10 percent from 1945 to 1992. One reason for this decline is that farmers, with government assistance, have improved the forage quality and productivity of grazing lands, which has meant that less grazing land is required.

- The relatively large land base in the United States suggests that there are potentially many options to improve land management practices and cost-effectively mitigate greenhouse gas emissions through enhanced carbon removals. The ancillary environmental benefits of improved land management practices - including improved soil, water, and air quality - may add significantly to their overall cost-effectiveness. Properly managing these lands is also critical for the long-term sustainability of food, fiber, and timber production.

B. Advantages of a broad and comprehensive approach

- The United States believes that the best long run approach to accounting for LULUCF activities under the Kyoto Protocol is full GHG accounting on all managed lands.

- Including broad activities (the United States proposes forest management, cropland management, and grazing land management), together with a land-based accounting approach, would be the most rigorous and scientifically-credible way to provide for comprehensive GHG accounting. A broad and comprehensive approach would:

    Provide the best long-term approach. A broad and comprehensive approach is most consistent with the objective and principles of the Convention and its Kyoto Protocol. (See Section IV(E) below for details.) This approach would bring managed lands into the accounting system by the first or second commitment periods without uncertainty or delay.

Reflect carbon exchanges between the atmosphere and the terrestrial biosphere that are ignored by the limited scope of Article 3.3. For example, a broad approach would capture carbon stock changes in forests that are degrading (e.g., from 70% canopy cover to 30% cover) but are not yet deforested, or that are growing and storing additional carbon.

Prevent biased selection of activities. Defining activities broadly would prevent Parties from selecting only those activities that sequester carbon or reduce net GHG emissions. If land management results in net emissions, those would be counted.

Provide incentives to protect carbon reservoirs. A broad approach combined with land-based accounting would account for emissions resulting from reductions in carbon reservoirs, such as could occur from the harvest or human-induced disturbance of primary native forests, maturing secondary native forests and other ecosystems. A broad and comprehensive approach to cropland would also provide incentives to maintain soil carbon stocks by continuing to apply sound management practices, even if those practices were adopted before 1990. In contrast, a limited approach that leaves out the harvest-regeneration cycle and agricultural soils may provide no new incentives to protect existing carbon reservoirs.

Improve measurement and monitoring. In many cases, a broad activity/land-based accounting approach could reduce measurement problems. For example, when multiple practices are used on the same land base during a commitment period, it may be impossible to separate out the effects of each practice. Land-based accounting could also rely more on direct and estimated measurements rather than default values, leading to more accurate accounting of exchanges with the atmosphere.

Create balanced accounting results. A broad and comprehensive approach would count emissions and removals symmetrically over the managed land base over time. The system would keep track of land as it moves through different uses. A narrow approach could exclude land that is more likely to produce emissions or include land that is more likely to produce removals, leading to a biased selection of lands for the accounting system. Under a narrow approach, land could leave or enter the system according to what practices are applied, which could also lead to a discrepancy between LULUCF accounts and exchanges with the atmosphere.

Better allow for appropriate technologies for the differing resource conditions across Parties so as not to inadvertently exclude beneficial practices. Given the wide variation in natural resource bases and practices available across Parties and over time, it will be very difficult to identify now the best set of practices for each Party between 2008 to 2012. Defining activities broadly avoids the need to identify specific land use management practices or to develop a common definition across Parties for agreed-upon practices. For example, if Parties agree to include cropland management, there would be no need to develop a universally-agreed upon definition of conservation tillage because reductions and emissions associated with all tillage types would be counted.

Provide incentives to develop new practices and apply them most cost-effectively. A broad approach, not limited to specified practices, would provide incentives to develop technologies that reduce net GHG from land management activities. Parties would be able to undertake these reductions where mitigation is most cost effective and/or where ancillary benefits can be maximized.

Minimize leakage and double counting. A broad and comprehensive approach would provide for wide inclusion of possible sources of LULUCF emissions, ensuring that if an activity results in the transfer of emissions from one location to another within a Party's borders, then those emissions would be counted. A single coherent system that properly tracks land across different uses would also help ensure that LULUCF activity accounts do not overlap and therefore that the same carbon stock changes are not counted twice.

Better use existing data. Countries such as the United States have existing LULUCF data on carbon emissions and removals that provide good comprehensive climate-relevant information but cannot identify the lands on which particular practices have occurred over the past. A broad and comprehensive approach would allow these Parties to apply their existing data collection systems in measuring and monitoring LULUCF activities under the Protocol.

Address many of the problems created by the limited scope of Article 3.3, even for the accounting of deforestation. For example, limiting the Kyoto Protocol accounting system to long-term changes in land use could make it difficult to ascertain and account for deforestation in the commitment period in which it occurs. To account for the full carbon loss from deforestation, one would have to look back over previous periods to account for any degradation that eventually led to deforestation. A broad approach would fully account for emissions from forest degradation as they occur.

- Given the clear benefits of comprehensive carbon accounting, the United States proposes (a) including broad activities under Article 3.4 and (b) using a land-based approach to account for GHG emissions and removals related to these broad activities.

- Although comprehensive greenhouse gas accounting is the most scientifically and environmentally sound approach for the long-term, the United States recognizes the policy issues that arise from adopting a broad approach in the first commitment period, particularly with regard to first commitment period targets. We are committed to seeking solutions as to how to initiate a broad approach in the first budget period, and set forth preliminary views on this issue below in Section VI.

III. Proposed definitions and accounting approaches related to afforestation, reforestation, and deforestation under Article 3.3

A. Afforestation and deforestation

Regarding the definitions of afforestation and deforestation, the United States proposes the following:

- Afforestation and deforestation should be defined as long-term changes in land use. *(See paragraphs 1(b) and 1(c) of decision text in Section VIII)*:

  Afforestation means the direct human-induced conversion of land to forest that has not historically been forest.

  Deforestation means the direct human-induced conversion of forest to land that is not forest.

United States views on general accounting procedures for lands under Article 3.3 and 3.4 are included below in Section VI. Regarding the specific definitions and accounting rules for afforestation and deforestation, the United States proposes the following:

- A definition of "forest" that is consistent with the FAO definition of forest should be included in the COP-6 decision. Some limited discretion regarding the canopy cover threshold and minimum area size is appropriate. Parties should be required to choose specific values in advance of the first commitment period. *(See paragraphs 1(a) and 2 of decision text in Section VIII)*

- A Party's definition of "forest" should be used to identify lands subject to afforestation, reforestation, and deforestation since 1990 for purposes of accounting under Article 3.3. The definition of "forest" used by a Party must be applied consistently over time, and a Party should use the same definition of forest when accounting for afforestation, reforestation, and deforestation. This view is reflected in our proposed decision text in two ways. First, each Party may elect only one definition of forest. Second, Article 3.3 activities are defined simply as conversions between land that is forest and land that is not forest. See discussion of reforestation below. *(See paragraph 1(e) of decision text in Section VIII)*

- The (re)establishment of forests through natural means should be considered a form of afforestation or reforestation.

- The United States recognizes that a land-use change approach to Article 3.3 activities, as opposed to approaches involving aggradation and degradation, may leave important anthropogenic emissions and removals unaccounted for. In our view, this is a strong argument for more comprehensive accounting under Article 3.4 through the inclusion of broad activities such as forest management, which would account for changes in carbon stocks as a result of aggradation and degradation. In addition, the United States believes the issue of forest definitions would be greatly simplified under a comprehensive approach that includes forest, cropland, and grazing land management, which would require that broad categories of managed lands are accounted for whether or not they meet a particular definition of forest.

The U.S. approach to defining forest

- The U.S definition of forest combines both vegetation and administrative aspects and is the FAO definition of forest with slight modifications. The definition the United States uses for its data is:

  > Land with tree crowns (or equivalent stocking) of more than 10 percent and area of more than 0.37 ha (1 acre). The trees should be able to reach a minimum height of 5 meters (16 feet) at maturity *in situ*. Stands may consist of either closed forest formations where trees of various stories and undergrowth cover a high proportion of the ground, or open forest formations with a continuous vegetation cover in which tree crown cover exceeds 10 percent and is not currently developed for nonforest use. 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 5 meters (16 feet) are included under forest, as are areas normally forming part of the forest which are temporarily non-stocked as a result of human intervention or natural causes but which are expected to revert to forest.

- The U.S. forest definition includes: forest nurseries and seed orchards that constitute an integral part of the forest; forest roads and trails (if less than 36 meters or 120 feet wide); cleared tracts; firebreaks; and reserves and other protected areas such as those of special environmental, scientific, historical, cultural, or spiritual interest; roadside, streamside, windbreak, and shelterbelt strips of trees with an area of more than 0.4 ha (1 acre) and a width of more than 36 meters (120 feet). Rubber plantations and cork oak stands are included. Lands predominantly used for agricultural purposes are excluded. However, marginal agricultural lands that are forested are included. Lands in the Conservation

Reserve Program (a set-aside program) that are planted to trees are considered forest rather than cropland.

Detecting and accounting for deforestation

- When a forest area is harvested, it may not be immediately obvious whether a long-term land-use change has occurred or whether the land is in the process of being replanted/regenerated. As the IPCC Special Report points out in Section 2.2.3.3, deforestation may not be confirmed until some years after the clearing – possibly not until the following commitment period.

- This difficulty can be fully addressed by including the broad activity of forest management under Article 3.4. Under this approach, reductions of carbon stock on managed forests would be accounted for during the commitment period in which they occur, whether or not the stock losses would qualify as "deforestation" under Article 3.3.

- If forest management is not included under Article 3.4, then not all emissions from harvest would be accounted for and the actual and accounted carbon stock changes on land cleared during the commitment period could differ.

B. Reforestation

- The IPCC Special Report on Land Use, Land Use Change and Forestry features several definitions of the term "reforestation", including one based on the 1996 IPPC Reporting Guidelines. Under this "IPCC definition," reforestation is defined in terms of land-use change. As discussed below, the United States can support a definition of reforestation as a long-term change in land use. *(See paragraph 1(d) of decision text in Section VIII)*

  "Reforestation" means the direct human-induced conversion of land to forest that has historically been forest but has been converted to land that is not forest.

- In elaborating Articles 3.3 and 3.4, the United States believes that it is essential to recognize the nature of the bargain that was struck at Kyoto. The United States negotiated for the inclusion of LULUCF in the Kyoto Protocol in a manner that would result in significant additions to the U.S. assigned amount in the first commitment period. Indeed, the agreement of the United States to take on the target it accepted in the Protocol was premised, in part, on the inclusion of LULUCF in the Protocol in just such a manner.[2]

- If the IPCC definition of reforestation were applied under Article 3.3, and no additional activities were included under Article 3.4, the United States would likely experience a *reduction* in its assigned amount from LULUCF of between 16 and 0 MMTCE in the first commitment period – a result at sharp variance with the basic Kyoto bargain, as the United States understood it, and in conflict with the fact that the managed lands of the United States as a whole remove large amounts of carbon from the atmosphere.

- Nevertheless, the United States believes that the IPCC approach has several important strengths and is prepared to support its application under Article 3.3. These strengths include:

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[2] For example, the U.S. projects that an approach to reforestation such as FAO land-based II would result in additions to its assigned amount of between 66 and 102 MMTCE per year during the first commitment period. See Table A below for information about other scenarios.

  - It clearly separates land-use changes into and out of forest use from other activities that affect emissions and removals from forests.

  - Combined with a land-based accounting system, it should accurately reflect, for land undergoing a land-use change related to forest, exchanges of greenhouse gases between the converted forest (including its above- and below-ground biomass, soils, and products) and the atmosphere.

  - It provides consistent incentives for Annex I Parties to reduce deforestation and promote afforestation and reforestation to mitigate climate change.

- However, the IPCC definition of reforestation leaves the vast majority of anthropogenic emissions and removals of greenhouse gases from forestry activities unaccounted for. Under the IPCC definition, only about 13% of U.S. managed forests would be included in the Kyoto Protocol accounting system under Article 3.3.

- Accordingly, based both on the negotiating history of the Protocol and on sound science, it is the emphatic view of the United States that, while the IPCC approach to Article 3.3 is appropriate, this is acceptable only if forest management is included in the Protocol in a comprehensive manner in the first commitment period pursuant to Article 3.4. As outlined in Section IV below, the United States strongly supports an approach to Article 3.4 of the Protocol that would count both emissions and removals associated with forest, cropland and grazing land management in a comprehensive and symmetric manner, and would give Annex I Parties whose managed lands as a whole are removing carbon from the atmosphere significant additions to their assigned amount for these removals, as intended under the Kyoto Protocol.

C. Afforestation, reforestation, and deforestation: Implications for the United States

- As reflected in Table A below, the United States projects that the contribution of afforestation (and reforestation under an IPCC definitional approach) to our assigned amount, assuming business as usual (BAU), would be about 26 to 54 MMTCE per year during the first commitment period. The BAU projections are slightly higher for subsequent commitment periods, although later projections are more uncertain.

- Assuming business-as-usual, the United States projects that lands deforested since 1990 will produce net emissions of 33 to 61 MMTCE per year during the first commitment period. The BAU projections for deforestation emissions are slightly lower for subsequent commitment periods, although later projections are more uncertain.

Table A:
Estimated U.S. Emissions and Removals from Afforestation, Reforestation, and Deforestation since 1990, assuming Business-as-Usual

Reference case: Estimated net carbon stock change for all U.S. managed forests, average annual MMTCE	**1997**	**2008-2012**	**2013-2017**	**2018-2022**
	(278) 310 (341)	(245) 288 (331)	(230) 277 (324)	(211) 263 (316)

Scenario 1. IPCC definition of reforestation	Estimated Annual MMTCE Carbon Sequestration (+) or Emissions (-) during the budget period (BAU Case) for the U.S.		
	2008-2012	2013-2017	2018-2022
Afforestation/ Reforestation	(26) 40 (54)	(29) 45 (61)	(30) 48 (66)
Deforestation	(-61) -47 (-33)	(-54) -39 (-24)	(-49) -31 (-13)
Total of ARD	(-16) -7 (0)	(-7) 6 (13)	(3) 17 (31)

Scenario 2. FAO definition of reforestation (Land-based I accounting)	Estimated Annual MMTCE Carbon Sequestration (+) or Emissions (-) during the budget period (BAU Case) for the U.S.		
	2008-2012	2013-2017	2018-2022
-- Reforestation accounting includes carbon stock changes on regenerated harvested forest lands; Counts carbon stock changes from beginning to end of period, so includes losses resulting from the harvest that precedes regeneration.			
Afforestation	(26) 40 (54)	(29) 45 (61)	(30) 48 (66)
Reforestation	(-16) -7 (0)	(14) 32 (50)	(48) 68 (88)
Deforestation	(-61) -47 (-33)	(-54) -39 (-24)	(-49) -31 (-13)
Total of ARD	(-25) -14 (-3)	(23) 38 (53)	(65) 85 (105)

Scenario 3. **FAO definition of reforestation** **(Land-based II accounting)**	Estimated Annual MMTCE Carbon Sequestration (+) or Emissions (-) during the budget period (BAU Case) for the U.S.		
	2008-2012	2013-2017	2018-2022
-- Reforestation accounting includes carbon stock changes on regenerated harvested forest lands; excludes carbon emitted at the time of the first harvest since 1990.			
Afforestation	(26) 40 (54)	(29) 45 (61)	(30) 48 (66)
Reforestation	(73) 91 (109)	(106) 129 (152)	(137) 163 (189)
Deforestation	(-61) -47 (-33)	(-54) -39 (-24)	(-49) -31 (-13)
Total of ARD	(66) 84 (102)	(111) 135 (159)	(151) 180 (209)

Scenario 4. **FAO definition of reforestation** **(Activity-based accounting)**	Estimated Annual MMTCE Carbon Sequestration (+) or Emissions (-) during the budget period (BAU Case) for the U.S.		
	2008-2012	2013-2017	2018-2022
-- Reforestation accounting includes carbon stock changes on regenerated harvested forest lands; excludes carbon emitted at the time of the first harvest since 1990.			
Afforestation	(26) 40 (54)	(29) 45 (61)	(30) 48 (66)
Reforestation	(144) 168 (192)	(176) 207 (238)	(203) 242 (281)
Deforestation	(-61) -47 (-33)	(-54) -39 (-24)	(-49) -31 (-13)
Total of ARD	(137) 161 (185)	(181) 213 (245)	(218) 259 (300)

Table A Notes:

1. These estimates are preliminary. See the explanatory text that accompanies Table I (in Section VII of this submission) for a discussion of these and other country-specific data and information relating to afforestation, deforestation, and reforestation.
2. Afforestation and deforestation are defined as changes in land use to and from forest, respectively (as opposed to using a degradation/aggradation approach, for example).
3. Data include the following carbon pools: above ground, litter, soils, woody debris, and harvest wood in products and landfills.
4. Under the accounting approach used in Table A, the FAO land-based II and activity-based approaches to reforestation would include carbon sequestered during the regrowth of forests regenerated since 1990, but would not account for the emissions from the initial harvesting that put the land into the set of lands under Article 3.3. Emissions from all harvests that occur after the first regrowth are counted.

5. For harvests that count (deforestation and, for FAO land-based II, the harvests after the first regeneration since 1990), the accounting approach accounts for the carbon that goes into harvested wood products and landfills.
6. Uncertainty analysis was used in developing the ranges in Table A. Numbers in parentheses represent lower and upper bounds of an 80% confidence interval. The middle numbers are the estimates of central tendency. The ranges for the totals for afforestation, reforestation, and deforestation are determined using appropriate statistical methods, rather than by simply adding the ranges for the individual activities.

IV. How and which additional human-induced activities should be included under Article 3.4, including modalities, rules, and guidelines related to these activities and their accounting

- The United States strongly supports including broad land management activities under Article 3.4. These land management activities are ongoing, and therefore have occurred since 1990, allowing their inclusion in the first commitment period. The United States proposal includes the following specific human-induced activities. *(See paragraph 3(a) of decision text in Section VIII)*

    1. Forest management
    2. Cropland management
    3. Grazing land management

- The human-induced activities of forest, cropland, and grazing land management cover the U.S. landscape of managed and vegetated lands. Land with a minimal amount of management (e.g. wilderness areas) should be excluded from accounting under Article 3.3 and 3.4, and the United States has taken this approach in the preparation of its data for Section VII.

- If other activities are necessary to account for anthropogenic emissions and removals from LULUCF, it may be desirable to include them under Article 3.4 along with the three broad activities the United States proposes. We welcome discussion regarding which other additional activities should be included.

- The United States proposes a land-based accounting system for lands under Articles 3.3 and 3.4. This accounting system should focus on changes in carbon stocks from the beginning of the activity or the beginning of the commitment period, whichever is later, to the end of the commitment period. Accounting should also account for emissions of other greenhouse gases during the commitment period to the extent that these can be estimated and verified. *(See paragraph 5 of decision text in Section VIII)*

- Each of these human-induced activities (forest, cropland, and grazing land management) refers to a combination of land management and land use alternatives that can be described along a continuum that ranges from low intensity to high intensity. Practices that are applied in combination increase the overall management intensity to a level above that of an individual practice.

A. Forest management

- Forest management is an activity involving the regeneration, tending, protection, harvest, access and utilization of forest resources to meet goals defined by the forest landowner. The goals can focus on one or more outcomes and outputs.

- For the purposes of accounting GHG emissions and removals, "managed forests" are defined in the U.S. database as forest lands that are capable of producing at least 1.4 $m^3ha^{-1}yr^{-1}$ of industrial wood under natural conditions and which are not reserved for purposes other than timber production. Managed forests include industrial timberland, but do not include parks, wilderness, recreation areas, wildlife preserves, or other forests that are inaccessible, low productivity, or otherwise not available or appropriate for wood production. For example, lands under Article 3.4 would not include the vast majority of Alaskan forests. The data provided in Section VII reflects this proposed approach as closely as possible. [3]

- The United States has about 200 million hectares of managed forest (see Table I in Section VII). We strongly believe that carbon emissions and removals in managed forests should be included under Article 3.4.

- A large variety of specific practices may be involved in forest management:

  Regeneration can involve either natural means, taking advantage of existing seed source or coppice material, or artificial means, using planting stock or direct seeding.

  Tending involves the manipulation of forest vegetation to meet product, species composition, habitat quality, and fire, insect and disease protection goals.

  Harvest systems that are efficient in material collection and delivery as well as resource conservation are a crucial part of forest management.

  Utilization involves the processing of raw material into a variety of products. Utilization encompasses the amount of biomass (carbon) that is removed from the forest system and the mix of products into which the biomass goes.

- Conservation of soil, water, vegetation, wildlife, carbon and nutrient resources is an integral part of each step in the process. Carbon sequestration can be one of the benefits of management, and the removal potential differs depending on the suite of management practices chosen.

<u>Net carbon removals from U.S. managed forests</u>

- As of 1997, managed forests in the United States removed between 278 and 341 MMTCE per year, with an estimate of central tendency of 310 MMTCE per year. During 2008 to 2012, managed forests are projected to remove (on net) between 245 and 331 MMTCE per year on average, with an estimate of central tendency of 288 MMTCE per year. See the explanatory text for Table III in Section VII for more information about these estimates.

- Much of the U.S. managed forest carbon uptake occurs in the Southeastern, Pacific Northwest, and Northeastern regions. The removals derive from a number of interacting factors, including growth and harvest rates, management regimes, forest type, forest age, and historic land use patterns. These factors vary within and across regions of the United States

[3] Alaska contains about 3% of U.S. managed forests, and those limited areas would be included under this proposal for forest management. Managed Alaskan forests represent only 1% of the U.S. forest area that is harvested each year. Because of data limitations, those limited Alaskan harvests are not included in the preliminary data in Section VII, but the projected data would not differ significantly with Alaskan harvests included. The United States does expect to account for Alaskan forest harvests comprehensively under its proposal.

- The U.S. assigned amount under the Kyoto Protocol represents a reduction of 7% below its base year (generally 1990) levels of emissions, or on average about 1,534 MMTCE per year over the first commitment period. In 1998, U.S. total GHG emissions were about 1,834 MMTCE and fossil fuel-related emissions were about 1,468 MMTCE. Assuming business-as-usual conditions, the total projected U.S. GHG emissions in 2010 would be approximately 600 MMTCE per year higher than the U.S. target.

- Thus, managed forests in the United States currently remove about 17% of total U.S. GHG emissions per year on a carbon-equivalent basis or about 21% of fossil fuel-related CO_2 emissions. Assuming business as usual, during 2008 to 2012 U.S. managed forests could remove from 12 to 16 % of total U.S. GHG emissions per year on a carbon equivalent basis.

- Within the next 50 years, U.S. forest productivity per unit area in some regions is likely to increase as a result of improved management and technology. The fertilizing effect of CO_2 on the nation's forests is also expected to have a positive impact on growth, but the magnitude of this remains very uncertain and will vary by location depending on site-specific conditions. Other factors that will affect growth are local environmental conditions and changes in forest fragmentation, atmospheric nutrient deposition, and tropospheric ozone.

- In the United States, climate change could increase the area and productivity of forests over the next 50-100 years. There is also some possibility that over the next 50 to 100 years, climate change could decrease the area and productivity of some forests. However, we expect that site-specific conditions, direct human management, air pollution and forest and soil ecology will be much more influential factors on forest productivity, decomposition and carbon balance than climate change or CO_2 fertilization. At the national scale, it is uncertain what the impact of climate change might be relative to other factors. At the local level, site-specific conditions would also include the local effects of natural and human-induced climate change, for example temperature and precipitation trends and variability, and it may be difficult to distinguish those effects from other site-specific factors.

B. Cropland management

- Cropland management includes cropping systems, tillage, crop residue management, cover crops, crop rotations, irrigation, pest management, and fertilization. It also includes application of manure, composts and other organic amendments, and elimination of bare fallow rotations.

- Tillage management practices range from conventional tillage to conservation tillage. Practices such as no-till leave the soil surface undisturbed from harvest until planting the next crop except for nutrient injection. Other conservation tillage practices disturb the soil surface but leave a significant portion of the soil surface covered with residue from the previous crop. These practices can reduce erosion, improve water and air quality, and help retain and enhance soil organic carbon.

- Land-use change activities that fall within cropland management include, for example, converting cropland to grassland, forest, wetlands, or urban uses. Land-use change activities also include the establishment of vegetated buffers along riparian areas, which can improve water quality, provide critical habitat, and increase carbon reservoirs.

- Assuming business as usual, the United States projects that cropland soils will remove between 9 and 24 MMTC per year during the commitment period, with an estimate of central tendency of 16 MMTC per year. See Table III in Section VII for more information about these estimates.

- GHG inventories already include emissions of N_2O and CH_4 from cropland soils. See Section V for a discussion regarding accounting for N_2O and CH_4 from LULUCF activities.

Management improvements on U.S. cropland

- From 1948 to 1994, the productivity of U.S. agriculture grew at the rate of 1.9 percent per year compared to only 1.1 percent per year for the non-farm sector. Improvements in management practices allowed agricultural production to double without increasing cropland area.

- Over roughly the same period, soil erosion has declined significantly. Since 1938, soil erosion has declined by an estimated 40 percent, minimizing the effects of soil erosion on soil productivity. Improved crop residue management practices, which can reduce both soil erosion and also reduce the loss of soil organic matter, have been increasingly adopted in the United States.

- Similarly, energy efficiency has increased dramatically. Since 1978, the total amount of energy used in the agricultural sector has fallen by 25 percent. Switching from gasoline to diesel-powered tractors, adopting conservation tillage, and creating new methods of drying crops and irrigating contributed to this decline.

C. Grazing land management

- Grazing land is defined by the Society for Range Management as: “a collective term that includes all lands having plants harvested by grazing without reference to land tenure or other land uses, management, or treatment practices.” Grazing land includes all land on which the primary productive use is for herbivore grazing, including permanent (or long-term) pasture and rangeland. The U.S. database definition for grazing land does not include forested land that is grazed or land used primarily for annual crops or hay production that may be seasonally grazed.

- Grazing land management encompasses all practices aimed at manipulating the amount and type of forage and livestock produced, including regulation of animal stocking rates, forage species selection, fertilization, liming and irrigation. For example, grazing land management includes: prescribed grazing to increase production of biomass; planting on pasture and hayland to produce high quality forage, improving efficiency of ruminant livestock and wildlife production; range seeding to restore or reclaim native vegetation; mechanical treatment to increase vegetation production capacities; and biological and chemical management to maintain or improve plant community sustainability and productivity (e.g., prescribed fire, herbicide applications, and introduction of organisms to control invasive plants and plant community dynamics).

- Because of the diversity of U.S. grazing lands, a wide range of improved land management options are available. Examples of improved grazing land management include: improved rangeland management (e.g. grazing intensity), improved pasture land management (e.g. fertility management, manure application, planting improved species), and improved cattle grazing management on pasture land. Grazing land-use change includes such activities as converting grazing land to cropland, forest, wetlands, or urban uses.

- Assuming business as usual, the United States projects that grazing land soils will remove between 3 and 23 MMTCE per year during the commitment period, with an estimate of central tendency of 8 MMTCE per year. See Table III in Section VII for more information about these estimates.

- GHG inventories already include emissions of CH_4 from grazing land soils. See Section V for a discussion regarding accounting for N_2O and CH_4 from LULUCF activities.

D. Other possible additional activities under Article 3.4

- As noted above, it may be desirable to include other land management activities under Article 3.4 to comprehensively account for anthropogenic LULUCF emissions and removals. For example, it may be desirable to add an activity under Article 3.4 that would include newly vegetated land. If revegetated land is managed land that qualifies as forest, cropland, or grazing land, then it would clearly be included within the U.S. proposal for a single coherent accounting system for lands under Article 3.3 and 3.4.

- If revegetated land is intended to remain in a generally unmanaged state, for example as a rehabilitated natural ecosystem, then an issue arises as to whether the land should be included under the Kyoto Protocol. After the vegetation is established, the carbon stocks on revegetated land may either experience few direct anthropogenic effects or require some human management to protect carbon reservoirs. Including revegetated land under Article 3.4 could encourage rehabilitation of degraded lands to natural undisturbed systems. Although the United States has very little revegetated natural land, it recognizes that including this land could be of interest to other Parties. The United States welcomes discussion about how revegetated land could be included in the accounting system under the Kyoto Protocol.

E. How proposed activities relate to the objective and principles of the Convention and its Kyoto Protocol

- The United States believes the broad and comprehensive approach it proposes is most consistent with the objective and principles of the UNFCCC.

- The ultimate objective of the UNFCCC 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. The United States believes its proposal for a broad and comprehensive approach to LULUCF for the long-term properly addresses a key sector that affects greenhouse gas concentrations in the atmosphere.

- The United States notes that the UNFCCC includes a number of references that are consistent with the broad inclusion of LULUCF in efforts to mitigate climate change, for example:

  - Article 3.3: “ [M]easures should be cost-effective…[and] be comprehensive, cover all relevant sources, sinks and reservoirs of greenhouse gases and adaptation, and comprise all economic sectors."
  - Article 4.1(d): “Promote sustainable management, and promote and cooperate in the conservation and enhancement, as appropriate, of sinks and reservoirs…including biomass, forests…as well as other…ecosystems”

- The broad activity approach would also provide flexibility, allowing measures to be “appropriate for the specific conditions of each Party,” as provided in Article 3.4.

- The United States further notes references in the Kyoto Protocol that support the expanded role of LULUCF:
  - Article 2.1(a)(ii): “protection and enhancement of sinks and reservoirs”

- Article 2.1(a)(iii): “promotion of sustainable agriculture in light of climate change considerations”
- Article 3.4: “modalities, rules and guidelines as to how, and which, additional human-induced activities related to changes in greenhouse gas emissions by sources and removals by sinks in the agricultural soils and the land-use change and forestry categories shall be added to, or subtracted from, the assigned amounts for Parties included in Annex I . . . .”

- The United States believes its proposal for the inclusion of broad additional activities under Article 3.4 in the first commitment period is consistent with these provisions of the Framework Convention and the Kyoto Protocol.

F. General U.S. views on narrowly-defined practices and activity-based accounting

- In addition to the general disadvantages of including narrow practices rather than broad activities, the United States sees a number of practical problems that would be posed by including narrow practices under Article 3.4. These problems generally would not arise with broad activities.

- Narrow approaches that include specific land management practices would require complex and arbitrary accounting decisions to implement.

  Most land managers implement a suite of practices simultaneously and, therefore, identifying individual management practices or projects and measuring their associated net greenhouse gas emissions is likely to be problematic. Ad hoc attempts to separate the effects of individual practices on net greenhouse gas emissions are likely to be misleading because the effects of individual practices are not additive.

  Land comes in and out of various management practices regularly (often with a different mix of other practices), raising the issue of exactly when the activities trigger accounting for carbon stock changes. Available data may not allow determination of, for example, which land has had a narrowly-defined practice during or since 1990.

  Even if a Party can determine the precise land area where a practice was applied, the accounting system for the practice would necessarily involve arbitrary decisions. For example, if the system includes land that experienced the practice only for one season (e.g., in 1992) and never since, then much of the accounted removals and emissions would have little to do with that practice. On the other hand, if a rule requires the land to have experienced the practice consistently since 1990, much of the land on which the activity has been applied would be excluded, and thus significant carbon stocks related to the practice would not be counted.

  Even narrowly-defined practices (e.g., conservation tillage) can refer to a wide variety of practices (e.g., reduced-, mulch-, and no-till soil management systems). Thus, it may be very difficult to determine the land base on which the activity is applied and to identify which emissions and removals are associated with the specific activity. Databases for narrow practices such as pest and fire management in forests may not be broken out spatially, making land-based accounting almost impossible.

- A limited list of narrow practices could provide incentives to concentrate mitigation efforts in a way that would be environmentally inappropriate. For example, if pest management were included as an

- activity, with few other options, then Parties could have an incentive to invest in pest management to an extent that would create ancillary environmental concerns.

- On the other hand, if a longer list of narrowly-defined practices were being considered, then it would be more straightforward to simply include the broad management activity associated with the land.

- The United States believes that narrowly-defined practices that are expressed as "improvements" over conventional practices have significant disadvantages compared to including broad activities under Article 3.4. Conventional practices vary significantly over time and location, making it very difficult to determine objectively what practice the "improvements" are relative to. Improvements relative to an historical date could inadvertently penalize Parties and their entities that adopted improved land management strategies early. Finally, if only the land with improved practices is included under Article 3.4, emissions from the remaining land (on which conventional practices are used) would be excluded. This could lead to a bias in selecting only those lands that provide positive net removals of carbon. The U.S. believes that emissions and removals from the entire managed land system should be included.

V. Methodologies for measuring and reporting in relation to Article 3.3 and 3.4 activities

A. Monitoring and measuring

- Parties should develop quality data and measurement systems to account for greenhouse gas emissions and removals associated with activities under Articles 3.3 and 3.4. The IPCC should be requested to prepare a report on good practice in preparation of inventories related to LULUCF. The report should consider the applicability of the IPCC Revised 1996 Guidelines for GHG Emission Inventories in light of the decisions under Articles 3.3 and 3.4. Once approved by the COP/MOP, the IPCC guidance should be incorporated into the methodological and reporting requirements under Articles 5 and 7 of the Protocol. *(See paragraph 4 of decision text in Section VIII, and the proposed freestanding provision at the end of Section VIII)*

- The United States is firmly committed to developing sound science and inventory methodologies for LULUCF accounting. In the Summary for Policymakers of the Special Report (paragraphs 53 and 54), the IPCC notes that Annex I Parties generally have the basic technical capacity to measure emissions and removals in terrestrial ecosystems, and that improved methods would be highly transferable. The current inventory infrastructure is well-suited to monitor and verify changes in carbon stocks on lands that fall under the broad activities of forest, cropland, and grazing land management. Accordingly, the United States believes that, by the first commitment period, it could fully comply with appropriate measurement, monitoring, and verification procedures for accounting for broad land-management activities. For more details about U.S. data and modeling methodologies, please see the explanatory text accompanying the tables in Section VII of this submission.

- As is done in other parts of the IPCC Guidelines, if Parties are unable to directly measure, statistically estimate, or model their changes in carbon stocks and emissions of other greenhouse gases, IPCC default values should be provided. Further, Parties should have the flexibility to develop national methods for LULUCF accounting that better reflect national circumstances and more accurately estimate changes in carbon stocks.

- The issue of uncertainty is extensively addressed in the IPCC Special Report on LULUCF. Uncertainty in estimates of emissions and removals associated with activities under Articles 3.3 and 3.4 should be treated in the same manner as in the 1996 Revised IPCC Guidelines, as elaborated by good practice. As part of its work to prepare good practice for LULUCF inventories, the IPCC should be requested to consider the applicability of this approach toward uncertainty in the LULUCF sector.

- The United States expects LULUCF accounts under Articles 3.3 and 3.4 to be reviewed and verified in the same manner as GHG inventories under Articles 7 and 8.

B. Accounting for non-CO_2 GHG emissions and removals

- If activities under Articles 3.3 and 3.4 affect emissions from GHG sources (both CO_2 and non-CO_2) included in Annex A, an issue arises as to whether those emissions should be counted as additions to Parties' assigned amounts pursuant to Articles 3.3 and 3.4, or should be reflected in Parties' emissions inventories.

- The United States believes that the major sources of non-CO_2 emissions related to LULUCF activities (particularly N_2O emissions from soils) are already included in the inventories provided pursuant to the UNFCCC and would be covered by Annex A sources under the Kyoto Protocol. It is possible that certain applications of nitrogen to soils might not be included currently by some Parties in their inventories (e.g., applications of nitrogen to industrial timberland or lawns), although we note that these emissions are covered by the U.S. inventory under "agricultural soil management." To address the issue of double-counting, "agricultural soils" under Annex A of the Kyoto Protocol should be interpreted broadly to include emissions from all nitrogen applied to soils, rather than including only nitrogen applied to cropland soils. *(See paragraph 5(c) of decision text in Section VIII)*

- The United States also recognizes that several potential non-CO_2 emissions and removals from the LULUCF sector are not currently included in Parties' emissions inventories. These include, for example, emissions of CH_4 and N_2O from forest burning and other forest management practices; CH_4 emissions from wetlands; and emissions and removals related to microbial action in soils. In these cases, limited data exist to quantify these emissions and removals reliably at the national scale. The IPCC Special Report on LULUCF provided little guidance for the treatment of non-CO_2 gases, and there are also no methodologies for such estimates in the 1996 IPCC Guidelines. For these reasons, we propose that such emissions and removals not be included in emissions inventories, at least in the first commitment period. Parties may want to consider whether the IPCC should be asked to revisit these issues and the state of science when it next revises the emissions inventory methodologies in preparation for future commitment periods.

VI. Overall accounting approaches in relation to requirements of Article 3.3, 3.4 and 3.7, and regarding, inter alia, reversibility, natural effects, and accounting interlinkages.

A. General accounting for LULUCF activities

- The United States notes that LULUCF activities under Articles 3.3 and 3.4 are included in the calculation of compliance with assigned amounts under the Kyoto Protocol as expressed by the following equation:

Actual Emissions ☐	Assigned Amount					
Demonstrate through measurement of emissions (Art. 5) and reporting (Art. 7)	{5 times the % in Annex B times baseline}	**+/- LULUCF**	+/- - JI	+/- trading	+ CDM	+/- banking
	Based on 1990 (Art. 3.7) or other year for EITs (Art. 3.5/3.6) or 1995 for 3 gases (Art 3.8) + 1990 net LUC if qualify under Art. 3.7	**Art. 3.3 + Art. 3.4**	(Art. 6)	(Art. 17)	(Art. 12)	(Art.3.13)

- Activities under Articles 3.3 and 3.4 should use land-based accounting, i.e. counting all of the changes in carbon stocks (natural or otherwise) associated with lands under Article 3.3 and 3.4. As recognized by the IPCC Special Report, a land-based approach is well-suited to broadly-defined activities.

- For each commitment period, the changes in carbon stocks associated with lands under Article 3.3 and 3.4 should be assessed from the time the activity first occurred since 1990 or the beginning of that commitment period, whichever is later, to the end of that commitment period. (See paragraphs 5(a) and 5(b) of decision text in Section VIII)

- Accounting for lands under Articles 3.3 should be consistent with accounting for lands under 3.4 in the second and subsequent periods. Each Party should develop a coherent accounting system that accounts for lands under Article 3.3 and 3.4. For the first commitment period, accounting procedures should be developed to address any overlap between lands under Article 3.3 and lands that could be subject to a phase-in approach under Article 3.4.

- Land that comes into the system under Articles 3.3 and 3.4 should remain in the overall LULUCF accounting system indefinitely, as long as there is a chance of significant changes in carbon stocks. That means that all applicable future emissions and removals would be counted in the commitment period in which they occur. *(See paragraph 5(d) of decision text in Section VIII)*

B. Accounting for carbon pools

- Carbon pools should include: live biomass including roots; litter mass; organic soil carbon to a depth appropriate to the land use; logging residue; carbon in products and landfills; and carbon in standing or down dead wood. Carbon accounting should take into account the transient nature of much of the above-ground biomass on cropland and grazing lands. However, in the case of grazing lands and converted cropland, the durable above-ground woody carbon pool can be significant and may be one of the main components that changes with management. *(See paragraph 5(b) of decision text in Section VIII)*

- If a Party chooses to apply one or more additional activities under Article 3.4, the Party should, at a minimum, account for pools that are likely to be decreasing in the first commitment period. To the extent that a pool is not changing or is likely only to increase, then in limited circumstances it may be desirable to give the Party the flexibility not to count it in the first commitment period, assuming that the Party has otherwise met data requirements to include additional broad activities under Article 3.4.

- While we would encourage Parties to account for all relevant pools to the extent possible in the first commitment period, the United States welcomes further discussion on this issue.

- To the extent feasible, the accounting system should reflect the actual emissions and removals from relevant pools as they occur.

- As indicated above, the United States believes that carbon in products and landfills should be included as accounted pools under Articles 3.3 and 3.4. Including these pools in the accounting system would more accurately reflect exchanges with the atmosphere and could encourage Parties to manage them to reduce net emissions. An issue arises as to how to account for carbon emitted from harvested wood products, especially those that are traded internationally. The United States supports the process for further decisions on this issue. For further discussion of carbon pool accounting issues, see the explanatory text for Table III in Section VII. (See paragraph 5(b) of decision text in Section VIII)

C. Incentives for land management

- Parties have significant flexibility in choosing domestic policies to implement the Protocol. In implementing Articles 3.3 and 3.4 of the Protocol, Parties should take into account, to the extent possible, any ancillary environmental effects of their policy decisions, including effects on biodiversity; soil, air and water quality; the capacity of ecosystems to adapt to climate change; risks of degradation; long-term vulnerability to disturbance by fire, pests and invasive species; and the protection of primary native and maturing secondary native forests. *(See paragraph 6 of decision text in Section VIII)*

- The United States notes that the broad-activity approach it proposes would account for the emission of GHGs resulting from the conversion of natural areas. For example, the harvest of primary or secondary native forest or the conversion of those forests to other uses would generate emissions at the time of the loss of native forest cover. Net emissions could continue for some time as a result of decaying harvest slash and soil disturbances. Because the approach proposed by the United States would account for these emissions, we believe it could provide new incentives to protect carbon reservoirs, particularly those in mature forests.

D. Accounting for changes in land use and rules to address double counting

- The United States believes that a single coherent system should account for activities under both Articles 3.3 and Article 3.4. For example, if multiple activities included under Articles 3.3 and 3.4 were applied to land, accounting rules and procedures must ensure that the carbon stock changes are counted only once.

- Parties should account for emissions and removals from the conversion of land from a natural state to one of the managed land categories under Article 3.4 and from forest, crop, or grazing uses to urban purposes. Carbon that is not actually emitted – for example, carbon that remains in soil and vegetation when land is converted to housing developments – should not appear as emissions in the accounting system.

E. How additional activities should be included in the first and subsequent commitment periods

Phase-in approach for the first commitment period

- The Kyoto Protocol requires that any decision regarding the inclusion of additional sink activities under Article 3.4 will apply in the second and subsequent commitment periods. For this reason, the United States strongly believes that the decisions taken at COP 6 regarding Article 3.4 need to get the system right for the long-term. As explained in Section II above, the United States believes that this would be best accomplished through the inclusion of broadly-defined land management activities, combined with comprehensive accounting of all pools and all relevant GHG emissions and removals related to lands under Article 3.4.

- Article 3.4 gives Parties the option of applying the decision on additional activities to the first commitment period, provided that the activities have taken place since 1990. Because the land management activities proposed by the United States are ongoing and therefore have occurred since 1990, they could be applied by Parties in the first commitment period pursuant to the final sentence of Article 3.4.

- The United States recognizes that some Parties have raised concerns regarding the effect of comprehensive accounting on the first commitment period targets of Annex I Parties. In light of these concerns, the United States is prepared to consider a phase-in for the first commitment period, under which the positive net LULUCF removals of Annex I Parties would be reduced for purposes of first commitment period accounting only.

- If a phase-in approach were used, the United States believes that it must:

  - Be simple and transparent.
  - Preserve incentives to reduce emissions, increase removals, and protect carbon reservoirs.
  - Take full GHG accounting as its point of departure.
  - Encourage the development of appropriate measurement, monitoring, and verification systems by Annex I Parties.

- A first commitment period phase-in could be structured in a number of ways. One possible approach would be to discount positive net removals under Article 3.4 by a certain percentage. An alternative approach would be to allow Parties to adjust their assigned amounts by only the net removals above a pre-determined threshold. The United States would consider these and other proposals for how a first commitment period phase-in could be structured. Further discussion will be needed to determine which approach, if any, is most appropriate and how any particular discount, threshold or other phase-in approach would be determined. *(See paragraph 3(c) of decision text in Section VIII)*

- From a carbon removal standpoint, forest management in the United States would be the activity most affected by a phase-in, since forests are likely to provide most of the U.S. estimated carbon removals in the first period.

<u>Election by Parties of Which Additional Activities They Intend to Apply in the First Commitment Period</u>

- In its pre-commitment period report, each Party should be required to specify its forest definition parameters and the additional activities under Article 3.4 that it intends to apply in the first commitment period. Parties should not be able to choose activities and definitions based on carbon stock changes that have already occurred. *(See paragraphs 2 and 3(b) of decision text in Section VIII)*

- Parties should be allowed to choose not to apply the COP/moP decision under Article 3.4 in the first commitment period. However, such Parties should assess and report on their emissions and removals from LULUCF activities in a comprehensive manner in order to prepare for the second and subsequent commitment periods.

- Parties that do not have national systems pursuant to Article 5.1 to estimate, monitor, verify, and report data for additional activities under Article 3.4 during the first commitment period in accordance with agreed methodologies and requirements under Articles 5 and 7 should not be able to apply those activities in the first period. Those Parties should work towards developing adequate national systems so that, beginning with the second commitment period, all Annex I Parties can comply with the Article 5, 7, and 8 requirements related to all LULUCF activities included under Articles 3.3 and 3.4. *(See paragraphs 3(b) and 4 of decision text in Section VIII)*

F. Duration of carbon removals and leakage

- Carbon removals related to LULUCF activities may not be permanent. The United States believes that any accounted removals that are later reversed (resulting from any cause, natural or human) should be accounted for at the time those emissions occur. A broad and comprehensive approach, contiguous commitment periods, and an accounting system that continuously tracks land that comes under Articles 3.3 and 3.4 will ensure that subsequent releases of carbon are accounted for. The United States believes that this inter-temporal balance in accounting for emissions and removals is a particular strength of a broad, comprehensive, and continuous approach. See the IPCC Special Report, Section 2.3.6.2, for more discussion of the duration issue.

- Activities to increase net carbon removals in one area or sector may stimulate emissions in another. As long as those emissions occur within Annex I Parties whose binding commitments require accounting for them, such leakage would not increase overall Annex I GHG emissions. Thus, the United States believes that the best long-term approach to prevent leakage is broad and comprehensive LULUCF accounting by all Annex I Parties. See the IPCC Special Report, Section 2.3.5.2, for more discussion of leakage.

G. LULUCF accounting and natural and indirect effects

- The IPCC Special Report notes a large terrestrial carbon uptake from land-use practices and natural regrowth in middle and high latitudes, the indirect effects of human activities (e.g., atmospheric CO_2 fertilization and nutrient deposition), and changing climate (both natural and anthropogenic) (paragraph 8 of the Summary for Policymakers). The IPCC Special Report notes that it is not possible to determine the relative importance of these different processes, which vary from region to region, and also notes the considerable uncertainty in the size of this indirectly-deduced terrestrial carbon sink.

- The United States believes that measurable, verifiable changes in carbon stocks should be the focus of policy development regarding LULUCF under the Kyoto Protocol. Concerns about natural and indirect effects could potentially be considered in connection with discussions regarding a possible phase-in approach for the first commitment period, as well as when future emissions limitation commitments are developed.

- The United States does not believe that complex methods of simultaneously factoring out natural and indirect factors from other factors that affect carbon stocks would be practicable for purposes of accounting under Articles 3.3 and 3.4.

H. The relationships between Articles 3.3 and 3.4 and other Articles of the Protocol

- The United States believes that project-based activities under Articles 6 and 12 could offer cost-effective opportunities to reduce emissions and increase removals of greenhouse gases. Significant project-level experience to date demonstrates the credibility of such projects, when they are properly designed.

- LULUCF activities account for about 20% of GHG emissions globally, and up to 70% of emissions of some developing countries. Substantial opportunities exist to enhance net removals in developing countries, for example through afforestation and restoration of degraded lands, reduced deforestation, improved forest management and improved agricultural and grazing practices.

- The United States believes that decisions regarding Articles 3.3 and 3.4 should not prejudice the eligibility or accounting for LULUCF projects under the Clean Development Mechanism. Decisions on the eligibility, accounting, monitoring, and other technical aspects of LULUCF projects in the CDM should be addressed by the Joint Contact Group on Mechanisms, in consultation with the SBSTA LULUCF Contact Group.

- LULUCF projects in the CDM could contribute to broader regional distribution of CDM projects, particularly because the LULUCF sector plays a significant role in the economies and territories of many developing countries. These projects could also produce significant ancillary benefits for local and regional communities, including enhanced protection of water and forest resources and biodiversity, local income, and support for local or national sustainable development objectives. In many cases, the local benefits of LULUCF projects may be larger than the greenhouse gas benefits.

- The United States believes that LULUCF projects share many of the same issues as other types of CDM/JI projects. Issues include determining environmental additionality through the setting of appropriate baselines, measurement and monitoring of greenhouse gas benefits and emissions, and addressing leakage. In addition, sinks projects raise the issue of the duration of greenhouse gas benefits because of the potential reversibility of carbon removals. The United States believes that these issues have been fully addressed in a number of LULUCF projects to date, and can be addressed in the CDM through appropriate rules and project designs.

- The potential for leakage varies widely for different types of LULUCF projects. In most cases, leakage can be minimized and accounted for by setting appropriate project boundaries, discounting, or addressing the underlying causes of leakage. Appropriate rules and project design can also ensure that LULUCF projects provide the same long-term climate benefits as energy projects. Where leakage and/or the duration of climate benefits cannot be addressed, credit should not be issued.

- The United States welcomes further discussions in the Joint Contact Group on Mechanisms to develop appropriate solutions to the issues of additionality, leakage and permanence.

I. Views on Article 3.7

- For Parties whose LUCF sector was a net source of emissions in 1990, Article 3.7 allows inclusion of emissions from land-use change in 1990 for purposes of determining the Party's initial assigned amount.

- The United States makes the following observations regarding the appropriate application of Article 3.7:

  - Consistent with a broad and comprehensive approach and Article 5.1, the base year GHG inventory should cover all emissions and removals in the LULUCF sector. Determination of whether a Party qualifies as a net emitter under Article 3.7 should be based on a complete, reviewed inventory.

  - The language in Article 3.7 indicates that CO2-equivalent emissions should be used, implying that all GHG emissions, in CO2-equivalents, associated with LUC should be used in calculating the initial assigned amount.

  - Emissions categories from the IPCC revised guidelines should be used to delineate which emissions are from land use change and which are associated with land use and forestry activities. If national methods are used, it must be clear which emissions and removals are associated with land-use change categories in the IPCC guidelines.

  - A single pre-commitment period review process should apply to LULUCF-related emissions and removals and other elements of a Party's inventory. Under this process, the base year inventory would be submitted, reviewed, and, if it does not meet reporting requirements, conservatively adjusted. Please see the United States submissions on Article 5, 7, and 8 for U.S. views regarding the details of this process.

  - Once the initial assigned amounts for Parties are definitively established, those levels, denominated in MMTCO2-equivalent, will be fixed numerical values that are independent of the inventories from which they were derived.

VII. Country-specific data and information: tables and explanatory text

In the material below, the United States provides country-specific data and information called for by SBSTA at its eleventh session (FCCC/SBSTA/1999/14, para.46 (g), (h), (i), (j)), in a format consistent with the conclusions of SBSTA at its twelfth sessions (FCCC/SBSTA/2000/CRP.2). All data, estimates, and projections are preliminary, and some may involve significant uncertainty. In addition, some estimates rely on assumptions about the eventual outcomes of accounting decisions.

As noted by SBSTA at its twelfth session, the formats, data, and information do not prejudge in any way the decisions or conclusions that may be made by either the COP or the SBSTA at future sessions.

The United States has completed sections of these tables that relate directly to its proposals. In addition we have also provided additional data and information that:

- Illustrate implications of approaches to reforestation that differ from our proposed approach (see Table I),

- Provide statistically appropriate figures for the total projected carbon stock decreases associated with afforestation, reforestation, and deforestation since 1990 (see Table Ib),
- Provide details regarding the model parameters for forest growth rates, yields, and logging debris (see Tables Ic, Id, and Ie),
- Express data as annual averages over the relevant periods to assist in comparing our data with data provided by other Parties (see Tables Ia and IIIa),
- Illustrate the relative carbon contributions of various carbon pools to forest carbon accumulation and examine important assumptions about accounting for wood products (see the Pool Table in the explanatory text for Table III),
- Provide references for more information (see literature sections below each table).

We have attempted to document areas where data were unavailable or incomplete and where appropriate data cannot be provided because they rely heavily on policy decisions that have not yet been made. We have also documented areas where we had to make assumptions about how various accounting rules might be elaborated.

Despite best efforts to be accurate and complete, it is possible that some of the data and information provided below contain errors or omissions. In particular, some data have only very recently become available and, with further processing, the estimates based on this data could change. Therefore, in reviewing the information below, Parties should recognize the preliminary nature of the information provided.

U.S. Table I

Preliminary data and information provided by the United States on areas and carbon stock changes related to Article 3.3 activities.

Row	Article 3.3 Country specific data	Definitions	Accounting framework	a_I (10^3 ha)	ΔC_I (10^6 t C)	a_{II} (10^3 ha)	ΔC_{II} (10^6 t C)	a_{cp} (10^3 ha)	ΔC_{cp} (10^6 t C)	Methods and approach	Data sources, data quality, and uncertainty	Other
1	Afforestation Reforestation	IPCC	Land based	784 **825** 866	1 **8** 15	3602 **3792** 3982	36 **47** 58	11479 **12754** 14029	171 **201** 231	Data analysis & models	Inventory and research data; 80% confidence	See below
2	Afforestation	FAO	Land based	784 **825** 866	1 **8** 15	3602 **3792** 3982	36 **47** 58	11479 **12754** 14029	171 **201** 231	Data analysis & models	Inventory and research data; 80% confidence	See below
3	Reforestation	FAO	Activity based	6397 **6733** 7070	62 **75** 88	20626 **21712** 22798	273 **300** 327	59818 **62966** 69263	712 **838** 964	Data analysis & models	Inventory and research data; 80% confidence	See below
4			Land based I	6397 **6733** 7070	-321 **-292** -263	20626 **21712** 22798	-1029 **-935** -841	59818 **62966** 69263	-49 **-37** -25	Data analysis & models	Inventory and research data; 80% confidence	See below
5			Land based II	6397 **6733** 7070	-21 **-13** -5	20626 **21712** 22798	-64 **-52** -40	59818 **62966** 69263	385 **453** 521	Data analysis & models	Inventory and research data; 80% confidence	See below
6	Deforestation	IPCC/FAO	Land based	1041 **1096** 1151	-102 **-88** -74	3928 **4135** 4342	-374 **-340** -306	12377 **13028** 13697	-261 **-237** -213	Data analysis & models	Inventory and research data; 80% confidence	See below

a_I Area (10^3 ha) afforested and reforested, or deforested between 1 January 1990 and 1 January 1992.
ΔC_I Carbon stock change (10^6 t C) between 1 January 1990 and 1 January 1992 on land afforested, reforested, or deforested.
a_{II} Area (10^3 ha) afforested and reforested, or deforested between 1 January 1990 and 1 January 1997.
ΔC_{II} Carbon stock change (10^6 t C) between 1 January 1990 and 1 January 1997 on land afforested, reforested, or deforested.
a_{cp} Projected area (10^3 ha) afforested and reforested, or deforested between 1 January 1990 and 31 December 2012.
ΔC_{cp} Projected carbon stock change (10^6 t C) over the first commitment period on land afforested and reforested, or deforested between 1 January 1990 and 31 December 2012.

See notes below Table Ib

Table Ia
Average annual preliminary data and information provided by the United States on areas and carbon stock changes related to Article 3.3 activities.

Row	Article 3.3 Country specific data	Definitions	Accounting framework	a_I (10^3 ha)	ΔC_I (10^6 t C)	a_{II} (10^3 ha)	ΔC_{II} (10^6 t C)	a_{cp} (10^3 ha)	ΔC_{cp} (10^6 t C)	Methods and approach	Data sources, data quality, and uncertainty	Other
1	Afforestation Reforestation	IPCC	Land based	392 **413** 433	0 **4** 8	514 **542** 569	0 **7** 16	499 **555** 611	26 **40** 54	Data analysis & models	Inventory and research data; 80% confidence	See below
2	Afforestation	FAO	Land based	392 **413** 433	0 **4** 8	514 **542** 569	0 **7** 16	499 **555** 611	26 **40** 54	Data analysis & models	Inventory and research data; 80% confidence	See below
3	Reforestation	FAO	Activity based	3198 **3366** 3534	26 **37** 48	2949 **3102** 3257	28 **43** 58	2464 **2738** 3011	144 **168** 192	Data analysis & models	Inventory and research data; 80% confidence	See below
4			Land based I	3198 **3366** 3534	-168 **-146** -124	2949 **3102** 3257	-155 **-134** -113	2464 **2738** 3011	-16 **-7** -0	Data analysis & models	Inventory and research data; 80% confidence	See below
5			Land based II	3198 **3366** 3534	-14 **-7** 0	2949 **3102** 3257	-16 **-7** 0	2464 **2738** 3011	73 **91** 109	Data analysis & models	Inventory and research data; 80% confidence	See below
6	Deforestation	IPCC/FAO	Land based	520 **548** 575	-59 -44 -29	561 **591** 621	-65 **-49** -35	509 **566** 623	-61 **-47** -33	Data analysis & models	Inventory and research data; 80% confidence	See below

a_I Average annual area (10^3 ha) afforested and reforested, or deforested between 1 January 1990 and 1 January 1992.
ΔC_I Average annual carbon stock change (10^6 t C) between 1 January 1990 and 1 January 1992 on land afforested, reforested, or deforested.
a_{II} Average annual area (10^3 ha) afforested and reforested, or deforested between 1 January 1990 and 1 January 1997.
ΔC_{II} Average annual carbon stock change (10^6 t C) between 1 January 1990 and 1 January 1997 on land afforested, reforested, or deforested.
a_{cp} Average annual projected area (10^3 ha) afforested and reforested, or deforested between 1 January 1990 and 31 December 2012.
ΔC_{cp} Average annual projected carbon stock change (10^6 t C) over the first commitment period on land afforested and reforested, or deforested between 1 January 1990 and 31 December 2012.

See notes below Table Ib

Table Ib
Total and annual average preliminary data and information provided by the United States carbon stock changes related to the sum of all Article 3.3 activities.

Article 3.3 Country specific data	**Definitions**	**Accounting framework**	**Total ΔC_{cp} (MMTC)** **Total over 2008-2012**	**Annual average ΔC_{cp} ($MMTCyr^{-1}$)** **Average annual over 2008-2012**
Total of ARD (Statistical sum of rows 1 and 6 in Tables I and Ia)	IPCC	Land based	-50 **-36** -22	-16 **-7** -0
Total of ARD (Statistical sum of rows 2, 4, and 6 in Tables I and Ia)	FAO	Land based I	-90 **-73** -56	-25 **-14** -3
Total of ARD (Statistical sum of rows 2, 5 and 6 in Tables I and Ia)	FAO	Land based II	375 **417** 459	66 **84** 102
Total of ARD (Statistical sum of rows 2, 3 and 6 in Tables I and Ia)	FAO	Activity based	722 **802** 882	137 **161** 185

ΔC_{cp} Projected carbon stock change (MMTC) over the first commitment period on land afforested and reforested, or deforested between 1 January 1990 and 31 December 2012.

Notes:
1. All data are preliminary.
2. Estimates in Table Ia are average annual equivalents of the data in Table I. The data in Table I were divided by the number of years in the relevant periods.
3. Estimates in Table Ib are the sums of the projected changes in C stocks from all Article 3.3 activities in the first commitment period.
4. Ranges are computed using statistical methods with 80% confidence intervals. Numbers in bold are estimates of central tendency

EXPLANATORY TEXT FOR U.S. TABLE I

1. Definitions and accounting

a) Forest

The U.S. uses the following definition of "forest." The definition involves a combination of land cover and land use:

> Land currently growing forest trees of any size with a total stocking value of at least 16.7 (10 base 100 in the West), or lands formerly forested, currently capable of becoming forest land, and not currently developed for nonforest uses. These lands must be a minimum of 1 acre in area. Roadside, streamside, and shelterbelt strips of timber must have a crown width of at least 120 feet to qualify as forest land. Unimproved roads, trails, streams, and clearings within forest areas are classified as forest land if they are less than 120 feet wide. Recently clearcut areas that are currently nonstocked are classed as forest land unless they are being used for a nonforest use such as agriculture. Forest land is divided into two categories (timberland and other forest land), and both of these categories may be further classified as reserved if harvesting of trees is prohibited by statutory or administrative restrictions.

The minimum stocking level of 16.7 percent is approximately equivalent to 10 percent crown cover once trees are well established. The U.S. definition of forest is compatible with the FAO definition of forest, which also used by IPCC.

b) Afforestation, reforestation, and deforestation

- "Afforestation" and "deforestation" are defined primarily as land use changes, but to qualify as deforestation the land must also meet the definition of forest prior to deforestation, and to qualify as afforestation the land must meet the definition of forest after afforestation. There is no difference in the definition of these terms for our calculations related to the IPCC or FAO definitions under Article 3.3.

- In applying the IPCC definition of reforestation, the distinction between reforestation afforestation is arbitrary. Therefore, for the IPCC approach, afforestation and reforestation are treated as one activity. Forest land in the U.S. is rarely cleared for nonforest use and subsequently returned to forest.

- In applying FAO definitions for the purpose of these illustrative calculations, reforestation has been interpreted to include heavy partial harvesting followed by regrowth of a new forest stand.

- See U.S. submission Section III for discussion of preferred approaches.

c) Accounting approaches

- The accounting approaches used to construct data in Table I are those described on p. 147 the IPCC Special Report: land-based I, land-based II, and activity-based.

2. Carbon pools included

The following carbon pools are included in Table I (where appropriate to the accounting approach):

- Live tree biomass including roots;
- Organic soil carbon to a depth of one meter;
- Forest floor mass, which may include fine twigs;
- Understory carbon, which is live biomass of shrubs, seedlings, and herbaceous plants;
- Coarse woody debris and logging residue;
- Carbon that goes into wood products and landfills.

Carbon in dead wood in the forest is not currently included; estimates of this pool are under construction. Carbon in wood products is not included in Table II.

<u>Wood products and accounting</u>

The U.S. believes that “emissions from harvested biomass” should appropriately take into account the harvested C remaining in wood products (including landfill disposition) that are not yet emissions. Therefore, in these estimates the quantity of harvested C not yet emitted is subtracted from the harvested biomass pool, and an appropriate decay rate applied to the product pool over time so that emissions are accounted approximately when they would occur.

The data in Tables I, Ia, and Ib would differ if one were to assume that all harvested carbon is emitted at the time of harvest. In particular, carbon stock loss estimates for deforestation and reforestation under the FAO land-based I accounting approach would be larger. Projected deforestation would produce 4 to 12 MMTC per year more accounted carbon stock losses in the first commitment period. Projected reforestation using an FAO land-based I accounting approach would produce an accounted carbon stock loss 40 to 60 MMTC per year greater if carbon going into wood products and landfills is assumed to be emitted at harvest.

3. Stratification

Multiple strata were used in developing the estimates in Tables I, Ia, and Ib. Strata include:

- Three owner groups
  - public, nonindustrial private, and forest industry;
- Six U.S. regions
  - Southeast, South Central, Northeast, North Central, Rocky Mountain, and Pacific Coast;
- Sixteen forest types;
- Two management intensities
  - plantation and natural;
- Four land uses
  - forest, agriculture, pasture, and urban/developed.

4. Methodologies and data

a) Data sources

An extensive and comprehensive forestry data collection, management, and reporting system underlies the carbon analysis for the U.S. (Powell et al. 1993; Smith 1999). U.S. states are inventoried on a cycle of about 10 years, with national statistics compiled every 5 years. Recent compilations of national statistics are for the years 1987 and 1992, and 1997. Land use and land use change statistics are also available for the years 1987, 1992, and 1997 for private lands from a separate National Resources Inventory (NRI) (USDA Natural Resources Conservation Service 1999). Thus, the periods chosen for Table I are 1990 to 1992 and 1990 to 1997. Data from sample surveys are supplemented where necessary with data from research studies (described in Birdsey and Heath 2000).

NRI estimates of land-use change were used for constructing Table I. The estimates of afforestation and deforestation in Table I are larger than earlier such estimates, in part because the newer NRI estimates of the land area undergoing a land-use change are larger than older estimates by the Resources Planning Act (RPA) Assessment.

b) Sampling techniques

Since the 1950s, U.S. forest inventories have used multi-phase sampling designs involving remote sensing and ground measurements (Schreuder et al. 1995). The phase one sample typically consists of interpretation of high-altitude color infrared photography, which is a widely available and highly accurate method for estimating changes in forest area and locating field sample plots. Interpreters classify more than 3,000,000 sample points nationally to monitor activities such as timber harvest and land use that may change the photo classification from forest to nonforest cover. Current research involves using satellite imagery for the first sample phase.

The phase two sample consists of more than 150,000 permanent field sample locations that are remeasured periodically to provide statistics on disturbance (e.g. harvest, mortality), growth, species composition change, and site descriptors such as ownership and forest type. At each sample location, a rigorous protocol is followed to select and measure a representative sample of trees. These measurements are then expanded to the population level using the statistics from the phase one sample.

A third sampling phase (known as Forest Health Monitoring) is the basis for more intensive ecosystem measurements. Soils, coarse woody debris, understory vegetation, and other ecological variables may be collected on the phase 3 sample plots, which are linked statistically to the phase 1 and 2 samples. Phase 3 consists of approximately 5,000 sample plots. Successive measurements have been initiated on about one-half of the phase 3 plots.

Ongoing changes in the way national forest inventories are implemented will facilitate annual reporting of basic statistics, which in turn will facilitate reporting of C flux on an annual basis.

Sampling techniques for the National Resources Inventory are similar to those described for Forest Inventory. The sampling grids for phases I and II are different, making the estimates from the two inventory systems statistically independent. Therefore estimates of land use changes for the same areas will not be identical but are comparable within established accuracy guidelines.

Identification of land under Article 3.3

Afforested and deforested lands can be identified from permanent sample plot records because all plots are monitored, whether forest or nonforest. When a plot changes from one class to another, it contributes to the estimate of land cover change that is derived from remote sensing in the first phase of the multiphase sample. If there is a small proportion of afforested and deforested land, then the error of the estimate is likely to be large due to the difficulty of estimating small proportions of a population with a random sample. Sample intensification for land use change may be required for accurate monitoring and identification of afforested and deforested land.

For reforestation (using the FAO definition), harvesting and regeneration activity can be observed during plot remeasurement and used to identify those sample plots that should comprise the basis for estimating stock changes.

Estimation of carbon stock changes

Inventory monitoring plots are permanent and are remeasured periodically, and methodology has been developed to estimate carbon density for inventory monitoring plots. Thus, it is feasible to determine the carbon density at the beginning and end of the reporting periods for different categories of forest land. Current inventory procedures do not include measurement of all ecosystem C components at all plots. Models are used to estimate C in coarse woody debris, litter, and soil. Full implementation of phase 3 sample plots will provide a more complete estimate of ecosystem C. Sampling in all phases may need intensification to accurately monitor changes in carbon stocks for plots that change land use.

Adjustments for reporting dates

Estimation methodology is needed to adjust estimates to the reporting dates, since plots are remeasured continuously at dates that will not always match the specified years. This process will be facilitated as the U.S. inventory moves from periodic to annual inventories with a faster remeasurement cycle. Specific updating methodology could be developed to be consistent with the Kyoto Protocol requirements.

c) Models and key parameters

The carbon budget of forest ecosystems of the United States is estimated using a core model, FORCARB, and several subroutines that calculate additional information, including carbon in wood products (Plantinga and Birdsey 1993; Birdsey et al. 1993; Birdsey and Heath 1995; Heath et al. 1996). FORCARB is part of an integrated model system consisting of an area change model (Alig 1985), a timber market model (TAMM - Adams and Haynes 1980), a pulp and paper model (NAPAP - Ince 1994) and an inventory projection model (ATLAS - Mills and Kincaid 1992). Through linkage with these models, FORCARB projects changes in carbon storage in private forests as a function of management intensity and land use change. A companion set of inputs was developed for public timberlands to use in this modeling system (Heath 1997)

The current version of FORCARB partitions carbon storage in the forest into four separate components: trees, soil, forest floor, and understory vegetation. A new version under construction will feature explicit ecosystem partitions for downed and standing dead wood. The definitions of these components are broad enough to include all sources of organic C in the forest ecosystem. The tree portion includes all above-ground and below-ground portions of all live and dead trees, including the merchantable stem, limbs, tops, cull sections, stump, foliage, bark and rootbark, and coarse tree roots (greater than 2 mm). The soil component includes all organic C in mineral horizons to a depth of 1 m, excluding coarse tree roots. Soil carbon is updated, based on the STATSGO database (USDA NRCS 1991). The forest floor includes all dead organic matter above the mineral soil horizons except standing dead trees: litter, humus, and other woody debris. Understory vegetation includes all live vegetation other than live trees.

Using data from forest inventories and intensive-site ecosystem studies, estimates of average C storage by age or volume classes of forest stands (analogous to a forest yield table) are made for each ecosystem component for forest classes defined by region, forest type, productivity class, and land use history. Equations are derived to estimate C storage in the forest floor, soil, and understory vegetation for each forest class. Additional details about estimating carbon storage for different regions, forest types, site productivity class, and past land use are provided in Birdsey (1996). These equations are then applied to projections of growing stock inventory and increment, harvested area and volumes, and timberland area obtained from ATLAS.

The C pools of wood from timber harvests on both private and public lands are estimated with a model based on the work of Row and Phelps (1991), updated with disposition estimates from Skog (1998). Carbon pools from forest harvests before 1980 are available based a similar method (Heath et al.1996), but these estimates are not included in this analysis. There are four disposition categories: products, landfills, energy, and emissions. Products are goods manufactured or processed from wood, including lumber and plywood for housing and furniture, and paper for packaging and newsprint. Landfills store C as discarded products that eventually decompose, releasing C as emissions. Emissions also include C from wood burned without generation of usable energy, and from decomposing wood. Energy is modeled as a separate category because wood used for energy may be accounted for differently that other disposition categories. However, estimates in Tables I and III include emissions from wood used for energy.

A simplified version of the integrated models was developed specifically to explore the various definitions and accounting approaches pertaining to Article 3.3 of the Kyoto Protocol. This model allows rapid revision and simulation of alternative scenarios. The new model is calibrated to results from previous FORCARB model runs.

Some of the key parameters used in estimating the values in Table I are listed below in Tables Ic, Id, and Ie.

Table Ic.
Average reforestation yields for land based accounting by region – Includes all forest types and ecosystem carbon pools (t C ha^{-1} y^{-1}).

Age	Southeast	South Central	Northeast	North Central	Rocky Mountain	Pacific Coast
0-5	-1.9	-3.4	-0.2	-0.2	1.3	0.5
5-10	-1.8	-2.0	0.7	0.5	0.4	1.0
10-15	2.2	2.4	0.9	0.7	0.2	1.0
15-20	3.4	4.6	1.4	1.3	0.6	1.9
20-25	4.0	5.0	1.3	1.4	0.6	2.0
25-30	3.4	4.2	1.6	1.6	0.8	3.4
30-35	2.8	3.2	1.5	1.8	1.0	3.4
35-40	2.8	2.8	1.7	1.8	1.6	4.0
40-45	2.1	2.7	1.6	1.8	1.5	3.9
45-50	2.2	2.5	1.6	2.0	2.0	3.7

Table Id.
Average forest biomass at time of harvest by region -- Includes all standing biomass and live roots (t C ha^{-1})

	Southeast	South Central	Northeast	North Central	Rocky Mountain	Pacific Coast
C removed[1]:	53.4	56.0	45.7	51.6	48.0	140.6
C emitted[2]:	10.2	15.8	10.1	25.9	14.4	19.8
Logging debris[3]:	36.0	50.1	42.9	48.1	45.8	79.0
Total:	99.7	121.9	98.7	125.6	108.2	239.4

[1] Merchantable stem (including bark) of live trees.
[2] Small branches and foliage of harvested trees.
[3] Unmerchantable live trees, standing and down dead trees, large branches, roots and rootbark.

Table Ie.
Average remaining logging debris by age class and region (t C ha^{-1}).

AGE	Southeast	South Central	Northeast	North Central	Rocky Mountain	Pacific Coast
0	36.0	50.1	42.9	48.1	45.8	79.0
5	23.1	32.1	31.1	31.3	41.2	65.6
10	14.8	20.5	22.6	20.3	37.1	54.4
15	9.4	13.1	16.4	13.2	33.4	45.2
20	6.0	8.4	11.9	8.6	30.0	37.5
25	3.9	5.4	8.6	5.6	27.0	31.1
30	2.5	3.4	6.2	3.6	24.3	25.8
35	1.6	2.2	4.5	2.4	21.9	21.4
40	1.0	1.4	3.3	1.5	19.7	17.8
45	0.6	0.9	2.4	1.0	17.7	14.8
50	0.4	0.6	1.7	0.6	16.0	12.3

d) Uncertainties

The most comprehensive and accurate regional estimates of C flux using inventory data are for above-ground biomass, which is closely related to the estimate of volume. Typically, the volume estimate for large areas that are inventoried is within 1 or 2 percent of the true value at the 95% confidence level (Phillips et al. 2000). The corresponding error estimate for volume growth is typically within 2 or 3 percent. The error of area in timberland is generally around plus/minus 3 percent on a state basis. There are significant gaps in data for areas that are not inventoried frequently, such as Interior Alaska, but these areas usually fall in the category “other forestland” rather than managed forest. Estimation errors for these areas are correspondingly large. For estimating biomass there are also estimation errors of the regression models used to estimate tree biomass from field measurements.

Some important progress has been made in applying the principles of uncertainty analysis (Smith and Heath 2000; Heath and Smith 2000; Smith and Heath in press) to identify consequences of uncertainty in our estimation process. Uncertainty analysis was used employing Monte Carlo simulation in developing the ranges reported above. In a preliminary analysis on only private timberlands, Heath and Smith (2000) estimated the uncertainty in forest carbon inventory was plus/minus 9 percent, with this range covering 95% of the distribution. The uncertainty for both public and private timberlands will probably not differ substantially. Total uncertainty depends on both component uncertainties and the scale of the estimates.

Confidence intervals can be viewed as standard deviations or errors from the mean, and translated to other confidence intervals easily. For instance, a 68% confidence interval is approximately 1 standard deviation from the mean, 80% is 1.25, 90 % is 1.65, and 95% is 2. Plus/minus uncertainty of 15% at the 80% confidence interval is approximately plus/minus uncertainty of 20% at the 90% confidence interval.

5. Treatment of non-CO_2 greenhouse gases

For a discussion of non-CO_2 greenhouse gases from the broad activity of forest management, please see the explanatory text for Table III and Section V of the U.S. submission. This section focuses on non-CO_2 greenhouse gases related to afforestation, reforestation, and deforestation.

The U.S. is researching basic processes occurring in forested systems and developing methods to better assess and account for all GHG emissions. This research encompasses experimental work, modeling and synthesis that will ultimately lead to comprehensive accounting. Currently available data regarding emissions of non-CO_2 GHGs from afforestation, reforestation, and deforestation activities are very limited, although evidence indicates that collectively those emissions are much smaller than CO_2 emissions and removals related to those activities.

Changes in non-CO_2 GHGs from afforestation, reforestation, and deforestation could be important relative to CO_2 emissions and removals in some limited land-use change scenarios. For example, drainage of forested wetlands can reduce natural CH_4 emissions and potentially increase CO_2 emissions. Creation of forested wetlands from a non-forested land use through hydrologic modification and afforestation could increase CH_4 emissions and CO_2 removals. Loss of forest cover due to wildfire could emit CO and other GHG emissions, although such emissions would not be counted under deforestation unless the forest does not regenerate.

Conclusion: Most afforestation, reforestation, and deforestation in the U.S. involves very little non-CO_2 GHG emissions or removals. Limited special cases where land use changes to or from forested wetlands could result in changes to levels of naturally-produced methane.

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

Projections for the first commitment period are based on a combination of recent trends in inventory estimates (covering the period up to 1997) and long-term baseline projections as developed for the Resources Planning Act (RPA) Assessment (Review Draft for 2000). The baseline projections represent a “business as usual” scenario of expected economic conditions and extensions of current policies.

Some of the basic assumptions for resource projections in the RPA Assessment include:

- The human population of the U.S. will increase 50% by 2050, and will have more discretionary income and leisure time. Recreation demand will increase substantially.
- The U.S. timber harvest is expected to increase from 20 to 29 billion cubic feet by 2050.
- Timber product prices will stabilize after increases in the 1990s.

- Harvest from public lands is expected to remain stable after the significant decline between 1987 and 1997.
- Imports of wood fiber will increase over the next two decades and then stabilize.
- Wood production from private lands will increase, especially from plantations.
- Programs to encourage better management of private lands will continue at current levels.
- Forest industry will continue to increase productivity of its timberlands and efficiency of manufacturing wood products.
- Environmental regulations in the U.S., already among the strictest in the world, will continue to be enforced.
- Climate change will not affect the productive capacity of forest land.

FORCARB is part of an integrated model system used for projecting resource conditions in the U.S. The model system consists of an area change model (Alig 1985), a timber market model (TAMM - Adams and Haynes 1980), a pulp and paper model (NAPAP - Ince 1994) and an inventory projection model (ATLAS - Mills and Kincaid 1992). Through linkage with these models, FORCARB projects changes in carbon storage in private forests as a function of management intensity and land use change. A spreadsheet version of FORCARB, unlinked with economic models, is used for public forest lands managed primarily through a policy and planning process, and for forest land not meeting the minimum productivity and land use criteria for timberland (formerly called “productive” forest).

Estimates of the area of reforestation are from preliminary forest resource projections for the 2000 RPA Assessment. Estimates of the area of afforestation and deforestation are from extrapolation of land use change data from the Natural Resources Inventory. Estimates of changes in carbon density are from methods described earlier for current and recent historical time periods.

Trends beyond the first commitment period

All of the estimates of afforestation and reforestation presented in Table I increase over time since the carbon stock of new or regrowing forests increases with age (Table Ie). For afforestation, the carbon stock changes stabilize at about 2020 since the projected area of afforestation decreases substantially. For reforestation, carbon stock of regrowth must overcome debits from harvesting (FAO land-based I) and decay of logging debris (both FAO land-based I and land-based II) to create net credits during a commitment period. Projections through 2040 show continued increases in C stock changes from reforestation.

Annual area deforested is projected to continue to decline, so projected annual carbon stock decreases from deforestation also fall over time after the first commitment period.

Conclusion: Under an IPCC approach to reforestation, only a small share of U.S. land would enter the accounting system under Article 3.3, even after many years. Under an FAO definition of reforestation, eventually almost all forest land managed for harvest would become land under Article 3.3. At that point, carbon accounting for Article 3.3 land using a land-based approach would be very similar to comprehensive accounting for carbon stocks on all such forest land. See Table A in Section III(C) for more information on future trends.

U.S. Table II
Preliminary data and information provided by the United States on carbon stocks and area estimates (First sentence of Article 3.4).

LAND SYSTEM *Land System*	***Area (ha)***	**Carbon Stock in 1990** ***(t C)***
Forest (managed only)	198,611,000	36,203,000,000
Crop lands	168,127,000	12,453,974,000
Grazing lands (privately owned)	212,130,000	16,404,150,000
Grazing lands (federally owned)	58,700,000	4,539,271,000
Wetland (privately owned)	8,909,000	3,006,885,000
Wetland (federally owned)	5,059,000	1,707,270,000
Other (includes urban, water, etc.)	75,153,000	4,163,307,000
Total (as listed above)	**726,689,000**	**78,477,857,000**

Notes for Table II:

1. All data are preliminary.
2. These data include the continental 48 states and Hawaii. Alaska has not historically been inventoried in the U.S. Natural Resources Inventory and is not included here. Only about 0.15% of US cropland is in Alaska.
3. In addition to the 198.6 million hectares of managed forest, the U.S. had about 52.2 million hectares of other forested land, including forests in parks and wilderness. Data on other forested lands is not included.
4. For descriptions of cropland, grazing lands, and managed forests, see the explanatory text for Table III.
5. Areas for "Wetland" derive from the category for organic soil, non-cropland in the IPCC inventory. Wetland areas include private lands that have histosols (i.e., organic) soils only. They do not include other wetland soils or tundra.
6. Federal grazing land area was obtained from Sobecki et al., 2000.
7. Federal wetland area was derived from Heimlich et al., 1998.
8. Tundra is not included in this table due to incomplete data. Most U.S. tundra is montane tundra owned by Federal or State governments.
9. Due to limited data on Federally-owned grasslands, the C stocks on Federally-owned grassland is estimated by multiplying the average C stock per hectare on privately owned grazing lands times the number of hectares in federally owned grazing lands.

EXPLANATORY TEXT FOR U.S. TABLE II

1. Description of land categories, including any land categories not covered.

The 1990 carbon stock assessment includes U.S. cropland, managed forests (timberland), grazing land (pasture and rangeland), wetland, and ‘other’ land (chiefly urban/peri-urban, other rural land, and some montane tundra). Data include the contiguous 48 United States and Hawaii. Alaska is not included in the assessment. Alaska contains only 0.15% of total U.S. cropland, minimal grazing land, and only 3% of U.S. timberland. The primary data source, except for the forest category and federally-owned lands, is the US National Resources Inventory (NRI). Prior to 1997 Alaska was not part of the NRI. Forests that are not managed forests (such as parks, wilderness, wildlife preserves, and recreation areas) are not included.

Areas and carbon stocks for former wetlands that are used for agricultural production were included in the estimation of areas and carbon stocks on agricultural lands rather than in the "Wetland " category. Areas and carbon stocks for wetlands not used for agricultural production are organic (i.e. histosols), non-cropland soils on private lands. Due to data limitations, tundra is not included as a unique category in the analysis, and no estimates of the Federal or private land area in tundra have been made.

2. Carbon pools - distinctions and assumptions.

<u>Managed forests</u>

The following carbon pools are included in Table II:
- live tree biomass including roots;
- organic soil carbon to a depth of one meter;
- forest floor mass, which may include fine twigs;
- coarse woody debris and logging residue;
- understory carbon, which is live biomass of shrubs, seedlings, and herbaceous plants.

Carbon in dead wood in the forest is not currently included; estimates of this pool are under construction. Carbon in wood products is not included in Table II.

The carbon stock estimates in Table II come from the carbon forest inventory corresponding to 1990 (as of January 1, 1990). Table II estimates are the beginning inventory estimates from which the flux estimates for historical periods in Table III begin.

<u>Cropland and grazing land</u>

Table II includes carbon stocks in the top 30 cm of soil. The estimates for non-forest do not account for above or below ground plant biomass, harvested materials, or litter and woody debris. Data, particularly soil taxonomic distributions, are not available in NRI to perform a detailed analysis of federal land. Therefore, the average *per hectare* soil carbon stocks on federal grazing land and wetlands were assumed to be the same as that on the privately owned equivalent designation. Other data exist that could be used to make more refined estimates of soil C stocks on federal lands in 1990, if necessary.

3. Data sources.

See explanatory text for Table I for discussion of forest data sources.

The area of non-federal agricultural, grazing land, wetland and ‘other land’ were derived from 1992 National Resources Inventory data (NRCS, 1994). Carbon stocks under native vegetation, which represent pre-land-use carbon stocks, were obtained from the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories reference manual, Chapter 5 (Land-use Change and Forestry). Current (i.e. 1992) carbon stocks for mineral (non-organic) soils were estimated using these default values and the management factors reported in the IPCC guidelines (See ‘Methods’ below). Carbon stocks for organic soil ("wetland") were derived from Armentano and Menges (1986), who report stocks to 1 m depth, and adjusted to account for the top 30 cm of soil. Federal wetland areas were derived from Heimlich et al. (1998). Area of grazing land under federal ownership was obtained from Sobecki et al. (2000). Data summaries from NRI by Kellogg et al. (1994) were used to validate total areas assigned to various land-use categories from the electronically derived NRI data.

Eight broadly-defined climatic regions are described in the IPCC reference manual, but only six apply to U.S. land area (cold/temperate/dry, cold/temperate/moist, warm/temperate/dry, warm/temperate/moist, tropical/dry, and tropical/moist (short, dry season)). Climatic regions for the U.S. land area were determined using the PRISM (Parameter-elevation Regressions on Independent Slopes Model) climate mapping program (Daly, 1994). Major Land Resource Regions (NRCS, 1981) in the NRI were assigned to the appropriate climatic region based upon precipitation and temperature to implement the IPCC soil carbon inventory accounting method.

4. Methods.

See explanatory text for Table I for discussion of forest models and inventories.

For cropland and grazing land, we applied the IPCC inventory method to estimate 1992 carbon stocks. The IPCC inventory method uses values for carbon under native vegetation to establish baseline carbon stocks which are then altered by agricultural and grazing land activities as defined by base factors, tillage factors, and input factors.

Base Factor. The base factor represents the change in soil C that results when land under native vegetation is converted to agricultural production. In general, agricultural activities reduce the carbon stock present under native vegetation (to 60-70% of original), but there are some instances where the carbon stock may increase relative to the native condition (e.g. conversion to improved pasture). Carbon stocks on Federal land are assumed to be unaffected by cultivation and are therefore assigned a base factor of 1.0.

Input Factor. Input factors account for levels of residue returned to the soil, through residue management, use of cover crops, mulching, agro-forestry, and fallow frequency. The input factor represents the change in soil C resulting from crop production. Low input factors (0.9) are used when crop residues are removed or burned, where crop rotations with bare fallow are used, or where crops have inherently low residue production. For our analysis, all wheat- bare fallow, continuous cotton and cotton in rotation are considered low input activities. When fallow frequency is decreased (e.g. W-W-F), we increase the input factor to 0.95. Medium input factors (1.0) are applied for the majority of field crops, when crop residues are retained on the field. Most annual cropping activities (row crops and continuous small grain) are considered medium residue input activities in our analysis. High input factors (1.1) are applied when residue additions are significantly enhanced through the addition of mulches, green manure, or enhanced crop residue production. For our analysis, crop rotations that include hay, pasture, cover crops or are irrigated are considered high input operations.

5. Possible changes in carbon stocks.

For discussion of possible future trends in net carbon removals related to managed forests, see explanatory text for Tables I and III and Table A in Section III(C).

Carbon stocks in croplands and grazing land are projected to increase in the future through land-use change and adoption of tillage activities that enhance soil carbon. Increased adoption of conservation tillage, particularly no-till, and eliminating or reducing the frequency of summer fallow operations can increase soil carbon stocks. Adding a winter cover crop to a crop rotation increases residue inputs that contribute to increased soil carbon. Adoption of conservation tillage in the U.S. has increased over historical levels and there are substantial opportunities for additional conversion. Soil carbon stocks may also be increased by removing marginal cropland, particularly highly erodible land, from crop production activities and placing them in a set-aside program such as the Conservation Reserve Program (CRP). The USDA Economic Research Service Baseline Projections show an anticipated increase in CRP enrollments of over 11% to 36.4 Mha by 2003.

6. Uncertainties.

<u>Managed forests</u>

For managed forests, the 80% confidence interval for 1990 estimated carbon stocks is 33,940 to 38,466 MMTC, with an estimate of central tendency of 36,203 MMTC.

<u>Cropland and grazing land</u>

The areas and distributions of the major categories of land use and management have a high degree of certainty for non-federal (i.e. private and other public) land as registered by the NRI. The NRI employs a robust statistical design which includes ca.1 million individual points which are resampled every 5 years, with information (for agricultural lands) on crops grown in the previous 3 of the intervening 4 years. Numerical statistical uncertainties can be generated from NRI – we are in the process of doing so, but the complete analysis is not available at this time. Estimates of wetland area are more uncertain, due in part to definitional issues (i.e. what constitutes a wetland) and to their often fragmented nature (i.e. many small patches) which aggravates sampling error. Our estimate of areas in federally-owned grazing land is based on published estimates which incorporate a variety of data from USDA agencies (USFS, BLM, ERS) which are deemed to have a relatively high degree of certainty, although probably less than that in NRI.

The estimates of carbon stocks have a relatively higher degree of uncertainty in their present form, largely due to the use of the default baseline C stocks given in the IPCC Guidelines. The baseline C stock values are defined for broad, highly aggregate soil types by broad regional climate categories. Thus, for example, inherent difference in C stocks as a function of native vegetation type under which the soils were formed are not adequately represented. Because the NRI points contain detailed information of the soil type present (identified to the soil series – the finest taxonomic level), a much more detailed estimate of C stocks is possible. This analysis is currently being carried out (scheduled to be completed in August) and will provide a basis for assessing the uncertainty in C stock estimates (at various levels of spatial aggregation) associated with using the IPCC defaults.

U.S. 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 (million ha)**	**$CO_{2,I}$ (MMTCO_2)***	**$CH_{4,I}$ (MMT CO_2 equiv.)*[§]**	**$N_2O_{,I}$ (t CO_2 equiv.)*[§]**	**a_{II} (million ha)**	**$CO_{2,II}$ (MMT CO_2)***	**$CH_{4,I}$ (MMT CO_2 equiv.)*[§]**	**$N_2O_{,I}$ (MMT CO_2 equiv.)*[§]**
Activity		**Year: 1992**	**Total over 2 yrs 1990-1991**	**Total over 2 yrs 1990-1991**	**Total over 2 yrs 1990-1991**	**Year: 1997**	**Total over 7 yrs 1990-1996**	**Total over 7 yrs 1990-1996**	**Total over 7 yrs 1990-1996**
Forest management	Land-based	192.10	1751 **2,593** 2,852	see text	see text	198.93	7,893 **8,770** 9,648	see text	see text
Cropland management	Land-based	167.77	-15 **28** 73	-27 **-18** -9	-610 **-410** -205	168.28	156 **305** 501	-102 **-68** -34	-2250 **-1500** -750
Grazing land management	Land-based	274.41	63 **72** 186	see text	-209 **-140** -70	276.14	116 **184** 573	see text	-400 **-270** -135

See notes below.

Table III- continued

Article 3.4 Country specific data	**Accounting framework**	**a_{cp} (million ha)**	**ΔC_{cp} (MMTC)**	**$CO_{2,cp}$ (MMT 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**	**Other information relevant to decisionmaking**
Activity		**Year: 2013**	**Total over 5 yrs 2008-2012**						
Forest management	Land-based	196.15	1,225 **1,442** 1,658	**	§§	§§	Data analysis and models	Inventory data and research information; 80% confidence	see text
Cropland management	Land-based	168.28	46 **78** 116	**	§§	§§	IPCC and other inventories, models	see text	see text
Grazing land management	Land-based	276.14	14 **41** 105	**	§§	§§	IPCC and other inventories, models	see text	see text

See notes below.

Footnotes for Table III

* These columns 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)

** Adjustments to assigned amount will depend on the accounting approach adopted for the first commitment period, including any phase-in approach.

§§ Emissions of these non-CO_2 gases are already included in GHG inventories and will not result in adjustments to assigned amounts.

Column headers for Table III

a_I Area (ha) of managed land in 1992.

$CO_{2, I}$ Net CO_2 emissions (MMT CO_2) by sources and removals by sinks accumulated from 1990 to 1992.

$CH_{4, I}$ CH_4 emissions (MMT CO_2 equivalent) by sources related to the Article 3.4 activity, accumulated from 1990 to 1992.

$N_2O,_I$ N_2O emissions (MMT CO_2 equivalent) by sources related to the Article 3.4 activity, accumulated from 1990 to 1992.

a_{II} Area (ha) of managed land in 1997.

$CO_{2, II}$ Net CO_2 emissions (MMT CO_2) by sources and removals by sinks related to the Article 3.4 activity, accumulated from 1990 to 1997.

$CH_{4, II}$ CH_4 emissions (t C CO_2 equivalent) by sources related to the Article 3.4 activity, accumulated from 1990 to 1997.

$N_2O,_{II}$ N_2O emissions (t CO_2 equivalent) by sources related to the Article 3.4 activity, accumulated from 1990 to 1997.

a_{cp} Projected managed land area (ha) in 2013.

ΔC_{cp} Projected carbon stock changes (MMTC) 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.

U.S. Table IIIa

Annual average 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**	**$a_{I,}$ (million ha)**	**$CO_{2,I}$ (MMTCO_2)***	**$CH_{4,I}$ (MMT CO_2 equiv.)*§**	**$N_2O_{,I}$ (t CO_2 equiv.)*§**	**a_{II} (million ha)**	**$CO_{2,II}$ (MMT CO_2)***	**$CH_{4,I}$ (MMT CO_2 equiv.)*§**	**$N_2O_{,I}$ (MMT CO_2 equiv.)*§**
Activity		**Year: 1992**	**Annual Average over 2 yrs 1990-1991**	**Annual Average over 2 yrs 1990-1991**	**Annual Average over 2 yrs 1990-1991**	**Year: 1997**	**Annual Average over 7 yrs 1990-1996**	**Annual Average over 7 yrs 1990-1996**	**Annual Average over 7 yrs 1990-1996**
Forest management	Land-based	**192.10**	1,167 **1,297** 1,426	see text	see text	198.93	1,128 **1,253** 1,379	see text	see text
Cropland management	Land-based	167.77	-7 **14** 37	-14 **-9** -4.6	-300 **-200** -100	168.28	22 **44** 72	-15 **-10** -4.9	-320 **-210** -105
Grazing land management	Land-based	274.41	32 **36** 93	see text	-56 **-37** -19	276.14	17 **26** 82	see text	-58 **-39** -19

See notes below.

Table IIIa - continued

Article 3.4 Country specific data	**Accounting framework**	**a_{cp} (million ha)**	**ΔC_{cp} (MMTC)**
Activity		**Year: 2013**	Annual average for the 5 yrs **2008-2012**
Forest management	Land-based	196.15	245 **288** 332
Cropland management	Land-based	168.28	9 **16** 24
Grazing land management	Land-based	276.14	3 **8** 23

See notes below.

Footnotes for Table IIIa

* These columns 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 CO2 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)

Column headers for Table IIIa

a_I Area (ha) of managed land in 1992.

$CO_{2,\,I}$ Net CO_2 emissions (MMT CO_2) by sources and removals by sinks accumulated from 1990 to 1992.

$CH_{4,\,I}$ CH_4 emissions (MMT CO_2 equivalent) by sources related to the Article 3.4 activity, accumulated from 1990 to 1992.

$N_2O,_I$ N_2O emissions (MMT CO_2 equivalent) by sources related to the Article 3.4 activity, accumulated from 1990 to 1992.

a_{II} Area (ha) of managed land in 1997.

$CO_{2,\,II}$ Net CO_2 emissions (MMT CO_2) by sources and removals by sinks related to the Article 3.4 activity, accumulated from 1990 to 1997.

$CH_{4,\,II}$ CH_4 emissions (t C CO_2 equivalent) by sources related to the Article 3.4 activity, accumulated from 1990 to 1997.

$N_2O,_{II}$ N_2O emissions (t CO_2 equivalent) by sources related to the Article 3.4 activity, accumulated from 1990 to 1997.

a_{cp} Projected managed land area (ha) in 2013.

ΔC_{cp} Projected carbon stock changes (MMTC) 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 notes for Tables III and IIIa

1. Cropland includes annual cropping systems, hay, and conservation set-aside program lands.

2. Grazing land includes rangeland and continuous pasture. Federal grazing lands were added based on Sobecki et al., 2000 (58.7Mha). These lands are included in the base, but assumed to be steady state (no net change in soil C).

3. This table includes the conterminous U.S. and Hawaii. Due to data limitations, Alaska is excluded. Alaska includes < 0.15% of U.S. cropland and < 0.5% of U.S. grazing land. Alaska also includes 3% of U.S. managed forests and 1% of timber harvested each year.

4. In the analysis for this table, land could shift between the cropland and grazing activities, and new land can be added into either activity. However, once land is included in one of the activities it is not later removed. It remains included in the inventory throughout the analysis.

5. Estimates of N_2O from agricultural soils and grazing and CH4 from rice came from: USEPA, Office of Policy, Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-1997. EPA236-R-99-003, April, 1999.

6. N_2O emission estimates are based on emission factors specified in the 1996 Revised IPCC Guidelines for National Greenhouse Gas Inventories. The emission factors represent globally averaged emission factors that may be different for the U.S. Initial modeling estimates for specific sectors of U.S. croplands suggest that model estimates and IPCC emission estimates are within the IPCC uncertainty range of +/- 50%. These emissions are currently accounted for in the US greenhouse gas emission inventory and are not additional emissions that would result from possible implementation of Cropland or Grazing Land Management activities under Article 3.4. CH4 emissions for rice cultivation are estimated from U.S. specific information and do not rely on IPCC default values.

7. Changes in C stocks were estimated using the IPCC approach and USDA-NRCS National Resources Inventory data as reported in Eve, M., K. Paustian, R. Follett and E.T. Elliott 2000. A national inventory of changes in soil carbon from National Resources Inventory data (in press).

EXPLANATORY TEXT FOR U.S. TABLE III

1. **Activities and accounting.**

a) Definitions and descriptions of all activities proposed.

Forestland Management. Forest management is an activity involving the regeneration, tending, protection, harvest, access and utilization of forest resources to meet goals defined by the forest landowner. "Managed forests" are also known in the U.S. as timberlands. They are defined in the U.S. database as those lands which are capable of producing at least 1.4 $m^3ha^{-1}yr^{-1}$ of industrial wood under natural conditions and are not reserved for purposes other than timber production. For example, timberlands do not include parks, wilderness, recreation areas, wildlife preserves, or other forests that are inaccessible or otherwise not available or appropriate for wood production. See Section IV(A) for a fuller description of forest management.

Cropland Management. Cropland includes all land on which agricultural field crops are grown. This includes annual crop production, perennial crop production such as hay, and land that is still considered agricultural land but is not currently being used for crop production (e.g. set-aside and Conservation Reserve Program). All cropland is considered as managed for purposes of food and fiber production, using a variety of practices including crop selection and rotation, tillage, manuring, fertilization, irrigation, harvest and residue management.

Grazing land Management. Grazing land is defined by the Society for Range Management as: "a collective term that includes all lands having plants harvested by grazing without reference to land tenure or other land uses, management, or treatment practices." Grazing land includes all land on which the primary productive use is for herbivore grazing, including permanent (or long-term) pasture and rangeland. Grazing land management encompasses all practices aimed at manipulating the amount and type of forage and livestock produced, including regulation of animal stocking rates, forage species selection, fertilization, liming and irrigation. Our definition for grazing land does not include forested land that is grazed or land used primarily for annual crops or hay production that may be seasonally grazed.

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

The proposed activities are each broad management categories. See Section II for a discussion of land use categories in the United States.

c) Accounting approaches.

The accounting approach is a broad, land-based approach in which the total managed land areas for each category are included. All net carbon removals associated with these activities are accounted for by estimating changes in carbon stocks from the beginning to the end of the period.

<u>Managed forest</u>

The carbon in forest inventories is estimated for key inventory years. Subtracting successive inventories and dividing by the length of period gives an estimated flux (change in carbon stocks). Products are accounted for using the production approach. Thus, all emissions and sequestration from wood grown in the United States is counted in these estimates. Land use change is also included in this table. The carbon of any area leaving the timberland base is subtracted from the carbon inventory estimate.

Cropland and grazing land

Within the cropland and grazing land categories, land areas are classified according to climate, soil type and management system type, based on climate, soil and management (i.e. 'base', 'tillage' and 'input') factors defined in the Revised 1996 IPCC Guidelines. IPCC is a "snapshot" of changes in soil C. It uses a beginning and ending condition, then averages the total change across all of the years in the inventory. This type of inventory has some limitations, especially in deriving annual rates of change for a specific year or short interval. Currently, research is underway to implement a dynamic modeling approach utilizing the Century model that will overcome many of the limitations of the IPCC approach.

Factor values in the IPCC Guidelines are based on a twenty-year period, in other words, changes in C stocks (for mineral soils), in the inventory year, are a function of changes in land use and management that have occurred on the land during the past twenty-years. For the shorter inventory intervals requested for the table, factor values were adjusted for the appropriate time period as described below. Changes in soil carbon stocks (equivalent to net CO_2-C emissions/sinks for soils) were calculated for each period using data primarily from the US National Resources Inventory for the period 1982 through 1997. Accounting was based on tracking changes in management practices and/or conversion to other land uses for each individual NRI inventory point (of total ca. 1 million points). Each inventory point has a statistically determined expansion factor used to estimate the total land area represented by the point. The change in carbon stocks for 1990-1992 were estimated with the IPCC inventory method using the 1982 and 1992 National Resources Inventory (NRI) data to identify land-use, land-use change, and management changes (Eve et al., 2000). Changes in soil carbon stocks in the period 1990-1992 are a function of management and land use changes that have occurred since 1982. The default twenty-year inventory period in IPCC inventory method was adjusted to account for ten years (i.e. the influence of ten years is one-half the full twenty year inventory carbon stock change). An annual carbon stock change was determined and summed over the three-year period to complete the second column in Table III.

The carbon stock changes for 1993-1997 were estimated using the IPCC inventory method and the 1997 NRI data, with 1982 as the initial year of the inventory. Carbon stock changes during the five-year period were estimated by adjusting the twenty-year inventory results to fifteen years and annualizing total soil carbon changes between 1982 and 1997. The 1/1/1990 to 1/1/1997 table values are the combined sum of the calculated totals for the two year period (1/1/1990 to 1/1/1992) and the five year period (1/1/1992 to 1/1/1997).

The projected 2008-2012 C stock changes were estimated using the 1982-1997 NRI data and IPCC inventory but with the incorporation of projected changes in land use and management that will be outlined in a later section.

Data on grazing land under Federal ownership (predominantly semi-arid and arid rangeland) is not available from the NRI. At the present time it was assumed that soil C values on these grazing lands are at steady-state, with no net emissions (or sinks) of CO_2 from soil. Thus the area of these lands is included in the table, but has no impact on the changes in soil C stocks.

d) Key accounting features.

Managed forests

Projections are based on business-as-usual scenario adopted by the USDA Forest Service RPA timber assessment. The scenario used here is a draft currently out for review that will be published in a few months. For general information about the kind of assumptions the business-as-usual scenario is based on, see Haynes and others (1995) and Explanatory Text for Table I above.

Cropland and grazing land

Baseline soil carbon stocks and stock changes on cropland and grazing land were estimated from the land-use and management designation, soil characteristics, climate, and carbon stocks under native vegetation as defined by the IPCC inventory method. Areas covered by each activity were estimated from the NRI. All land area within the cropland and grazing land categories as of 1992 (closest survey date to 1990) were maintained as part of the total inventory area in subsequent years, regardless of subsequent changes in land use or management. Land was not allowed to shift between activities, but additional land may be identified as either cropland or grazing land. Once it has been identified as cropland or grazing land, it is included in the inventory throughout the analysis and cannot be assigned to another category.

3. Carbon pools included.

Managed forests

The following carbon pools are included in Table III :

- Live tree biomass including roots;
- Organic soil carbon to a depth of one meter;
- Forest floor mass, which may include fine twigs;
- Understory carbon, which is live biomass of shrubs, seedlings, and herbaceous plants;
- Coarse woody debris and logging residue;
- Carbon that goes into wood products and landfills.

Carbon in dead wood in the forest is not currently included; estimates of this pool are under construction.

Accounting issue: treatment of carbon in historical harvested wood

If comprehensive accounting for carbon pools begins in 2008 and harvested wood products are included in the accounting system, then an issue arises as to how and whether to count carbon in wood products and landfills that entered those pools before 2008, the so-called “historical carbon.” Historical carbon in products is decaying during the commitment period, and if that decay is counted, then those emissions would reduce the total net removals from forest management and affect the projections provided in Table III. The Pool Table below illustrates this effect.

Pool Table

Average annual projected carbon flux (MMTC/yr) for U.S. managed forests for the period 2008-2012, comparing three starting dates for accounting for carbon from harvested wood products in MMTCE (central estimates only)			
Product accounting begins in:	**1970**	**1990**	**2008**
Carbon taken up by managed forests	381.9	381.9	381.9
Total carbon in harvested trees	-276.0	-276.0	-276.0
Carbon taken up by forest soils	52.4	52.4	52.4
Carbon taken up by forest floor	12.8	12.8	12.8
Carbon taken up by understory	0.7	0.7	0.7
Net carbon accrual in live biomass and soils (sum of pools above)	**65.9**	**65.9**	**65.9**
Carbon Stored in Logging Residue	**15.2**	**26.1**	**26.1**
Carbon in products in use	33.1	39.1	90.2
Carbon in products in landfills	52.7	51.3	20.2
Total carbon stored in products in use and in landfills	**85.8**	**90.4**	**110.4**
Net Carbon Removals related to managed forests (live biomass and soils, logging residue, products)	**272.8**	**288.3**	**308.3**

The column labeled "1970" includes changes in the products and logging residue pools starting in 1970. The column labeled "1990" includes changes in these pools starting in 1990. The column labeled "2008" includes changes in these pools starting in the year 2008, with the exception of logging residue, which is counted since 1990. If, instead, logging residue had been counted starting in the year 2008, the C in logging residue would be higher than 26.1 MMT/yr, and the total net C removal would have been correspondingly higher.

In the set of illustrative projections in the Pool Table, the net carbon removals can differ by 35 MMTE per year with the only difference being the treatment of the timing for accounting for carbon in harvested wood products. If comprehensive accounting includes changes in the logging residue and products pools starting in 1970, the total net carbon removals is estimated at 273 MMTCE per year.[4] If comprehensive accounting includes changes in the logging residue and products pools starting in 2008, the total net carbon removals is 308 MMTCE per year greater. For the purposes of providing projections for Table III, we have used an intermediate date of 1990 for accounting for carbon emitted by harvest wood in products and landfills.

<u>Cropland and grazing land</u>

The data presented in Table III represent carbon stock changes in the top 30 cm of soil during the accounting period.

Data on above or below ground plant biomass, harvested materials, or litter and woody debris are not yet available for grazing lands, where those pools may be significant. Because grazing lands represent such a large part of land use in the U.S., understanding their carbon storage dynamics and

[4] Starting before 1970 would add little to this accounting. On a national level, most of the dynamics of emissions from harvested wood products occur in the first 20 to 25 years after harvest.

the mechanisms whereby carbon is emitted or stored is important. Most of the soil organic carbon in grassland soils (about 75%) is recalcitrant, has a slow rate of turnover, is well protected from natural disturbances, and is generally resistant to change. The above-ground plant biomass and below ground plant biomass pools are more dynamic but represent a small amount of the total amount of carbon. For example, in the central U.S. grasslands, it has been estimated that the above-ground plant-biomass carbon pool is less than 1% of the total amount of carbon while the below-ground plant-biomass carbon pool is about 10% of the total amount of carbon. Thus, short-term perturbations of above-ground biomass alone are not likely to cause large changes in soil carbon storage; recovery from such perturbations is likely to be rapid.

See Section VI above more discussion on carbon pools.

4. Methodologies and data.

a) Data sources.

<u>Managed forests</u>

See Explanatory Text for Table I for discussion of forest data sources.

<u>Cropland and grazing land</u>

Areas in cropland and grazing land categories were derived from 1982-1997 National Resources Inventory data (Kellogg et al., 1994; NRCS, 1994; NRCS unpublished). For the analysis, more specific delineation of major land use/land cover types, i.e., forest, cropland, pasture, rangeland, urban/peri-urban, wetland and water were made. NRI points were further subdivided according to climate, soil and management practices as described in the Explanatory Text for Table II (See Methods). Carbon stocks, as a function of climate, soil and management attributes were based on native C stock estimates and default factor values the 1996 Revised IPCC Guidelines for National Greenhouse Gas Inventories reference manual, Chapter 5 (Land-use Change and Forestry). Data on tillage practices are not routinely collected as part of the current NRI and thus estimates of tillage practices were derived from the Conservation Tillage Information Center (CTIC-www.ctic.purdue.edu) database. CTIC collects data annually on areas by tillage practices by major crop types at the county-level for the US. CTIC data do not currently differentiate between continuous and intermittent use of no-tillage, and thus regional-based estimates for continuous no-tillage (defined as 5 or more years continuous use) were developed from consultation with CTIC experts (through downward adjustment of total no-tillage acres reported).

b) Sampling techniques.

<u>Managed forests</u>

See Explanatory Text for Table I for discussion of forest data sampling techniques.

<u>Cropland and grazing land</u>

The NRI is stratified multi-stage design, where primary sample units (PSU) are stratified on the basis of county and township boundaries defined by the US Public Land Survey (Nusser and Goebel 1997). Within a PSU, typically a 160-acre (64.75 ha) square quarter-section, three sample points are selected according to a restricted randomization procedure. Primary sources for data collected at each sample point include aerial photography and remote sensing materials as well as field visits and county office records. CTIC data are collected from survey methods on a county-by-county basis, with counties having > 10,000 ha providing annual reports. Data are collected by USDA-NRCS field offices and by soil and water conservation districts, including tillage system used prior to planting, pre-plant residue level, area per crop planted.

c) Models and key parameters.

Managed forests

See Explanatory Text for Table I for discussion of forest models and parameters.

Cropland and grazing land

The estimation procedure uses the IPCC inventory method to estimate carbon stock changes and CO_2 emissions (or sinks) from soils. The IPCC inventory method uses values for carbon under native vegetation to establish baseline carbon stocks which are decreased through agricultural activities as defined by base factors, tillage factors, and input factors, as described in the Explanatory Text for Table II (see Eve et al., 2000). IPCC global default values were used to derive the changes in soil C stocks resulting from changes in land use and land management. Land use changes were determined Through analysis of the 1997 NRI data. An error was discovered in the 1997 NRI database that is currently being corrected (see www.nhq.nrcs.usda.gov/NRI/). The error is not expected to have an impact on cropland or grazing land analysis, but results reported here should be considered preliminary until the analysis can be run on corrected NRI data. The 1990-1992 analysis is based on NRI data from 1982 and 1992. The 1993-1997 analysis is based on NRI data from 1982 and 1997. The projected 2008-2012 BAU estimate is based upon NRI data from 1982 and 1997, with projected changes incorporated into the 1997 data.

The base factor used for set-aside in the IPCC manual is 0.8. This is the factor used for land enrolled in the CRP program. We compared the result of this analysis with recently published literature on the effect of CRP on soil C levels (Paustian et al., 2000; Follett et al., 2000; Huggins et al., 1998; Gebhart et al., 1994). It was decided that a base factor of 0.9 is a more accurate factor specific to the U.S. situation. For the low value in the range, the CRP base factor of 0.8 was used. For the high value, 0.9 was used.

The IPCC manual outlines a base factor of 1.1 for improved pasture lands. For the low value in the U.S. inventory range, we used a base factor of 1.1 for pasture that the NRI indicated is either irrigated or has legumes in the species mix. We used a value of 1.0 for the remainder of the pasture lands. For the higher value in the range, we assumed that all privately owned pasture lands in the U.S. are highly managed, and thus applied the base factor of 1.1. Schnabel et al. (2000) estimate 25% of pastures have animal manure applied as part of pasture management. For purposes of the 1993-1997 inventory, we conservatively assumed that 15% of the pasture lands had manure application. Then for the projection (2008-2012) we assumed the full 25% from Schnabel et al. (2000). The effect of manuring in IPCC is a base factor of 1.2. We applied this increase in soil C to the high number in each range, leaving the effect of manuring out of the lower value.

As mentioned previously, CTIC tillage numbers were adjusted to account for long-term adoption of no-till or conservation tillage. The adjusted values were used in computing the low value in each range. We applied the unadjusted tillage numbers directly from the CTIC Crop Residue Management Survey data base to derive the higher value in the range.

d) Uncertainties.

Managed forests

See Explanatory Text for Table I for discussion of uncertainty in forest estimates.

Cropland and grazing land

Uncertainties in our estimates of CO_2 emissions/sinks and changes in carbon are dependent on the accuracy of area estimates of land use/management changes and accuracy and representativeness of factor values in the IPCC method. The NRI data quantifying land use and management changes has a high degree of certainty. For example, the 95% confidence limit for estimated change in area between the major land use categories (e.g. forest, cropland, range, pasture, etc.) for the inventory period 1982-1992, for US aggregate numbers, is about 1% of the mean. Changes in management, within a land-use, have somewhat greater uncertainty, particularly for tillage, where the data source (CTIC surveys) is based on a less rigorous sampling design. We have not yet evaluated the uncertainty of the factor values from the 1996 Revised IPCC Guidelines for their appropriateness for US conditions. The default factors were derived from an extensive survey of published studies, largely comprised of long-term replicated field experiments, as described in the Reference Manual for the 1996 Revised Guidelines. We are currently assembling a comprehensive and updated set of comparable data for the US in order to evaluate the uncertainty of the factor values under US conditions.

An additional area of uncertainty is the potential change in soil C stocks as a result of factors other than changes in land use and management systems as defined in the IPCC methods. Among these is the overall increase in amounts of carbon being returned to soils in crop residues, due to the steady rise in agricultural productivity that has occurred in the US and elsewhere over the past several decades, due to crop improvements and increased fertilization. Such changes, more or less ubiquitous across crop rotation and tillage type, are not addressed in the IPCC method. Likewise, the possible effects of changes in climate conditions (as well as CO_2 enrichment and N deposition), which might be significant on decadal time scales, are not captured with the current IPCC method. We have ongoing work to evaluate these uncertainties using simulation model based approaches.

Because of these uncertainties, we purposely used conservative input values (e.g. adjusting the CTIC tillage numbers downward to better represent long-term adoption). The result is a range of soil C stock changes associated with a high degree of confidence. While the actual change could be higher than the range presented, our conservative approach makes it highly unlikely that the actual change would be lower than the range presented.

5. Treatment of non-CO_2 greenhouse gases.

Managed forests

The United States includes estimates of all N_2O emissions from soil on which nitrogen fertilizer is applied in Table III under “cropland management,” even though some of those emissions would actually derive from fertilizer applications in managed forests. Data limitations precluded breaking out the land category on which fertilizer is applied.

The IPCC Special Report on LULUCF provided little guidance for the treatment of non-CO_2 gases, and there are also no methodologies for such estimates in the 1996 IPCC Guidelines. For these reasons, we propose that such emissions and removals not be included in emissions inventories, at least in the first commitment period. Parties may want to consider whether the IPCC should be asked to revisit these issues and the state of science when it next revises the emissions inventory methodologies in preparation for future commitment periods.

Cropland and grazing land

N_2O (from cropland and grazing land) and CH_4 (from cropland) emission estimates are based on emission factors specified in the 1996 Revised IPCC Guidelines for National Greenhouse Gas Inventories (US EPA, 1999). The emission factors represent globally averaged emission factors that may be different for the U.S. Initial modeling estimates for specific sectors of U.S. croplands suggest that model estimates and IPCC emission estimates are within the IPCC uncertainty range of +/- 50%. These emissions are currently accounted for in the US greenhouse gas emission inventory and are not additional emissions that would result from possible implementation of Cropland or Grazing Land Management activities under Article 3.4.

Grazing land soils remove CH_4 from the atmosphere as a result of microbial processes in the soil. For example, based on area projections in Table III and rate per unit area estimates by Mosier et al. (1996), grazing lands could remove from 3 to 7 MMTCE per year during the first commitment period. Those estimates are not included in Table III because the United States has not proposed including those removals under Article 3.4.

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.

Managed forests

Projections for forests are based on business-as-usual scenario adopted by the USDA Forest Service RPA timber assessment. The scenario used here is a draft that is currently out for review. For general information about the kind of assumptions in the business-as-usual scenario, see Haynes and others (1995) and the Explanatory Text for Table I. See discussion of Table A in Section III for data and information regarding trends beyond the first commitment period.

Cropland and grazing land

Greenhouse gas changes during the commitment period were estimated using the IPCC inventory method assuming agricultural production would be represented in a "business-as-usual" fashion. Total carbon stock changes during the commitment period are based upon the assumption that agricultural cropping practices and land-use remain the same as identified in the 1997 NRI except for hectares enrolled in Conservation Reserve Program (CRP). The USDA Baseline Projections (2000) identify CRP hectares increasing to 14.7 Mha (36.4 M ac.) by the start of the commitment period. In our data, this represents about an 11.5% increase in CRP, which results in the increased mitigation of CO_2 shown in Table III. To assign CRP enrollments to the climatic region most likely to increase CRP participation, we determined the location of historic CRP enrollments and proportioned additional CRP areas to each region weighted by its historic enrollments. CTIC data indicate that new adoption of no-till and conservation tillage had leveled off by the late 1990's. For our first commitment period projection, we assumed that new adoption of improved tillage practices remains level.

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VIII. Proposed Decision Text for COP-6

- The United States proposes the following elements for inclusion in a decision by the COP at its Sixth Session recommending adoption of a decision on sinks by the COP/moP. For ease of compilation, these proposals correspond to elements contained in the Draft Conclusions by the Chairman, FCCC/SBSTA/2000/CRP.2.

- In the view of the United States, issues related to Articles 3.3 and 3.4 need to be dealt with in a single decision.

- We note that the final content of any decision will depend on the full package to be negotiated, and that changes in these proposals may be needed depending upon discussions within SBSTA and the relevant working groups.

The Conference of the Parties serving as the meeting of the Parties,

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

Noting the scientific and technical information provided in the Special Report on Land Use, Land Use Change and Forestry prepared by the IPCC,

[Proposed definitions and accounting approaches related to afforestation, reforestation and deforestation under Article 3.3]

1. *Decides* that for the purposes of implementation of Article 3.3 and Article 3.4, the following definitions shall apply:

a. "forest" means land

(i) with tree crowns (or equivalent stocking) of a percentage determined in accordance with paragraph 2 below, and

(ii) with a minimum area determined in accordance with paragraph 2 below, and

(iii) on which the trees have a potential to reach a minimum height of 5 meters at maturity *in situ*, and

(iv) on which trees are found in either a closed formation where trees of one or more stories and undergrowth cover a high proportion of the ground, or an open formation with a continuous vegetation cover in which tree crown cover exceeds the percentage determined in accordance with paragraph 2 below, and

(v) where use is not predominantly for agricultural purposes and the land has not been developed for a nonforest use.

"Forest" also includes [young natural stands and plantations established for forestry purposes which have yet to reach a crown density or area as specified in accordance with paragraph 2 below; areas normally forming part of the forest which are temporarily non-stocked as a result of human intervention or natural causes but which are expected to revert to forest; and, forest nurseries and seed orchards that constitute an integral part thereof; forest roads and trails; cleared tracts; firebreaks, reserves and other protected areas such as those of special environmental, scientific, historical, cultural, or spiritual interest; windbreak and shelterbelt trees with an area of more than 0.3 hectares; rubber plantations and cork oak stands.][5]

b. "afforestation" means the direct human-induced conversion (including planting, seeding, and natural regeneration) of land to forest that has not historically been forest.

c. "deforestation" means the direct human-induced conversion of forest to land that is not forest.

d. "reforestation" means the direct human-induced conversion (including planting, seeding, and natural regeneration) of land to forest that has historically been forest but has been converted to land that is not forest.

e. "land under Article 3.3" means land that is afforested, deforested, or reforested since 1990.

f. "land under Article 3.4" means land on which an activity under paragraph 3(a) below has taken place since 1990.

g. "management" means the human application of practices intended to control or maintain land-based resources. Management of forest includes, <u>inter alia</u>, commercial forestry practices. Management of cropland includes, <u>inter alia</u>, practices on land on which agricultural field crops are grown and on land that is considered cropland but is not being used for crop production. Management of grazing land includes, <u>inter alia</u>, practices aimed at manipulating the amount and type of forage and livestock produced.

2. *Further* decides that each Party in Annex I shall, for purposes of applying the definition of "forest" in paragraph 1(a) above to its own lands, elect a minimum tree cover of between 10 percent and 25 percent, and a minimum land area of between 0.3 hectares and 1.0 hectare, and shall specify its elections in its pre-commitment period report submitted under Article 7.4. This election is irrevocable.

[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.]

3. *Decides* pursuant to Article 3.4 that

a. The following additional human-induced activities related to changes in greenhouse gas emissions by sources and removals by sinks in the agricultural soils and the land-use change and forestry categories shall be added to, or subtracted from, the assigned amounts for Parties included in Annex I for the second and subsequent commitment periods:

(i) forest management;

(ii) cropland management;

(iii) grazing land management.

[For definition of "management," see definitions section above.]

[5] This material is based on the FAO definition of "forest." Further work will be needed to express these ideas in legal form.

b. If a Party meets the accounting requirements set forth in paragraph 4 below, it may elect to apply one or more of the additional activities specified in paragraph 3(a) above to its assigned amount in the first commitment period, provided that these activities have taken place since 1990. The Party shall specify the additional activities it elects to apply in its pre-commitment period report submitted under Article 7.4. This election is irrevocable for the first commitment period.

[c. Discount Option: A Party electing to apply [one or more additional activities][specific activity Y]under paragraph 3(a) above for its first commitment period may add to its assigned amount for that commitment period only [X] percent of any positive net removals related to [those activities][activity Y].

or

Threshold Option: A Party electing to apply [one or more additional activities][specific activity Y] under paragraph 3(a) above for its first commitment period may add to its assigned amount for that commitment period only the positive net removals in excess of the threshold [specified for that Party in Annex Z][formula based on country-specific data and information].]

[Methodologies for measuring and reporting in relation to Article 3.3 and 3.4 activities.]

4. *Decides* that Parties shall develop, maintain and use data and measurement systems related to land use, land use change and forestry categories in accordance with methods included in the 1996 Revised IPCC Guidelines, as elaborated through Good Practice Guidance approved by the COP/moP.

[Overall accounting approaches in relation to requirements of Article 3.3, 3.4 and 3.7, and regarding, <u>inter alia</u>, reversibility, natural effects, and accounting interlinkages.]

5. *Decides* that, for the purposes of implementation of Article 3.3 and Article 3.4, the following accounting rules shall apply:

a. For each commitment period, the changes in carbon stocks associated with land under Articles 3.3 and 3.4 shall be measured from the time the activity first occurred since 1990 or the beginning of that commitment period, whichever is later, to the end of that commitment period.

b. Parties shall account for carbon pools associated with land under Articles 3.3 and 3.4. These carbon pools include, <u>inter alia</u>, live biomass including roots, litter mass, organic soil carbon to a depth appropriate to the vegetative cover, logging residue, standing or down dead wood, and products in landfills. Carbon in harvested biomass products should be included in accordance with rules to be established by the COP/moP.

c. Applicable non-CO_2 greenhouse gas emissions associated with land under Article 3.4 shall be included in a Party's inventories in a manner consistent with COP/moP decisions on agreed methodologies, including good practice;

d. Once land is accounted for under Articles 3.3 and 3.4, Parties must continue to account for that land unless emissions associated with that land are insignificant.

[Other]

6. *Decides* that:

a. Parties should take into account, as appropriate, ancillary environmental effects in developing their domestic approaches related to implementation of Article 3.3 and Article 3.4, including effects on biodiversity, soil, air and water quality, the capacity of ecosystems to adapt to climate change, risks of degradation, long-term vulnerability to disturbance by fire, pests and invasive species, and the protection of primary and maturing secondary native forests.

The decision by the COP should also contain a freestanding provision (i.e., not part of the recommended COP/moP decision) along the following lines:

. Requests that the IPCC develop good practice guidance on accounting for emissions and removals under Article 3.3 and Article 3.4 to be applied in accordance with future decisions of the COP/moP.

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