United States Submission on

Land-Use, Land-Use Change, and Forestry

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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:

- 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. 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

[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.

emissions both at the time of the loss of native forest cover and thereafter (resulting from decaying 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

<u>Land use trends in the United States</u>

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.

<u>The U.S. approach to defining forest</u>

- 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

[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.

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:

  - 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:	**1997**	**2008-2012**	**2013-2017**	**2018-2022**
Estimated net carbon stock change for all U.S. managed forests, average annual MMTCE	(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

- 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.

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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.

- 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.

<u>Management improvements on U.S. cropland</u>

- 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

<u>Phase-in approach for the first commitment period</u>

- 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)*

G. 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.

H. 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.

I. 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.

J. 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.

Wood products and accounting

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

c) 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	***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.

Managed forests

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.

Cropland and grazing land

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.

Managed forests

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.

Cropland and grazing land

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.

Cropland and grazing land

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 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 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.

Managed forests

See Explanatory Text for Table I for discussion of forest data sources.

Cropland and grazing land

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.

Managed forests

See Explanatory Text for Table I for discussion of forest data sampling techniques.

Cropland and grazing land

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, inter alia, commercial forestry practices. Management of cropland includes, inter alia, 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, inter alia, 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.

5 This material is based on the FAO definition of "forest." Further work will be needed to express these ideas in legal form.

[For definition of "management," see definitions section above.]

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, inter alia, 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, inter alia, 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.