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ESTIMATION, REPORTING AND ACCOUNTING OF HARVESTED WOOD PRODUCTS

Technical paper

Summary

This document provides technical information on estimating, reporting and accounting of harvested wood products. It contains a set of definitions relating to wood products, global data on stocks and trade of wood products and descriptions of methodologies for estimating and measuring carbon stocks contained in these products.

It also describes the socio-economic and environmental impacts of different approaches for accounting. Each approach is analysed with regard to the implications of accounting of emissions and removals on prices, demand and supply of wood products, bioenergy, recycling, selected social variables, the environment, incentives created for sustainable forest management, and the emission-limitation targets under the Kyoto Protocol. Examples of the possible effects of different approaches on national greenhouse gas emissions and removals in selected countries are also provided.

CONTENTS

I. INTRODUCTION

A. Mandate

1. The Subsidiary Body for Scientific and Technological Advice (SBSTA), at its fifteenth session, requested the secretariat to prepare a technical paper on harvested wood products accounting, taking into account socio-economic and environmental impacts, including impacts on developing countries, for consideration at its nineteenth session. The SBSTA requested the secretariat to prepare this technical paper with the assistance of a limited number of experts from the United Nations Framework Convention on Climate Change (UNFCCC) roster of experts, ensuring an adequate participation of experts from developing and developed countries, as well as from countries with economies in transition (FCCC/SBSTA/2001/8, para. 29 (l)).

B. Scope of the note

2. In accordance with the mandate from the SBSTA, this technical paper builds upon submissions by Parties contained in documents FCCC/SBSTA/2001/MISC.1 and FCCC/SBSTA/2003/MISC.1 and Add.1–2, and on the report of the Intergovernmental Panel on Climate Change (IPCC) expert meeting held in Dakar, Senegal, on 5–7 May 1998 (Brown et al., 1999). Issues and questions raised by Parties in their submissions have been taken into account in this technical paper. The paper has drawn on information from other relevant sources (see list of references), in particular a paper prepared for the secretariat by a consultant (Pingoud, 2003).

3. A group of experts assisted the secretariat in the preparation of the present document: Mr. Justin Ford-Robertson (New Zealand), Mr. Wojciech Galinski (Poland), Mr. Daniel Martino (Uruguay), Mr. Kim Pingoud (Finland), Mr. Kenneth Skog (United States of America), Mr. Mario Tonosaki (Japan) and Ms. Jenny Wong (Malaysia). Mr. Adrian Whiteman (Food and Agriculture Organization of the United Nations (FAO)) also assisted the secretariat in the preparation of this paper.

4. The concept of “harvested wood products” includes two separate elements which were highlighted during the IPCC expert meeting in Dakar: forest harvesting and wood products (Brown et al., 1999). For the purposes of this document, the term “wood products” is used instead of “harvested wood products” to draw attention to the difference between changes in carbon stocks and greenhouse gas emissions resulting from forest harvesting, and those associated with wood products.

5. The technical paper is divided into six chapters. Chapter II includes background information to answer the question on whether global stocks of carbon in wood products are increasing. It also illustrates the movements of wood products in the international markets as well as their distribution, and provides a background for chapter V.

6. The implications and impacts derived from the consideration of wood products within the UNFCCC and its Kyoto Protocol are contained in chapter V. This chapter builds on the information included in the former chapters and is the result of the discussions in a two-day expert meeting organized by the secretariat and held in Bonn from 4 to 5 September 2003. In its first part, chapter V focuses on the socio-economic implications for both developing and developed countries, in particular on impacts on trade.

C. Possible action by the SBSTA

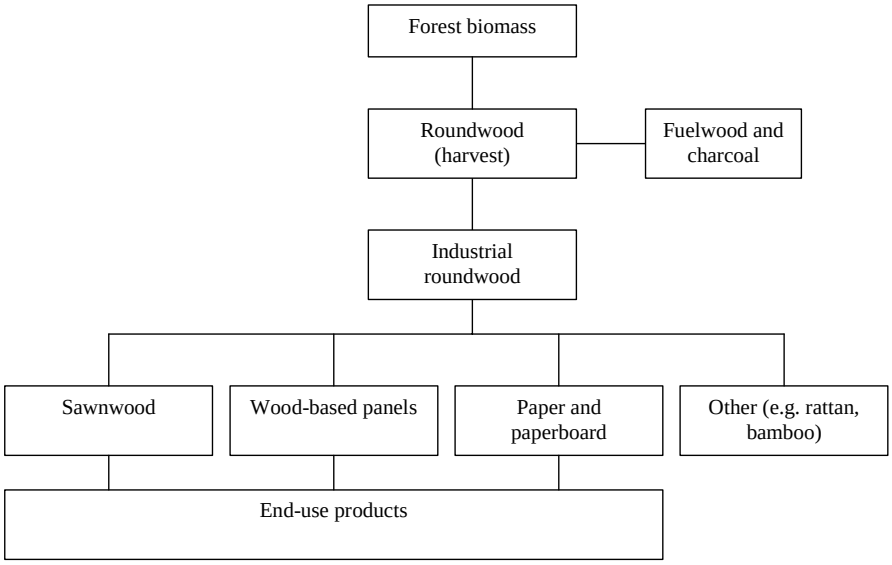
7. The SBSTA may with to take note of the information contained in this technical paper, with a view to agreeing on what further work, if any, is needed with regard to the treatment of wood products.

II. TECHNICAL BACKGROUND

A. Concepts and definitions

8. **Wood products** are wood-based materials harvested from forests, which are used for the production of commodities such as furniture, plywood, and paper and paper-like products, or for energy. In principle, other fibre products from non-timber sources, such as rattan or bamboo, could also be considered wood products. Figure 1 introduces the classification of wood products used in this document.

Figure 1: Classification of wood products



Source: Based on FAO (2000).

9. The FAO defines **roundwood** as "wood in the rough", which includes all wood in its natural state, as felled or harvested. It may or may not have bark[1] and may come in any shape (round, split, roughly squared and others). Roundwood may be used as raw material for wood products or for energy production (FAO, 2000, pp. xx–xxii).

10. The portion of roundwood used for the production of wood commodities, known as **industrial roundwood**, is further converted into sawnwood, wood-based panels or paper and paperboard:

(a) **Sawnwood** is roundwood that is sawed lengthways or by profile chipping, to produce planks, beams, joists, sleepers and lumber;

(b) **Wood-based panels** include veneer sheets, plywood, particle board and fibreboard;

[1] The international agreed convention to record statistical information on roundwood is to measure it under the bark.

(c) **Paper and paperboard** include newsprint, printing and writing paper, and other products, which are usually manufactured in strips and rolls more than 15 cm wide. Paper and paperboard are produced from pulp, a fibrous material prepared from pulpwood, wood chips, wood residues and/or recovered paper.

11. Other materials harvested from forests or other wooded lands that accumulate carbon in their biomass, include natural cork, bamboo and rattan. Bamboo and rattan are often used for furniture and construction.

12. **End-use products** are products with a specific use that will not go through an additional transformation other that recycling, disposal in solid waste disposal sites (SWDS) or energy production. They include furniture, wooden tools, paper and others.

13. **Life cycle** of wood products refers to the set of subsequent transformations that wood undergoes between harvesting and final disposal in SWDS, by incineration, or by recycling.

14. Some concepts used to describe the durability of wood products may be relevant for the purposes of developing greenhouse gas inventories. **Lifetime** means the period of time that an end-product is in use, before it is disposed of or recycled. Lifetime is usually expressed in two different ways: **half-life** refers to the time taken for half of the carbon contained in wood products to be emitted (Skog and Nicholson, 2000); and **average lifetime** is the time, on average, during which a specific product is in use. Once a product has reached the end of its lifetime, this does not necessarily imply that the carbon contained in it will be emitted into the atmosphere, as recycling or land filling can further delay emissions.

15. In the context of the present document, it is important to distinguish the terms “method” and “approach”. **Approach** means “a conceptual framework for estimating emissions and removals of greenhouse gases in inventories” (Brown et al., 1999, p. 19). In practice, the approach refers to the allocation of the emissions or changes in carbon stocks between consuming and producing countries (e.g. where and when allocation is done). **Method** is the calculation framework within an approach for estimating emissions and removals resulting from changes in the stocks of wood products. In practice, method refers to the measurement and estimation of greenhouse gas emissions from wood products.

16. Additional concepts which need to be defined include: **estimation**, which is the process of calculating emissions or changes in carbon stocks; **reporting**, which is the action of providing the results of the estimation to the UNFCCC secretariat in a standardized manner; and **accounting**, which refers to the rules for comparing emissions and removals, as reported, with the commitments assumed by all Annex I Parties under the Kyoto Protocol.

B. Life cycle of carbon in wood products

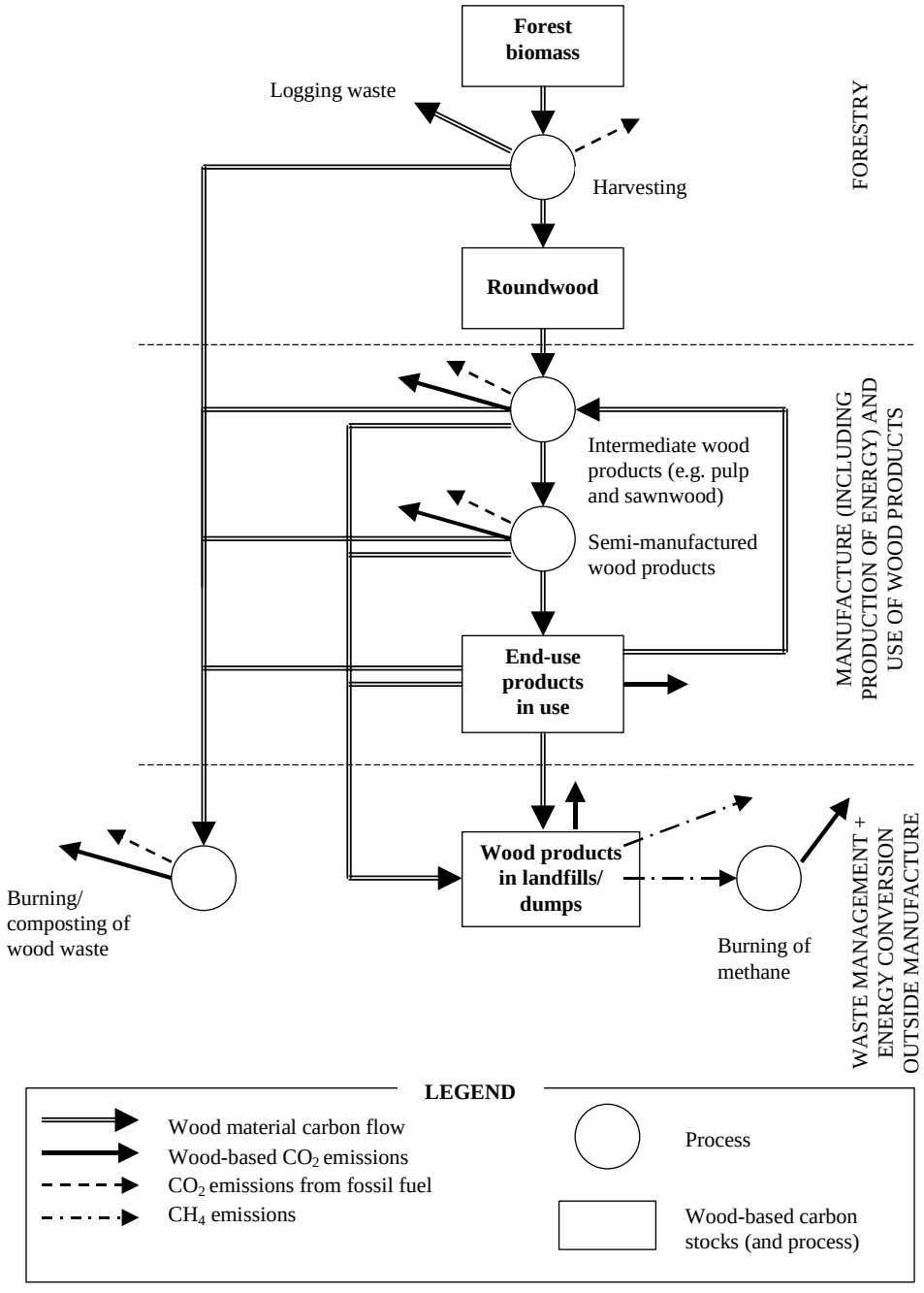
17. Trees are a stock of carbon which has been converted into biomass as the result of photosynthesis. When this biomass is harvested and transformed into wood products, a portion of the carbon contained in the biomass remains fixed until the products decay or are burned. Wood products themselves are not sinks of carbon but rather reservoirs to which the carbon resulting from photosynthesis is transferred. However, decaying products are a source of greenhouse gas emissions, principally CO_2. A distinction must be made between an increasing stock of carbon resulting from the accumulation of wood products and emissions resulting from decay of the products.

18. According to Nabuurs and Sikemma (2001), wood products can affect the carbon cycle because they store carbon, they are substitutes of materials whose production results in larger fossil fuel emissions, and they are a renewable source of energy. In addition, existing wood

products are a source of carbon dioxide and methane emissions as they decay. On the other hand, by using wood products as a substitute energy source, emissions from other sources, such as fossil fuels, could be reduced.

19. Within the cycle of carbon in wood products, a distinction should be made between emissions from harvesting and changes in carbon stocks resulting from wood products. Harvesting causes direct emissions of greenhouse gases due to soil being exposed to oxidation, and slash. The carbon stored in the harvested wood will enter the cycle of manufacturing, use and disposal, and any emissions from this source will occur at different stages of the process (figure 2).

Figure 2: Life cycle of wood products



Source: Adapted from Pingoud (2003).

20. In general, the flow of carbon within the life cycle of wood products follows four main steps: transfer of carbon from forests to harvested roundwood; transfer of carbon from roundwood to intermediate products; transfer of carbon from intermediate products to secondary and/or end-use products; and transfer of carbon from end-use products to SWDS or the atmosphere.

C. Lifetimes and end-uses of wood products

21. End-use wood products include long-term products such as multi- and single-family housing, mobile homes, repair and construction, non-residential construction, shipping, furniture and railroad ties, and short-term products, such as paper and paperboard, including newsprint, boxes, office paper, coated paper, recycled paper categories, corrugated containers and books (Skog and Nicholson, 2000).

22. The rate of decay of wood products depends on various factors including the method of processing, the type of product and its end-use, and climatic conditions. On average, paper and paper products decay within five years, whereas lumber used for housing can last for more than 100 years. Table 1 provides some examples of half-lives of some end-use wood products. From an inventory perspective, however, the use of average lifetimes or half-lives implies the application of common decay factors for groups of wood products. In other words, a decay factor which is statistically obtained by measuring changes in carbon stocks of wood products is used to estimate emissions from these products.

Table 1. Examples of half-lives of wood products in end-uses

End use	Half-life of carbon (years)
Single family homes (pre-1980)	80
Single family homes (post-1980)	100
Multi-family homes	70
Mobile homes	20
Non-residential construction	67
Pallets	6
Furniture	30
Railroad ties	30
Paper (free sheet)	6
Paper (other)	1

Source: Skog and Nicholson (2000), p. 82.

23. The amount of carbon from wood products released into the atmosphere depends on the average lifetime and on the consumption of wood products. In addition, not all wood is converted into long-term products, due to material losses and residues at every stage of the manufacturing process.

24. There are several ways in which the lifetime of wood products could be increased, thus delaying the emission of carbon into the atmosphere. These include increasing their quality (e.g. making them more durable) and reusing or recycling them. In addition, management practices in landfill sites can also delay the emission of carbon from wood products; under anaerobic conditions, the lifetime of wood products can be very long and some wood-based material such as lignin may not decay at all.

25. Recycling is mostly used for paper and related products; however, other products, such as wood from construction sites and furniture, are increasingly being recycled. Recycling paper

usually means converting it into lower paper grades, such as tissue – materials which usually end up in SWDS, composting or waste-water treatment plants.

26. If the lifetime of wood products is short (e.g. paper products) and, simultaneously, the landfilling rate is high, major stocks of carbon from paper may be in landfills. It is conceivable that, under anaerobic conditions, solid wood may form a permanent, almost fossil-like carbon stock (Micales and Skog, 1997). If decay of solid wood in landfill sites proves to be negligible, wood waste deposited in landfills may form a very important carbon reservoir. Micales and Skog (1997) estimated that of the total 123 Tg C in wood products disposed of in the USA in 1993, as either paper or other wood products, 28 Tg C will remain stored in landfills, most of which will be slowly emitted into the atmosphere.

27. Lifetimes and end-uses of wood products are not constant over time, as consumption and production patterns change with societal preferences. In general, it can be said that carbon stock associated with wood products has increased, although, in relative terms, this increase has been higher for paper and paper-like products than for other wood products.

D. Methods for estimating carbon stock changes and GHG emissions from forest harvesting and wood products

28. This paper cites three types of methods for estimating changes in carbon stocks from wood products: inflow–outflow methods, stock-data methods, and direct estimation of emissions. In principle, these methods should give the same results, should all data sources be complete, accurate and consistent. A detailed description of some of these methods, as well as a combination of them has been included in the forthcoming *Draft Report on Good Practice Guidance for Land Use, Land-Use Change and Forestry (Task 1)* prepared by the IPCC.[2]

1. Inflow–outflow methods

29. Inflow–outflow methods estimate changes in carbon stocks by counting the amount of wood products into and out of the stock. Two main methods are available: direct observation and lifetime analysis, where changes in carbon stocks are estimated on the basis of information on the inflow of wood products into the stock and of assumed lifetimes and decay factors of these products. Examples of these methods can be found in Ford-Robertson (2003), Gjesdal et al. (1998) and Winjum et al. (1998).

2. Stock-data methods

30. Stock-data methods estimate the changes in carbon stocks of wood products by calculating the difference between the total stock at the beginning and at the end of a given period (Flugsrud et al., 2001). Stocks of wood products are estimated directly by, for example, the use of statistics or sampling techniques. Stock-data methods are also known as inventory-based methods and, in practice, they are limited to stocks of some major long-lived wood products, such as wood used for housing. Examples of this method are found in Alexander (1997), Gjesdal et al. (1996) and Pingoud et al. (1996, 2001).

3. Direct estimation of emissions

31. All forms of emissions from decomposition and combustion of wood materials in a country are estimated directly and added up to obtain an estimate of all emissions from wood products. Sources of emissions which could be measured and monitored include bioenergy, waste incineration, SWDS gas, fires in buildings and natural decay of wood-based materials in

[2] See appendix 3 a.1 *Harvested wood products: Basis for future methodological development.*

buildings. However, this method may underestimate emissions, as some sources cannot be detected or monitored.

4. Choice of methods

32. The final choice of the method depends chiefly on the availability and quality of data, as well as on the characteristics of the storage of wood products in a country. In general, figures for production, exports and imports are well documented. However, decay rates and average lifetimes or of half-lives are poorly known. As a consequence, a combination of methods could be used to adapt the estimation to the realities of a country and of different product types.

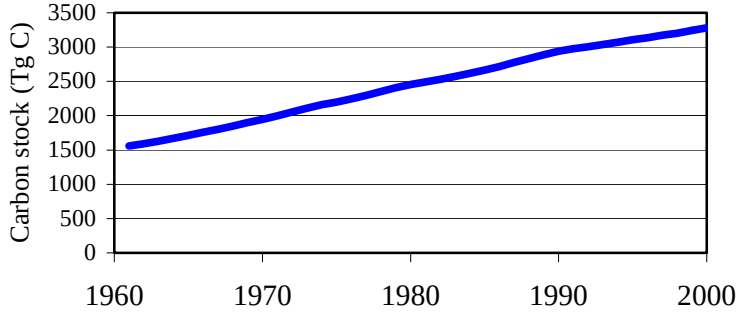
E. Estimated changes in carbon stocks resulting from global wood products in use

33. Several studies suggest that the global stocks of carbon from wood products are increasing. The estimates of the trends vary widely. For example, Winjum et al. (1998) estimated the growth at about 139 Tg C per year, whereas the IPCC second assessment report (SAR) estimated a value of 26 Tg C per year (Watson et al., 1996). Sampson et al. (1993) estimate the global total stock of carbon stored in wood products at 10,000 to 20,000 Tg C, whereas the IPCC SAR estimated this stock to be about 4,200 Tg C. The variation in these results can be explained primarily by the sensitivity of the models to the assumed lifetime and decay factors of products.

34. Pingoud (2003) developed a model to estimate the annual change of carbon contained in wood products based on statistics provided by FAO. He found the increase to be about 40 Tg C per year, and the total stocks of carbon to have increased from 1,500 Tg C in 1960 to more than 3,000 Tg C in 2000 (figure 3). Furthermore, he showed that during the second half of the 20th century, the changes in the stock of carbon have varied widely year by year (e.g. between 30 and 60 Tg C per year, as showed in figure 4).[3]

35. At the country level, stocks of wood products may be decreasing. This might indicate that the introduction of wood products into the country may be less than the disposal of existing ones, but when writing this paper no information on this subject was available.

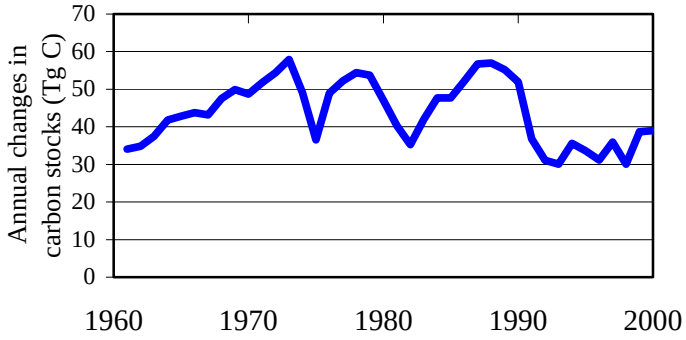
Figure 3: Global carbon stocks in wood products, 1960 to 2000



Source: Pingoud (2003)

[3] The basic assumptions of the model used for calculating the stocks are that the average lifetime is 30 years for solid products (annual decay factor equal to 3.3 per cent) and 1 year for paper products (annual decay factor equal to 100 per cent). Consumption of wood products between 1961 and 2000 was calculated on the basis of the FAO database (http://www.fao.org/forestry/index.jsp). An annual increase of 2 per cent in consumption was assumed before 1961. Stocks of wood products in 1900 were assumed to be zero. The figures do not include stocks of carbon in SWDS.

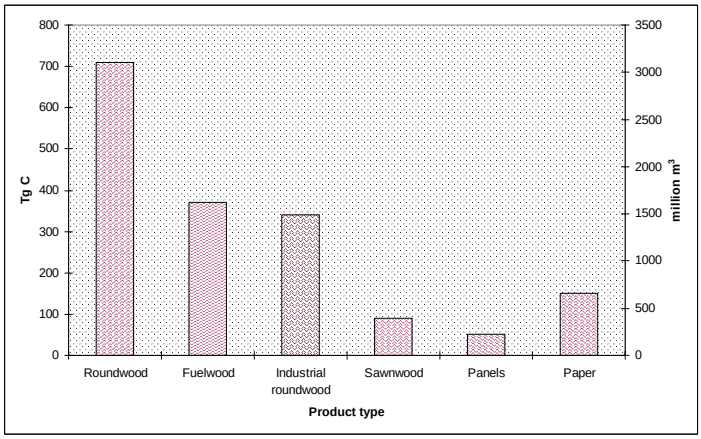
Figure 4: Estimated annual global increment of carbon in wood products in use, 1960 to 2000



Source: Pingoud (2003)

36. In 2000, world production of roundwood reached 3,100 million m^3, representing about 700 Tg C (Pingoud, 2003).[4] About 20 per cent remained as long-term manufactured wood products: production of sawnwood was 420 million m^3, representing about 90 Tg C, and of wood-based panels and fiberboard was 220 million m^3, representing about 50 Tg C. Production of pulp for paper was about 480 m^3, which was used to produce about 230 million tonnes of paper and paperboard, representing about 150 Tg C (figure 5).

Figure 5: Global wood production, 2000[a]



Source: Calculated from FAO statistical data

[a] The value for paper refers only to the carbon content scale, on the left-hand side of the figure (Tg C), and not to the scale of volume on the right-hand side.

F. An overview of the international market in wood products

37. Trade is an important activity for the forestry sector, as about one quarter of the industrial production of wood is traded in the international market every year, with a value of more than US$100 billion (Michie and Wardle, 2003). In 1999, the total trade in wood was

[4] For the purposes of estimating the carbon content of wood products, it is assumed that the average dry weight is 0.4 Mg/m^3 for coniferous wood, 0.7 Mg/m^3 for non-coniferous wood and 0.9 Mg/adt for paper products, and that the carbon fraction by weight is 0.5 (adt means air dried tonnes).

about US$140 billion (FAO, 2003), a figure which includes both global imports and exports (e.g. about US$ 70 million each). Global imports of tropical timber during 2000 were valued at $16 billion (Rytkönen, 2003).

1. Production

38. The trends in production, consumption and use of wood products are affected by several factors. Industrialization, improved management of forests and the increase in wealth are factors that contribute to increasing trend, whereas the development of substitute materials, such as cement, metal and plastic, contribute to decreases. Statistics compiled by FAO since 1960 show that the production of wood products has shown an increasing trend since then. For solid wood products, this increase has been at a constant rate, but for paper the increase has been at an increasing rate.

39. Latest figures for production show that in the period 1994–1999 the world production of roundwood averaged 3,288 million m^3 per year, of which about 60 per cent came from developing countries. Production of industrial roundwood was about one half of this amount. About one third of the industrial roundwood was converted into sawnwood, one tenth into wood-based panels and the rest either into pulp for the production of paper or into residues (see annex I, table 1).

40. Given the small amount of the total production of roundwood converted to sawnwood and pulp in developing countries (about 12 per cent), it can be concluded that most of the roundwood produced in these countries was used to produce of energy. Makundi (1998 in: Kauppi and Sedjo, 2001) found that most of the fuelwood and charcoal in the developing world was used for cooking. In developed countries about one third of the roundwood production was converted to sawnwood.

41. The production of value added products, including sawnwood and paper pulp, was much higher in developed countries than in developing countries. Sawnwood production averaged 756 million m^3 per year in the same period, of which developed countries produced almost two thirds. For the same period, total paper and paperboard production by developed countries was almost four times that by developing ones (see annex I, table 1).

42. According to FAO (no date), consumption of industrial roundwood, which for the second half of the 1990s averaged 1,526 million m^3 per year, is expected to increase to about 1,850 million m^3 per year by 2010. Consumption of sawnwood is also expected to increase steadily whereas the consumption of wood-based panels and paper products is expected to increase at a higher rate. Most of this increase is expected to take place in Asia.

2. Exports

43. Exports of roundwood during the period 1994–1999 averaged 84 million m^3 per year. Global exports of sawnwood were higher than of roundwood, but in developing countries exports of roundwood were almost double those of sawnwood.

44. The total amount of exported roundwood coming from developed countries was three times, on average, that coming from developing countries. Exports or sawnwood were four times higher from developed countries than from developed countries; wood-based panels showed smaller differences; and paper and paperboard exported by developed countries was, on average, seven times that from developing countries (see annex I, tables 2 and 3).

3. Imports and balance of exports/imports

45. Annex II of this document provides a classification of Annex I and non-Annex I Parties according to whether they are net importers or exporters of wood. The classification has been determined by the total amount of traded wood products in monetary terms; countries where imports were more than twice the exports were classified as net importers and vice-versa.

46. World imports of roundwood during the period 1994–1999 averaged 89 million m^3 per year, whereas exports averaged 84 million m^3 per year. The difference between global exports and imports of wood products is a consequence of either statistical errors when compiling the data, or of differences in how countries define each product (for example, for some countries, roundwood includes bark, but for others it does not). For the same period, global imports of sawnwood averaged 105 million m^3 per year and exports 112 million m^3 per year.

47. Statistics of exports and imports from developing and developed countries have been compiled in annex I, tables 2 and 3. Imports of roundwood by developed countries were four times those by developing countries. Developed countries import five times as much roundwood as do developing countries.

48. Developed countries showed slightly higher imports than exports of roundwood during the period 1994–1999, whereas for sawnwood there was almost a balance between exports and imports. Exports of paper and paperboard in developed countries were 18 per cent higher than imports (annex I, table 3). In contrast, imports of wood-based panels were higher than exports but the difference was not significant.

49. Developing countries presented an almost neutral balance of roundwood and sawnwood imports/exports during the period 1994–1999. However imports of paper and paperboard were almost double the exports (annex I, table 2).

III. FOREST HARVESTING, WOOD PRODUCTS AND THE UNFCCC

A. Current treatment of forest harvesting and wood products in the UNFCCC

1. Commitments

50. Article 4.1(d) of the UNFCCC states that Parties shall promote the sustainable management, and cooperate in the conservation and enhancement, of sinks[5] and reservoirs[6] of all greenhouse gases (GHG) not controlled by the Montreal Protocol, including biomass and forests. Parties to the UNFCCC have also agreed, through Article 4.1(a), to develop, periodically update, publish and make available to the Conference of Parties (COP) national inventories of anthropogenic emissions by sources and removals by sinks of GHG using comparable methodologies agreed upon the COP. Relevant decisions of the COP request that reporting of GHG emissions and removals should be transparent, consistent, comparable, complete and accurate.[7]

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[5] Article 1 of the Convention defines “sink” as any process, activity or mechanism which removes a greenhouse gas, an aerosol or a precursor of a greenhouse gas from the atmosphere.

[6] Article 1 of the Convention defines “reservoir” as a component or components of the climate system where a greenhouse gas or a precursor of a greenhouse gas is stored.

[7] Decisions 3/CP.5 and 18/CP.8.

2. Greenhouse gas inventories

51. With the objective of assisting Parties in preparing national GHG inventories, the IPCC produced the *Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories* (IPCC Guidelines) (IPCC, 1997). On the basis of these guidelines, the COP adopted the common reporting format (CRF) that has the objective of standardizing the way Parties report national GHG inventories. Both the IPCC Guidelines and the CRF are divided into six sectors: energy; industrial processes; solvent and other product use; agriculture; land-use change and forestry (LUCF); and waste. In general, national inventories should include GHG emissions and removals taking place within national territories and offshore areas over which the country has jurisdiction.

52. Table 5 of the CRF, for reporting on the LUCF sector, is further divided into five GHG source and sink categories:

(a) Changes in forest and other woody biomass stocks

(b) Forest and grassland conversion

(c) Abandonment of croplands, pastures, plantation forests, or other managed lands

(d) Changes in soil carbon

(e) Other

53. Changes in forest and other woody biomass stocks may be either a source or a sink of CO_2 for a given year in a given country or region. Changes in carbon stocks are calculated by comparing the annual biomass growth with the annual harvest, including the decay of forest products and slash left during the harvest. According to the IPCC Guidelines, the default is to assume that all carbon removed in wood and other biomass from forest is emitted in the year of removal and in the country where the wood was harvested (this is known as the IPCC default approach). The underlying assumption is that there is no change in the size of the wood products pool, which implies that changes in carbon stocks are assumed to take place only in forests. The IPCC Guidelines note that this is not an accurate estimate, given that part of the carbon will remain stored in some wood products. However, the IPCC Guidelines allow for the inclusion of carbon in wood products within the national inventory, only if the country can document that existing stocks of long-term wood products are in fact increasing (see Box 1).

54. According to the IPCC Guidelines, in order to avoiding double counting, CO_2 emissions from biomass used as fuels are excluded from the total CO_2 emissions figure.[8] Biomass is treated differently to fossil fuels because of the sustainable nature of biofuels. In the inventories, non-CO_2 emissions from biofuels are reported under the energy sector, as fuel combustion.

55. Emissions resulting from solid waste disposal on land, and from waste-water, waste incineration and other waste management activities, are reported under the waste sector. CO_2 emissions from organic waste handling and decay, such as from wood products, are not included into national estimates. Methane from anaerobic decomposition of organic matter in SWDS, methane and nitrous oxide from anaerobic decomposition of organic matter in sewage facilities and all non-CO_2 GHG emissions from waste incineration, other than for energy production, should be reported under the waste sector.

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[8] Emissions resulting from non-biomass fuel combustion are reported under the energy sector, and emissions relating to processing of wood products are reported under industrial processes, for example, under the paper and paper source category.

Box 1. Extract from "The fate of harvested wood" according to the IPCC Guidelines, reference manual, page 5.17, box 5 (IPCC, 1997).

THE FATE OF HARVESTED WOOD

Harvested wood releases its carbon at rates dependent upon its method of processing and its end-use: waste wood is usually burned immediately or within a couple of years, paper usually decays in up to 5 years (although landfilling of paper can result in longer-term storage of the carbon and eventual release as methane or CO), and lumber decays in up to 100 or more years. Because of this latter fact, forest harvest (with other forms of forest management) could result in a net uptake of carbon if the wood that is harvested is used for long-term products such as building lumber, and the regrowth is relatively rapid. This may in fact become a response strategy.

For the initial calculations of CO_2 emissions from changes in forest and other woody biomass stocks, however, the recommended default assumption is that all carbon in biomass harvested is oxidised in the removal year. This is based on the perception that stocks of forest products in most countries are not increasing significantly on an annual basis. It is the net change in stocks of forest products which should be the best indicator of a net removal of carbon from the atmosphere, rather than the gross amount of forest products produced in a given year. New products with long lifetimes from current harvests frequently replace existing product stocks, which are in turn discarded and oxidised. The proposed method recommends that storage of carbon in forest products be included in a national inventory only in the case where a country can document that existing stocks of long term forest products are in fact increasing.

3. Policies and measures and wood products

56. Under Article 4.2(a) of the UNFCCC, developed country Parties and other Parties included in Annex I are committed to adopt national policies and measures on the mitigation climate change. Under UNFCCC guidelines, Parties are requested to report periodically on policies and measures through their national communications.[9]

57. In their third national communication, most Annex I Parties reported policies and measures to increase sequestration of CO_2 through afforestation and reforestation, through forest management and through wider forest policy frameworks. Nearly all Parties reported policies and measures promoting the use of wood and biomass for energy, and improved treatment of waste in landfills. Some Annex I Parties (Germany, Finland, France and Norway) have reported policies and measures relating to the promotion of the use of wood products as a means to store carbon. Germany and Norway further estimated carbon stored in wood products as part of their reports on policies and measures.

58. Further clarification of approaches and methodologies relating to estimation of changes in carbon stored in wood products will enable Parties to develop and report on policies and measures on wood products. In fact, the main problem for applying such policies and measures may at present be the lack of awareness of the substitution impacts.

[9] "Guidelines for preparation of national communications by Parties included in Annex I to the Convention, Part II: UNFCCC reporting guidelines on national communications" (FCCC/CP/1999/7). The secretariat has compiled and synthesized the latest information provided in national communications (FCCC/SBI/2003/7/Add.2).

4. Preparation of the good practice guidance for the LULUCF

59. The COP, by its decision 11/CP.7, paragraph 3 (b), invited the IPCC to prepare a report on good practice guidance and uncertainty management relating to the measurement, estimation, assessment of uncertainties, monitoring and reporting of net carbon stock changes and anthropogenic GHG emissions by sources and removals by sinks in the LULUCF sector, to be submitted for consideration and possible adoption by the COP at its ninth session.

60. The IPCC National Greenhouse Gas Inventories Programme has developed the *Draft Report on Good Practice Guidance for Land Use, Land-Use Change and Forestry (Task 1),* which is expected to be considered and approved by the twenty-first session of the IPCC in November 2003.[10] The good practice guidance needs to be consistent with the IPCC Guidelines because Parties have agreed to use the latter for estimation of GHG emissions and removals. For scientific and technical reasons, the draft good practice guidance report further elaborates reporting guidance and introduces new reporting categories based on consistent representation of land areas. In the current draft, guidance is given to new inventory categories:

(a) Forest land

(b) Cropland

(c) Grassland

(d) Wetland

(e) Settlements

(f) Other land.

61. Within the methods described for estimating changes in carbon stocks of different land categories, the draft good practice guidance report includes a methodology for estimating changes in carbon stocks relating to wood and paper products. The draft report notes that wood products and other biomass products may be produced from all above-mentioned lands but does not provide average lifetimes for wood and other products resulting from different land categories. The SBSTA, at its eighteenth session, noted the possible inclusion of methods to estimate the change in carbon stored in wood products as an annex or appendix to the IPCC report on good practice guidance for LULUCF.[11]

B. Relationship to the Kyoto Protocol

62. During the negotiations on LULUCF activities under the Kyoto Protocol, some consideration was given to forest harvesting and wood products. As the result, Parties have agreed on definitions, modalities, rules and guidelines for LULUCF activities under the Kyoto Protocol (decision 11/CP.7). The wood product pool was excluded from accounting and, therefore, wood products are currently not included as a separate pool or activity for the first commitment period. However, the COP, by its decision 11/CP.7, paragraph 4, also decided that any changes to the treatment of wood products shall be in accordance with future decisions of the COP.

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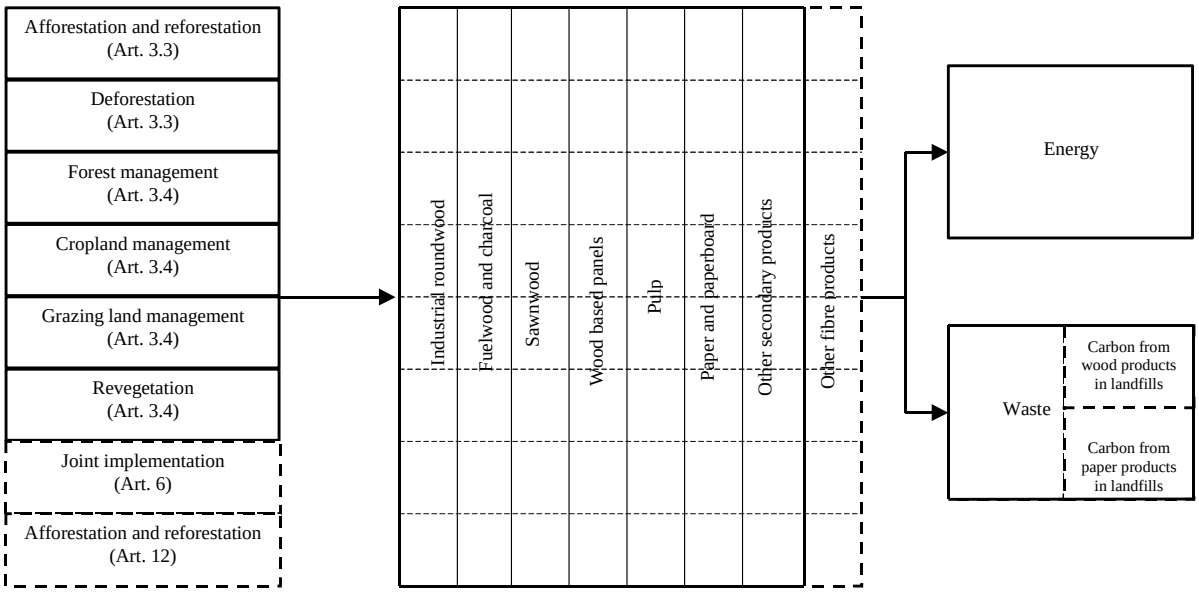
[10] The IPCC is expected to make hard copies of these reports available to Parties at SBSTA 19 through a separate distribution system. It is anticipated that electronic copies of the reports will be available on the IPCC/NGGIP web site (http://www.ipcc-nggip.iges.or.jp) in the second half of November 2003.

[11] FCCC/SBSTA/2003/10, paragraph 26 (a).

63. Should wood products be considered under the accounting of emissions and removals under the Kyoto Protocol in future commitment periods, three main options of inclusion of wood products may be considered: as a separate activity (for example, management of wood products); as a separate, non-site specific pool; and as a separate pool attached to eligible activities and land areas. From a technical and practical point of view, the main challenge of the third option would be the difficulty in linking emissions from wood products pools to specific lands and/or activities. Figure 6 illustrates the elements for considering wood products within the Kyoto Protocol.

Figure 6: LULUCF activities under the Kyoto Protocol and wood products



64. The management of wood products, either as a pool or as a separate activity, is influenced by human practices. Changes in carbon stocks are, to great extent, due to practices taking place since 1990. However, any chosen system would need to determine how to treat changes in carbon stocks or emissions associated with wood products harvested before 1990 and with transformation of wood from one product category to another. Estimating changes in carbon stored in wood products separately for each eligible activity under the Protocol may raise technical and practical challenges. It seems technically feasible to consider further the possible inclusion of wood products as a separate activity.

IV. APPROACHES FOR ACCOUNTING OF CHANGES IN CARBON STOCKS AND GHG EMISSIONS FROM FOREST HARVESTING AND WOOD PRODUCTS

A. Introduction

65. The IPCC expert meeting on forest harvesting and wood products, held in Dakar in 1998, identified four approaches to accounting for GHG emissions resulting from wood products: the IPCC default, the stock-change, the production and the atmospheric-flow approaches. It also identified and applied scientific, technical and policy relevant criteria for evaluating the three last approaches in order to compare them to the IPCC default.

66. These criteria related to the feasibility and accuracy of the approaches, and to their relevance to national policies and the reporting needs of the Convention and the Protocol. The meeting noted that the current IPCC default approach could be considered the simplest form of the stock-change and production approaches. However, even the simplest form of the

atmospheric-flow approach differs from the IPCC default approach because emissions associated with traded roundwood are allocated to the consuming country. The meeting, furthermore, noted that one major difference between the approaches relates **where** and **when** changes in carbon stocks or emission occur.

B. IPCC default approach

67. In the IPCC default approach, the underlying assumption is that there is no change in the size of the wood products pool. Only emissions and removals relating to the changes of stock in forests are reported. Emissions from harvested wood are attributed to the year of production and to the country of harvest (i.e. where the roundwood is produced). The stock change in forests is defined as forest growth minus slash minus roundwood production.

68. As a portion of the harvested wood is converted into wood products rather than being burnt or disposed of, the IPCC default approach overestimates emissions from harvesting at a given point in time. The overall effect of this overestimation varies from country to country and, for some, it could be considerable.

69. From the GHG inventory point of view, forest harvesting implies an immediate emission. Consequently, CO_2 emissions resulting from wood products, for example when they burned for energy production or disposed of in SWDS, should not be included in the energy or in the waste sectors (table 2). However, non-CO_2 GHG emissions in the energy and waste sectors are included in national inventories.

Table 2. Possible treatment of anthropogenic CO_2 emissions and removals in the IPCC default approach

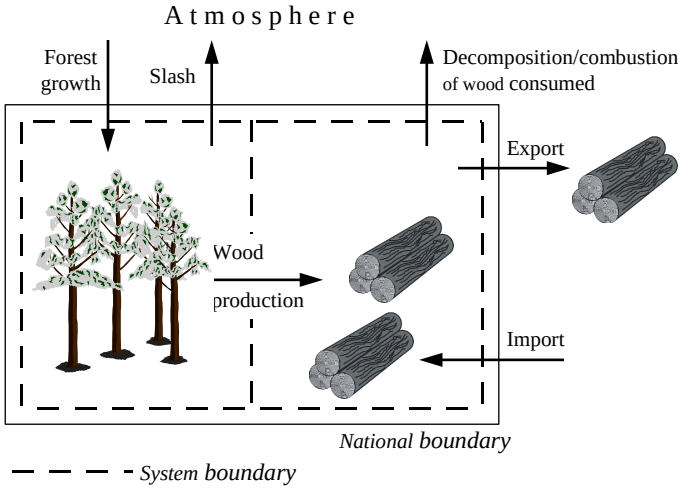
LULUCF	Energy	Waste
Removals: Uptake from forests growing Emissions: Forest harvest and forest decay	CO_2 emissions from wood-based bioenergy noted but not included in national estimates	CO_2 emissions from changes in carbon stocks from wood products noted but not included in national estimates

C. Stock-change approach

70. The stock-change approach estimates net changes in carbon stocks in the forest and wood-products pool. Changes in carbon stock in forests are accounted for in the country where the wood is grown, referred to as the **producing** country. Changes in the products pool are accounted for in the country where the products are used, referred to as the **consuming** country. These stock changes are counted within national boundaries, **where** and **when** they occur (figure 7).

71. Any export of wood will decrease the national stock of carbon contained in wood products which, from the reporting perspective, could be interpreted as an immediate "emission" for the producing country. In contrast, any import of wood will increase the national stock of carbon which, from the reporting perspective, could be interpreted as a "removal". However, emissions from imported wood will have to be reported within national boundaries as all wood products in use decay.

Figure 7: Stock-change approach



Stock change = (stock change forest) + (stock change consumed products)
= (forest growth - slash -wood production)
+ (wood consumption
- decomposition/combustion of wood consumed)

Source: Brown et al. (1999); Lim et al. (1999)

72. The treatment of emissions from wood products differs from that of those from fossil fuels. For carbon in wood products with an annual life cycle, the average change in stock is zero. Any carbon stocks that cross a national boundary are transferred from one country's inventory to another.

73. For including wood products in inventory systems, Parties could continue to estimate emissions at the time of forest harvesting under the LULUCF category and then create a separate inventory category or sub-category for wood products (table 3). This would mean that, regardless of the origin of the wood (imported or exported), actual changes in carbon stored within different product pools in use could be estimated for a certain year based on input–output data. Thus, it is not necessary to change the treatment of emissions resulting from biomass in the energy and waste sectors.

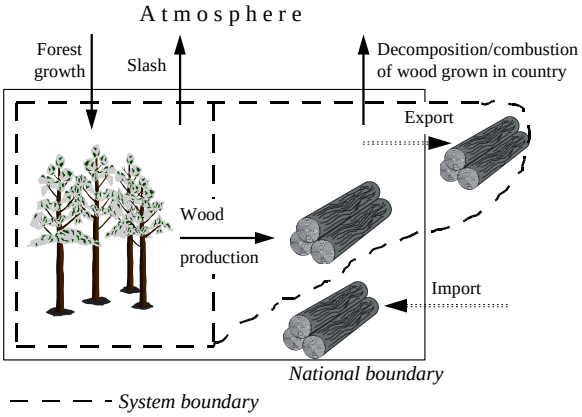
Table 3. Possible treatment of anthropogenic CO_2 emissions and removals in the stock-change approach

LULUCF	Energy	Waste
Forests Removals: Uptake from forests growing Emissions: Forest harvest and forest decay *Wood products* "Removals": Increase in the stock of wood products within national boundaries Emissions: Decrease in the stock of carbon after exporting; emissions from decay, burn and/or disposal of wood products within national boundaries	CO_2 emissions from wood-based bioenergy noted but not included into national estimates	CO_2 emissions from changes in carbon stocks from wood products noted but not included into national estimates

D. Production approach

74. The production approach estimates the net changes in carbon stocks in the forests and in the wood-products pool, but attributes both to the **producing** country. Stock changes are counted **when**, but not **where** they occur (figure 8).

Figure 8: Production approach



Stock change = (stock change forest) + (stock change domestic-grown products)
= (forest growth - slash -wood production) + (wood production - decomposition/combustion of wood grown in country)

Source: Brown et al. (1999); Lim et al. (1999)

75. The producing country will have to report immediate emissions from harvesting and slash, but emissions for wood products will be delayed and reported as the products decay. Any stock of carbon that crosses a national boundary is not transferred from one country's inventory to another; the exported carbon remains in the inventory of the producing country. Effects for the consuming country are neutral in terms of reporting, but technical difficulties may arise, as there may be a need for the producing country to track exports when reporting emissions that occur outside its national boundaries.

76. The treatment of emissions from wood products differs from that of those from fossil fuels. For carbon in wood products with an annual life cycle, the average change in carbon stock is zero. Any carbon stocks that cross a national boundary are not transferred from one country's inventory to another; the exported carbon remains in the inventory of the producing country.

77. Wood products could be included in the inventories by using different lifetime factors for different types of products. This alternative, for a specific inventory year, would combine actual changes in carbon stocks and other GHG emissions for that year with potential future emissions calculated on the basis of the lifetimes of wood products (table 4).

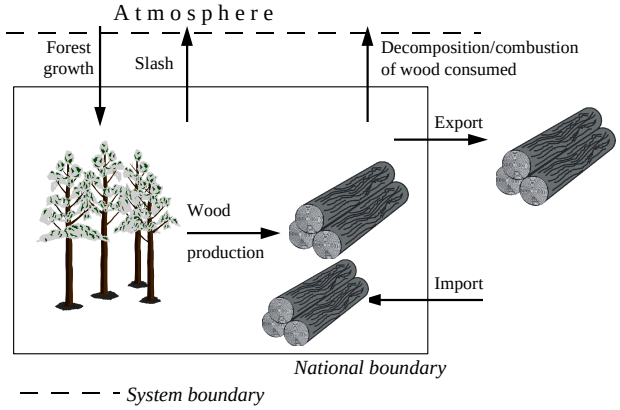
Table 4. Possible treatment of anthropogenic CO_2 emissions and removals in the production approach

LULUCF	Energy	Waste
Removals: Uptake from forests growing Emissions: Forest decay, forest slash and wood products decay	CO_2 emissions from wood-based bioenergy noted but not included into national estimates	CO_2 emissions from changes in carbon stocks from wood products noted but not included into national estimates

E. Atmospheric-flow approach

78. The atmospheric-flow approach accounts for net emissions or removals of carbon to/from the atmosphere within national boundaries, **where** and **when** emissions and removals occur. Removals of carbon from the atmosphere due to forest growth are accounted for in the **producing** country, and emissions of carbon to the atmosphere from oxidation of wood products are accounted for in the **consuming** country (figure 9).

Figure 9: Atmospheric-flow approach



Atmospheric flow = forest growth - slash - decomposition/combustion of wood consumed

Source: Brown et al. (1999); Lim et al. (1999)

79. The producing country will have to report only emissions resulting directly from harvesting, such as the slash. In contrast to the stock-change approach, the consuming country will not increase its pool of carbon in wood products but will have to report the emissions as imported wood products decay. In that case where the producing country is also the consuming country, this is translated into a direct delay of emissions from wood products.

80. The treatment of emissions from wood products is the same as that of those from fossil fuels. If the wood is domestically produced and consumed, there is no change in the allocation of emissions. Any emissions associated with carbon stocks that cross the national boundary are transferred from one country's inventory to another.

81. From a GHG inventory perspective, the atmospheric-flow approach could be implemented by considering only removals from forest growth and emissions from harvest (e.g. slash) and forest decay in the LULUCF sector. Emissions from wood products could be considered and reported either in the energy sector (if they are used for the production of energy) or in the waste sector (if they are disposed) (table 5).

Table 5. Possible treatment of anthropogenic CO_2 emissions and removals in the atmospheric-flow approach

LULUCF	Energy	Waste
Removals: Uptake from forests growing Emissions: Forest decay, slash, decay of wood products out of SWDS, and burning of wood products for purposes other than energy	CO_2 emissions from wood-based bioenergy noted and included into national estimates (such emissions could alternately be reported in the LULUCF sector)	CO_2 emissions from changes in carbon stocks from wood products in SWDS noted and included into national estimates. (Such emissions could alternately be reported in the LULUCF sector)

F. Other approaches

82. Some Parties, in their submissions, suggested exploring options beyond the four existing approaches. These suggestions cover two separate topics: an accounting approach describing where and when to allocate emissions and changes in carbon stocks; and methods for estimating and reporting emissions and changes in carbon stocks. As described above, it is possible to develop and apply different estimating and reporting methods in combination with different approaches.

83. A document describing the so-called "simple decay approach" was made available during the expert meeting referred to in paragraph 6 (Ford-Robertson, 2003). This approach assumes that emissions from wood products are estimated over time as products decay. Rather than allocating emissions where they occur, as in the atmospheric-flow or stock-change approaches, the simple decay approach suggests that these emissions be allocated to the producer. The suggested approach seems to be similar to production approach as it estimates emissions when, but not where, they occur. It is argued that, in contrast to the production approach, the simple decay approach focuses on emissions and not on changes in carbon stocks.

84. The simple decay approach includes a proposal for a simplified method for estimating emissions resulting from decay of wood products. The document suggests that the basic data requirements include data on annual stock changes at forest or stand level, annual harvested volume, and lifetime of products. For simplicity and transparency, the value for "average lifetime" could be an assumed value (e.g. 16 ½ years) and applied to the entire harvest. The document includes further information and examples of the application of the proposed simple decay approach.

G. Effects resulting from the application of different approaches

1. Introduction

85. This section analyses the effects associated with the approaches to allocating emissions described above. Table 6 summarizes the main reporting implications for each approach in terms of where and when emissions or changes in carbon stocks from wood products should be reported. These implications will be used to analyse the possible immediate market effects for consuming and producing countries. For the purposes of the analysis, table 6 assumes that consuming countries do not produce wood products within national boundaries and that producing countries export 100 per cent of their production to consuming countries.

Table 6. Reporting implications of applying the four approaches

Country	IPCC default approach	Stock-change approach	Production approach	Atmospheric-flow approach
Producing	Reports immediate emissions of all harvested wood	Reports emissions from slash and decreases in carbon stocks (emissions) when exporting wood products	Reports emissions from slash and decreases in carbon stocks (emissions) as wood products decay	Reports emissions from slash
Consuming	Not applicable	Reports increases in carbon stocks ("removal") from imported wood products and decreases in carbon stocks (emissions) as they decay	Not applicable	Reports decrease in carbon stocks (emissions) from wood products as they decay

86. The effects of the different approaches depend, first, on whether wood products are estimated within national GHG emissions inventories under the Convention, and second, on whether they are also incorporated into the **accounting** under the Kyoto Protocol. Effects due to the inclusion of wood products in the national **reporting** system to the UNFCCC are conceivably weaker as they are only related to the contribution of wood products in storing carbon or delaying emissions, and would not count in establishing emission target levels. In contrast, the inclusion of wood products in the accounting under the Kyoto Protocol may bring stronger incentives as it implies direct economic consequences for countries with emissions limitation commitments. Furthermore, the fact that not all countries engaged in international trade of wood and wood products have commitments, brings additional implications for the accounting of wood products under the Kyoto Protocol, which will be analysed in chapter V.

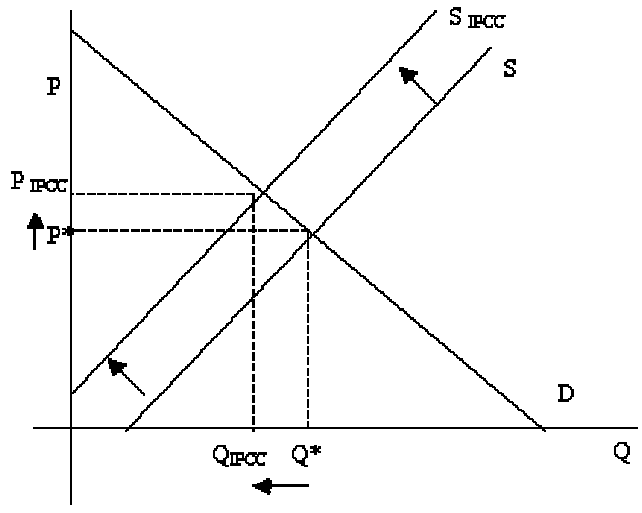
87. As only limited information on the market price for carbon is available, a quantitative assessment of incentives and disincentives would be speculative. Factors such as the cost of reducing emissions, discount rates and the international price of carbon are needed to undertake a quantitative analysis. Therefore, only qualitative effects are discussed below.

2. Market effects

88. The following paragraphs describe the possible effects of accounting of wood products on the market for wood products, including price, supply and demand. Having as a basis the case where there is no "cost" for reducing emissions resulting from wood products, the present analysis indicates how the demand, the supply and the price may change if a particular accounting approach is adopted. It is assumed that, as a consequence of accounting of wood products, countries are compelled to reduce emissions resulting from forest harvesting and/or the decay of wood products (i.e. the cost of reducing these emissions is transferred to either the consumption or production of wood products, depending on the approach followed). The analysis also assumes that wood products are a homogeneous commodity and the market effect of substitute materials is not taken into account. For the purposes of this analysis, no distinction is made between Annex I and non-Annex I Parties. Further impacts on trade and incentives for consumption and production compared with the IPCC default will be the subject of chapter V.

89. The **IPCC default approach** penalizes forest harvesting by treating it as an immediate emission. The cost of reducing this emission is added to the production cost of wood, thus increasing production costs (e.g. displacing the supply curve to the left). Prices of harvested wood are, therefore, likely to increase and quantities produced may decrease accordingly (figure 10).

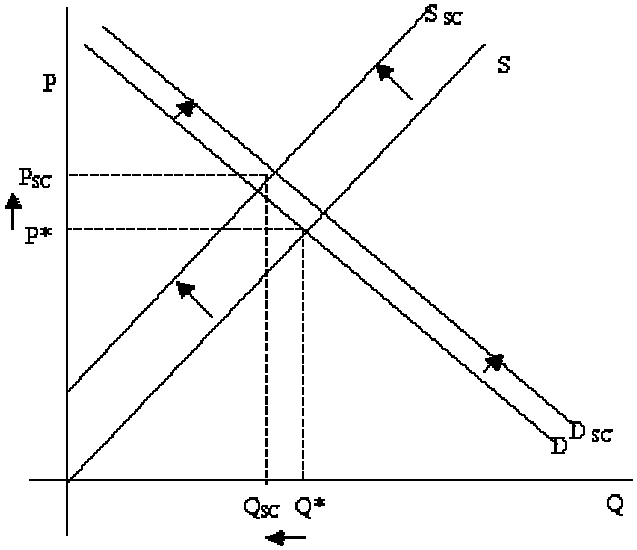
Figure 10: Market effects of the IPCC default approach



S= Supply curve
S_{IPCC}= Supply after IPCC default approach.
D = Demand
P = Price
P* = Market price
P_{IPCC}= Market price after IPCC default approach
Q = Quantity
Q*= Market quantity
Q_{IPCC}= Market quantity after IPCC default approach

90. **The stock-change approach** does not penalize forest harvesting, but rather exports of wood products, as a decrease in national stocks represents an immediate emission. Thus, this approach represents a cost from the production side that displaces the supply curve in the same way as the IPCC default approach does. On the other hand, from the demand side, the increase of domestic and imported wood products represents an increase of national stocks, thus displacing the demand curve to the right. However, this displacement is limited by the fact that the consuming country will have to report emissions of wood products decay. The market price for wood products is expected to increase; this increase may be higher than under the IPCC default approach (figure 11).

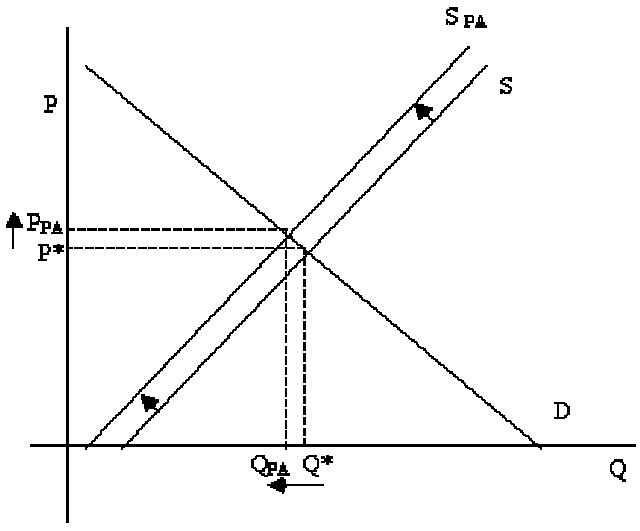
Figure 11: Market effects of the stock-change approach



S= Supply curve
S_{sc}= Supply after stock-change approach.
D = Demand
D_{sc}= Demand after stock-change approach
P = Price
P* = Market price
P_{SC}= Market price after stock-change approach
Q = Quantity
Q*= Market quantity
Q_{SC}= Market quantity after stock-change approach

91. The **production approach** does not penalize either forest harvesting or exports of wood, as changes in carbon stocks of all wood products will have to be reported only by the producing country. Emissions from the decay of the wood products will have to be compensated by the producing country, but the time at which this compensation takes place is delayed. This implies that production costs will increase somewhat (e.g. displacing the supply curve somewhat to the left). The market price for wood products is expected to increase; this increase may be lower than under both the IPCC default and stock-change approaches (figure 12).

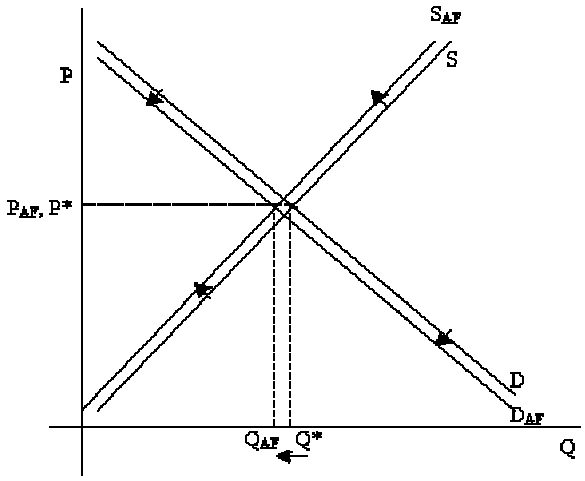
Figure 12: Market effects of the production approach



S= Supply curve
S_{PA}= Supply after production approach
D = Demand
P = Price
P* = Market price
P_{PA}= Market price after production approach
Q = Quantity
Q*= Market quantity
Q_{PA}= Market quantity after production approach

92. The basic feature of the **atmospheric-flow approach** is separation of biological sinks and sources from each other. Harvesting is slightly penalized as the slash has to be reported, thus representing a slight increase in the production costs and displacing the supply curve slightly to the left. Likewise, emissions will have to be reported by the consuming country, but these emissions will be delayed as wood decays, which adds a cost to the consumption of wood and displaces the demand curve slightly to the left. The market price for wood products is expected to increase slightly; this increase may be lower than under the rest of the approaches (figure 13).

Figure 13: Market effects of the atmospheric-flow approach



S= Supply curve
S_{AF}= Supply after atmospheric-flow approach.
D = Demand
D_{AF}= Demand after atmospheric-flow approach
P = Price
P* = Market price
P_{AF}= Market price after atmospheric-flow approach
Q = Quantity
Q*= Market quantity
Q_{AF}= Market quantity after atmospheric-flow approach

Note: Effects on price will depend on the forms of the supply and demand curves. In this figure price remains constant, but this is not necessarily the case.

93. **It is unlikely that reporting and accounting of wood products would be a major factor determining prices and quantities of wood and wood products traded, as other factors such as domestic roundwood markets, production costs, tariffs, subsidies and other incentives may have a greater influence.** In practice, the approaches may provide more complicated indirect outcomes. Crediting of wood product stocks in the stock-change approach can increase the use of, and trade in, long-lived wood products. In the production approach, it should be noted that there are severe practical difficulties to verifying stock changes of exported wood products. Thus, approximate estimation methods would be needed that would, to some extent, change the incentives and impacts on international trade on wood products. Finally, with the atmospheric-flow approach, as the imports of wood products are, to some extent, imports of emissions, from a climate change perspective, wood products could be comparable to fossil fuels.

V. IMPACTS AND IMPLICATIONS

A. Introduction

94. The estimation, reporting and accounting of carbon stored in wood products in the context of the UNFCCC and its Kyoto Protocol could potentially affect forest and wood products management practices, as they may influence the development of policies and measures that affect the quantity and possibly the quality of the national stock of wood products.

95. Policies and measures to mitigate climate change relating to wood products depend on various factors, such as the cost of the policies and measures of wood products relative to the cost of other types of policies and measures and relative to the opportunity costs of other uses of wood products; the approach agreed by Parties to allocate emissions from wood products; and other factors specific to the national and international markets for wood products.

96. Socio-economic and environmental implications resulting from the accounting of wood products in the context of the Kyoto Protocol depend very much on the approach followed to allocate emissions. Likewise, the implications will be different for developed and developing nations, and for net exporters and importers of these products.

B. Socio-economic impacts and implications deriving from the application of the four approaches

97. Social and economic impacts are discussed for trade, consumption and production of wood products, and for the consequences of these to other society-related variables such as employment and population dynamics. It can be assumed that economic impacts will be stronger for low-cost products, because the carbon price constitutes a higher share of their price. The nature of the impact will depend on the approach selected.

98. Increases in the demand for wood could have positive effects on production, potentially increasing the demand for labour and other resources. Likewise, demand for labour can affect population dynamics and social factors. Additional social and economic impacts may arise from changes in practices, should incentives for these practices be introduced; examples include changes in production towards more durable, environmentally friendly and value added products. Impacts on bioenergy, recycling and SWDS management may also occur as a consequence of policies and measures relating to wood products.

1. Impacts on trade and other socio-economic variables

99. The following paragraphs summarize some possible impacts on trade and other socio-economic variables resulting from the application of the four approaches. Annex IV to this document shows a comparison between all the approaches.

100. As described in paragraph 89 above, the IPCC default approach may raise the international price for wood as it penalizes forest harvesting, thus possibly having an impact on the production of roundwood. For products such as sawnwood, wood-based panels, paper and other manufactured products, impacts may be an indirect consequence of the rising prices of roundwood. Some potential impacts are that:

(a) Production of roundwood may decrease in Annex I Parties due to the rise in production costs. **Annex I net importers** of roundwood might demand more wood from international sources and avoid the costs of reducing emissions from national forest harvesting.

(b) **Non-Annex I Party net exporters** of roundwood may benefit from both the rise in prices and the fact that harvesting will not be penalized in these countries (e.g. they are not compelled to reduce the emissions from harvesting). These Parties will tend to increase their exports of roundwood to Annex I countries. For **non-Annex I Party net importers**, higher market prices for roundwood may decrease imports and increase national harvest. Increases in national production of roundwood for non-Annex I Parties may have additional consequences on employment, as an increasing production requires more labour, and on revenue. Low-forest-cover countries, which may not be able to afford international wood prices, may need to switch to lower-cost substitutes, such as plastics.

101. As stated in paragraph 90 above, the stock-change approach raises the international price for wood as it penalizes exports, but, compared to the IPCC default approach, the increase may be higher. This approach has incentives for Annex I Parties to increase national stocks of wood products and to decrease exports of any kind of wood products. Some potential impacts are that:

(a) **Annex I Party net importers** may tend to import more wood products, in particular low-cost roundwood, for the production of furniture and other long-life products. On the other hand, **Annex I Party net exporters** of wood products will have fewer incentives to export long-life products, as this implies a need to reduce emissions from the decrease in national stocks. However, trade of short-life products, such as paper, may not be affected.

(b) Non-Annex I Parties will respond to the market price for wood, which will be higher that for the IPCC default approach. **Non-Annex I Party net exporters** of wood may seek opportunities in the international market as a consequence of higher prices, and increase production. This may imply higher revenue and more employment opportunities in the forestry sector.

(c) **Non-Annex I Party net importers** of wood may face higher market prices for wood products in particular for long-life ones, and therefore decrease imports and increase national production. Increases in national production may have positive effects on employment.

102. The production approach, as stated in paragraph 91 above, does not penalize either forest harvesting or exports, and therefore the market price for wood may fall compared to prices under the IPCC default approach. This fall in price may be slightly counteracted by the fact that emissions from slash have to be reduced. Some potential impacts are that:

(a) **Annex I Party net importers** may tend to increase national production, and thus demand slightly less from the market. **Annex I Party net exporters** will be willing to export more, in particular long-life products, as the production approach gives incentives to exports. However, due to the increased production in Annex I Party net importers, a portion of the exports may be directed to non-Annex I Party net importers.

(b) As a consequence of the fall in the market price, **non-Annex I Party net importers** may increase imports from the international market, whereas **non-Annex I Party net exporters** may export less to Annex I Parties as a consequence of the disincentive for imports.

103. With the atmospheric-flow approach, the value of the carbon remains with the wood products. It is expected that this approach will affect both the supply and demand in a similar way, and thus have lesser effects on market prices. Some potential impacts are that:

(a) **Annex I Party net importers** may be inclined to import less than they would under the IPCC default approach, given that any import of wood will imply a cost of reducing an emission for which a removal was not credited. Exports from **Annex I Party net exporters** may increase, and are promoted by the fact that exports are translated into export of emissions, for which exporters will not be responsible.

(b) For **non-Annex I Party net importers and exporters**, the situation will be somewhat similar to the market scenario where wood products are not accounted for. It is likely that the price for wood products will increase slightly but, in comparison to the IPCC approach, the price for wood products actually decreases, and therefore imports from **non-Annex I Party net importers** may increase. Likewise, the competitive advantage given to **non-Annex I Party net exporters** by the IPCC default approach will not be there, so these countries are likely to export smaller quantities of wood products.

2. Impacts on bioenergy

104. The IPCC default approach does not create disincentives for wood-based bioenergy production, given that emissions from changes in carbon stock due to burning wood have already been accounted for at the moment of harvesting. Moreover, this approach may promote the use of wood harvesting residues to produce energy, as a reduction in the use of fossil fuel may result in lower emissions for the energy sector.

105. In comparison to the IPCC default approach, the other approaches may represent a disincentive for Annex I Parties to produce bioenergy, in particular from the burning of long-life wood products. The impacts of each approach are as follows:

(a) The stock-change approach discourages the use of wood for energy production as any emissions from the burning of wood will need to be reduced elsewhere.

(b) The production approach will discourage a country from burning the wood it has produced, and may create incentives for burning wood that is imported, as importers will not be responsible for any emission. However, exporters would have an incentive to export products that are less likely to be burned immediately by the importer.

(c) The atmospheric-flow approach will discourage the use of bioenergy in a similar way to that of the stock-change approach. For imported wood products, this discouragement will be stronger than in the stock-change approach, given that emissions from burning a non-credited imported stock will have to be reduced.

3. Impacts on recycling

106. The IPCC default approach may also bring incentives for recycling products, particularly for Annex I Parties, given that it may represent less need to harvest forests.

107. All the other approaches may bring incentives for recycling. In contrast to the IPCC default approach, in the other approaches the incentive is related to both the lower level of harvest and the extended lifetime of products (or the delay in emissions from decay). The atmospheric-flow approach may provide the greatest incentive for recycling provided that net imports decrease when recycling increases. The production approach may provide the least incentive because recycling of imported products would not affect national stocks of wood products.

C. Environmental implications and impacts

108. Accounting for wood products in the context of the UNFCCC and the Kyoto Protocol may not directly result in impacts on forests, biodiversity or deforestation. However, as already stated, the accounting may have direct effects on practices such as harvesting, production and trade. Therefore, environmental impacts should be analysed in the context of changes in these practices and their respective impacts. Furthermore, the impacts of these practices on the environment are very much related to national circumstances, in which institutions play a central role.

109. Harvesting and forest management are perhaps the most important activities in this respect, and their related impacts include deforestation, decrease of habitats for biodiversity, soil erosion and degradation and pollution of water sources. Increasing harvesting of lands that are not managed sustainably may increase the severity of these impacts. Furthermore, impacts on biodiversity are likely to be site-specific rather than specifically affected by the selected approaches. These impacts will depend on various factors, for example, land-use change trends,

forest management practices and species composition. Wherever sustainable forest management practices are in place, impacts are likely to be fewer.

110. As for the distribution of impacts, an intersessional meeting of the United Nations Forum on Forests (UNFF) noted that 35 per cent of the world's wood supply is provided by five per cent of the global forest area (UNFF, 2003). For the case of many developing tropical countries, current trends of forest harvesting indicate that a big proportion of the wood harvested is used domestically for energy. On the other hand, FAO estimates that more than 90 per cent of deforestation is caused by the expansion of the agricultural frontier (FAO, no date). Wood from developed countries used for the production of wood products comes from forests that are sustainably managed, thus indicating a potential low source of environmental impacts resulting from the global production of wood products as a whole.

111. As described in paragraphs 100 (a) and (b), above, the IPCC default approach discourages harvesting in Annex I Parties, thus raising incentives to increase the stock of carbon in forests and to manage these forests sustainably.

112. For non-Annex I Parties, the IPCC default approach may increase harvesting. The intensity of the increase in harvest in these Parties will depend on several factors, such as the price of carbon. The approach itself does not provide any incentive for sustainable management, where national regulation of both consumers and producers may play a better role. Thus, in those areas where no incentives for forest management practices are in place or operating, this approach may lead to increased levels of deforestation.

113. The impacts of the stock-change approach are similar to those caused by the IPCC default approach, with the difference that there are no disincentives for harvesting but there are for exporting. For Annex I Parties, the stock-change approach may promote sustainable forest management arising from the incentive of increasing national consumption and building up national stocks of carbon from forests. For non-Annex I Parties, impacts from the increased national harvesting may be similar to those under the IPCC default approach.

114. The production approach encourages national production of wood in Annex I Parties as a whole, in particular, for the production of long-life products. The production of long-life products may need longer rotation periods, which may have an impact on forest management practices. Impacts on forests in non-Annex I Parties may be smaller compared to the IPCC and stock-change approaches, as there are fewer incentives for increasing harvesting. On the other hand, the production approach may give incentives to Annex-I Parties to import wood from non-Annex I Parties for the production of bioenergy.

115. The atmospheric-flow approach may encourage the sustainable use of forests, in particular the use of high-productivity species, in Annex I Parties. For non-Annex I Parties, in comparison to the IPCC default approach, there may be less demand for their wood products and harvesting for exports may decrease, as Annex I Parties will focus on national wood production and exporting.

D. Impacts in relation to emission-limitation targets

116. The application of the different approaches in the context of the Kyoto Protocol may lead to large differences in the accounting of emissions and removals, particularly when trade between Annex I Parties and non-Annex I Parties takes place. For example, the IPCC default approach overestimates emissions at a given point in time; however, because emissions from wood products are accounted for from harvest, trade between Annex I Parties and non-Annex I Parties does not have an impact over the accounting of emissions from Annex I Parties.

117. The stock-change approach has the potential for a Party to buy stocks of carbon in the international market and account for this stock increase. Wood that is grown in non-Annex I Parties may be used by an Annex I Party to increase its national stock. In the long run, however, emissions from this stock of carbon will have to be reported, either when products are exported again or when they decay. For this reason, trade does not have any negative impacts on the accounting of emissions, given that Annex I Parties will report changes in national stocks whenever wood and/or wood products enter or leave their territory.

118. The production approach will account for the emissions for the party where wood products were produced, and therefore trade does not have any potential negative impact in terms of accounting.

119. The atmospheric-flow approach may have negative implications for the accounting of emissions when trade occurs. When wood is produced in an Annex I Party, this stock of carbon will be accounted for within the stock of carbon resulting from forest growth. If a non-Annex I Party imports this wood, this Party will not need to reduce emissions from the decay of this import.

120. Annex III to this document contains an indicative analysis of the possible outcomes of the three approaches for accounting of emissions for some selected I Parties.

VI. CONCLUSIONS AND ISSUES FOR FURTHER CONSIDERATION

121. The treatment of wood products in the context of the UNFCCC and its Kyoto Protocol presents several complex issues for consideration. These issues include definitions and classification of wood products; concepts relating to the accounting, in particular the treatment of emissions versus the treatment of changes in carbon stocks, the accounting of old stocks of wood products (pre-1990), and the timing and place of accounting (when and where); methodological aspects relating to estimation; and the analysis of implications of a possible accounting system that does not create perverse incentives or result in negative socio-economic and environmental impacts.

122. Further complications relate to the trade in wood products within and between Annex I Parties and non-Annex I Parties, the treatment of existing stocks of carbon versus newly harvested wood, and the limited availability of data for implementing comparable estimating and measuring methods for reporting. *Parties may wish to consider these complications in the context of the reporting under the Convention, the reference to the base-year (1990) for activities under the Kyoto Protocol, and the options for including wood products as described in paragraph 63 above.*

123. Wood products include a wide range of goods at different stages of the production cycle (e.g. harvested materials, raw materials, intermediary products, end-use products, products in SWDS and raw material for the production of energy). Carbon contained in the biomass of wood products could undergo several stages before it is completely emitted into the atmosphere. Emissions associated with each of these types of products vary in both quantity and timing. *Parties may wish to consider definitions with regard to estimation, reporting and accounting of harvested wood products, in particular to whether wood products will be considered as a whole, or to the need for restricting wood products to only a specific set of wood products. This may also include the consideration of the role of wood products in SWDS.*[12]

[12] Annex V to this document contains an initial proposal for the classification of wood products.

124. Wood products are not a "sink" per se, but rather a reservoir of carbon. As products decay, or are burned, carbon is released into the atmosphere, and thus wood products are turned into a source of GHGs. The IPCC default approach assumes that forest harvesting creates immediate emissions and that there is no change in the stock of carbon in wood products. Three approaches recognize that some of the emissions are delayed, but that there are differences in when and where emissions or changes in carbon stocks are calculated. Available data and information indicate that the stock of wood products is currently increasing at the global level; however, at the country level, wood products stocks may be decreasing. In fact, for some countries, emissions from wood products decaying may be larger than the increases in the stocks of carbon in these products. *Parties may wish to consider further different approaches, data and information on wood products.*

125. Changes in carbon stocks or emissions relating to wood products can be estimated using various methods. The forthcoming IPCC report on good practice guidance for LULUCF presents methodological guidance in an appendix, which could be used for the various approaches. *Parties may wish to consider the estimation methods contained in the good practice guidance report.*

126. The approaches described for the accounting of wood products in the context of the UNFCCC differ, not only in the way emissions are allocated between consuming and producing countries, but also in the attribution of these emissions throughout the life cycle of wood products, and thus it is difficult to compare them. *Parties may wish to discuss whether the available approaches are sufficient to enter into discussions on the inclusion of wood products in the context of the UNFCCC and its Kyoto Protocol, or whether there is a need to consider new approaches that take into account the methods for estimating emissions from wood products, as well as the allocation among Parties.*

127. The approaches described within this document present differences in terms of socio-economic and environmental impacts, as well as implications for the emission limitation commitments, in particular when trade between Parties occurs. From the point of view of environmental impacts, the approaches themselves do not seem to represent either incentives or disincentives for deforestation, biodiversity loss or other matters, where management practices, national policies and circumstances may play a more important role. Approaches may have various implications for the markets, for the use of wood and for recycling, as well as for sustainable forest management. *Parties may wish to analyse further the implications for each approach and any derived need to regulate the application of each approach, so that negative impacts resulting from its application are eliminated or minimized.*

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Annex I

Data on international trade in wood products

Table 1: World production of wood products, 1994–1999

Type	Country type	1994–96	1997	1998	1999	Average
Roundwood (million m^3 per year)	Developing	2015	2002	1987	2042	2011.5
	Developed	1234	1295	1282	1293	1276
	Total	3249	3297	3269	3335	3287.5
Industrial roundwood (million m^3 per year)	Developing	442	449	424	450	441.3
	Developed	1044	1098	1092	1103	1084.3
	Total	1486	1547	1516	1553	1525.5
Sawn wood (million m^3 per year)	Developing	114	109	97	108	107
	Developed	318	322	318	328	321.5
	Total	432	431	415	436	428.5
Wood-based panels (million m^3 per year)	Developing	39	46	39	37	40.3
	Developed	102	111	112	116	110.3
	Total	141	157	151	153	150.5
Paper and paperboard (million tonnes per year)	Developing	59	69	70	71	67.3
	Developed	220	220	224	225	222.3
	Total	279	289	294	296	289.5

Source: Calculated from FAO (no date)

Table 2: Imports and exports of wood products, developing countries

Type	Import/export	1994–96	1997	1998	1999	Average
Roundwood (million m^3 per year)	Imports	19.1	20.4	16.2	15.3	17.8
	Exports	22.6	22.6	17.6	18.6	20.4
	Balance	3.5	2.2	1.4	3.3	2.6
Sawn wood (million m^3 per year)	Imports	17.1	18	17.6	15.3	17
	Exports	11.9	11.7	11.4	11.7	11.7
	Balance	–5.2	–6.3	–6.2	–3.6	–5.3
Wood-based panels (million m^3 per year)	Imports	11.7	12.8	12.4	13.2	12.5
	Exports	18.2	19.6	16.2	17.3	17.8
	Balance	6.5	6.8	3.8	4.1	5.3
Paper and paperboard (million tonnes per year)	Imports	18.5	24	23	21.6	21.8
	Exports	7.4	9.8	10.5	11.2	9.7
	Balance	–11.1	–14.2	–12.5	–10.4	–12.1

Source: Calculated from FAO (no date)

Table 3: Imports and exports imports of wood products, developed countries

Type	Import/export	1994–96	1997	1998	1999	Average
Roundwood (million m^3 per year)	Imports	69.5	70.6	71.7	72.7	71.1
	Exports	59.5	62.1	64.4	68.7	63.7
	Balance	–10	–8.5	–7.3	–4	–7.5
Sawn wood (million m^3 per year)	Imports	91.4	99.6	98.1	102.3	97.9
	Exports	97.4	102.1	102.5	105.1	101.8
	Balance	6	2.5	4.4	2.8	3.9
Wood-based panels (million m^3 per year)	Imports	30	36.2	37	38.1	35.3
	Exports	24.8	30.8	32	34.2	30.5
	Balance	–5.2	–5.4	–5	–3.9	–4.9
Paper and paperboard (million tonnes per year)	Imports	53	61.6	65.0	69.5	62.3
	Exports	67.1	78.9	79.3	80.1	76.4
	Balance	14.1	17.3	14.3	10.6	14.1

Source: Calculated from FAO (no date)

Note: According to FAO (2000), leading producers of industrial roundwood include the United States, Canada, China, Brazil and the Russian Federation. The five leading producers of sawnwood are the United States, Canada, the Russian Federation, China and Japan. Leading producers of paper and paperboard include the United States, China, Japan, Canada and Germany. Leading exporters of industrial roundwood include the Russian Federation, the United States, Malaysia, New Zealand and Germany. For sawnwood, principal exporters are Canada, Sweden, Finland, the United States and Austria. The main exporters of paper and paperboard include Canada, the United States, Finland, Sweden and Germany.

Annex II

Parties exporting and importing wood products

Importance of forest products trade	Parties included in Annex I to the UNFCCC	Countries and territories not included in Annex I to the UNFCCC	
		Non-tropical countries	Tropical countries
Parties with large import of wood products	Denmark Greece Iceland Ireland Italy Japan Ukraine United Kingdom	Afghanistan Algeria Argentina Armenia Azerbaijan Bahrain China Cyprus Democratic People's Republic of Korea Egypt Faeroe Islands Iraq Islamic Republic of Iran Israel Jordan Kazakhstan Kuwait Kyrgyzstan Lebanon Libyan Arab Jamahiriya Malta Mongolia Morocco Oman Qatar Republic of Korea Republic of Moldova Saudi Arabia Syrian Arab Republic Tajikistan Tunisia Turkey Turkmenistan United Arab Emirates Uzbekistan Yemen	American Samoa Angola Antigua and Barbuda Aruba Bahamas Bangladesh Barbados Benin Bhutan Botswana Burkina Faso Burundi Cape Verde Colombia Comoros Cook Islands Costa Rica Cuba Djibouti Dominica Dominican Republic Ecuador El Salvador Eritrea Ethiopia Gambia Grenada Guadeloupe Guatemala Haiti India Jamaica Kenya Kiribati Malawi Maldives Mali Marshall Islands Mauritania Mauritius Mexico Micronesia, Fed Namibia Nauru Nepal Niger Nigeria Niue Pakistan Palau Panama Peru Philippines Rwanda Saint Kitts and Nevis Saint Lucia Saint Vincent and the Grenadines Samoa Sâo Tomé and Príncipe Senegal Seychelles Sierra Leone Sri Lanka Sudan Togo Tonga Trinidad and Tobago Tuvalu Uganda Venezuela Viet Nam Zambia Zimbabwe
Parties with small import of wood products	Australia Austria Belarus Belgium Bulgaria Croatia Czech Republic France Germany Hungary Lithuania Luxembourg Netherlands Norway Poland Portugal Spain Switzerland Slovenia Slovakia United States of America	Lesotho Uruguay	Belize Bolivia Cambodia Chad Fiji French Guiana Guinea Honduras Madagascar Nicaragua Paraguay Singapore Suriname Tanzania Thailand United Republic of Tanzania Vanuatu
Parties with large export of wood products	Canada Estonia Finland Latvia New Zealand Romania Russian Federation Sweden	Chile Georgia South Africa Swaziland	Brazil Cameroon Central African Republic Congo Côte d'Ivoire Democratic Republic of Congo Equatorial Guinea Gabon Ghana Guinea-Bissau Guyana Indonesia Lao People's Democratic Republic Liberia Malaysia Mozambique Myanmar Papua New Guinea Solomon Islands Somalia

Annex III

Indicative quantitative analysis of different approaches for selected countries

1. Background

1. The secretariat commissioned a consultancy study on "Harvested wood products: Considerations on issues related to estimation, reporting and accounting of greenhouse gases" in 2002. One of the tasks was to analyse the implications of the different approaches (stock-change, production and atmospheric-flow approaches) to possible accounting of wood products. The results of the study (Pingoud, 2003) are summarized in this annex. The result should be considered only as indicative as it covers only some selected countries. There are limitations to the model used and the data available.

2. Description of method used and sources of data

2. The method used by the consultant to calculate the emissions associated with wood products consisted of estimating the changes in carbon stocks over time. In order to estimate the present stock changes of harvested wood products, inherited emissions from old wood products were estimated by using historical input data on forest production and trade, and by estimating outputs assuming that a constant percentage of the wood product stock decayed each year. The input to national stocks was estimated on the basis of national and international statistics compiled by FAO. The output from the system was based on the decay of the stock. In the context of this exercise, it was assumed that a constant percentage of the total stock decayed each year: 3.3 per cent for solid wood products and 100 per cent for paper products. These numbers are consistent with the average lifetime for solid products (30 years) and for paper products (1 year). The model is highly sensitive to the assumptions and any change in these assumptions will lead to different results. Likewise, applying a different method to estimate changes in the stock of carbon may also lead to different results. The results from this annex, therefore, should be taken only as an illustration of applying the mentioned assumptions to the model and should not be interpreted as real outcomes of the application of the approaches for allocating emissions.

3. Statistical data on production and trade were based on the FAO database (FAOSTAT). The end products, such as pre-fabricated houses, furniture and books, are excluded from the analysis. GHG inventory data were taken from UNFCCC documents FCCC/SB/2002/INF.2 and FCCC/WEB/2002/10.

3. Quantitative analysis

4. The summary of the analysis is presented in table 1.

4. Discussion

5. Some bias is caused by the fact that trade and consumption of certain end-use products is excluded from the analysis; the FAO statistics, used as the basis of the model, include only roundwood and semi-finished wood products. Thus, for instance, furniture manufactured in a country, but exported, has been counted in the stock-change of the producer country.

6. Considering the stock-change approach, the study suggests that wood products in use constituted a net removal for all of the selected countries in 2000, varying between 0.1 per cent (Japan) and 4 per cent (Austria) compared to the base year emissions. The removal estimates appear to vary yearly depending on the wood products consumption (for example, in Finland, wood products were a source of carbon in 1991). The application of the stock-change approach appears to have major results in terms of the accounting of emissions and removals. For some countries with a small forest area the estimated changes in wood products stocks are much larger than carbon stock changes in the LUCF category.

Table 1. Total GHG emissions excluding LUCF, and emissions from LUCF only, for the base year 1990, reported in national communications under the UNFCCC. Indicative calculated *excess emissions* from wood products (i.e. excess compared to IPCC default approach) in 2000 using the three approaches and compared to reported base-year emissions

(Gg CO_2 equivalent, and per cent)

		Total without CO_2 from LUCF		CO_2 from LUCF		Excess emissions from wood products **Stock-change approach**		Excess emissions from wood products **Production approach**		Excess emissions from wood products **Atmospheric-flow approach**	
	Base year 1990	Base year 1990	2000	% of total base year	% of LUCF base year	2000	% of total base year	% of LUCF base year	2000	% of total base year	% of LUCF base year
Australia	**425 175**	78 124	–2 061	–0.5	–3	–2 117	–0.5	–3	–443	–0.1	–1
Austria	**773 88**	–9 215	–3 088	–4.0	34	–1 835	–2.4	20	–3 355	–4.3	36
Belgium	**142 741**	–1 600	–1 443	–1.0	90	–694	–0.5	43	1 342	0.9	–84
Canada	**607 183**	–61 498	–9 207	–1.5	15	–33 848	–5.6	55	–91 509	–15.1	149
Denmark	**69 360**	–916	–1 892	–2.7	207	–106	–0.2	12	2 286	3.3	–250
Finland	**77 093**	–23 798	–2 381	–3.1	10	–4 484	–5.8	19	–23 582	–30.6	99
France	**559 342**	–56 232	–6 707	–1.2	12	–8 077	–1.4	14	–2 995	–0.5	5
Germany	**12 22 765**	–33 719	–10 844	–0.9	32	–12 566	–1.0	37	–6 725	–0.6	20
Greece	**104 895**	1 441	–591	–0.6	–41	–52	0	–4	1 536	1.5	107
Ireland	**53 700**	–89	–879	–1.6	991	–932	–1.7	1 050	–225	–0.4	254
Italy	**520 571**	–23 532	–6 529	–1.3	28	–1 310	–0.3	6	13 733	2.6	–58
Japan	**1 246 724**	–83 903	–1 187	–0.1	1	5 153	0.4	–6	29 843	2.4	–36
Netherlands	**210 347**	–1 422	–966	–0.5	68	–458	–0.2	32	4 792	2.3	–337
New Zealand	**73 161**	–21 845	–1 178	–1.6	5	–4 025	–5.5	18	–9 383	–12.8	43
Norway	**51 965**	–9 765	–720	–1.4	7	–182	–0.4	2	–1 409	–2.7	14
Portugal	**64 948**	–3 751	–1 146	–1.8	31	–660	–1.0	18	–2 690	–4.1	72
Spain	**286 428**	–29 252	–5 512	–1.9	19	–1 293	–0.5	4	7 848	2.7	–27
Sweden	**70 566**	–20 292	–1 051	–1.5	5	–2 808	–4.0	14	–18 397	–26.1	91
United Kingdom	**919 189**	–52 107	–3 434	–0.4	7	–3 073	–0.3	6	15 068	1.6	–29
United States	**6 130 724**	–10 977 47	–72 571	–1.2	7	–46 085	–0.8	4	–40 302	–0.7	4

Note: Negative emission means removal.

7. The production approach appears to provide a smaller quantitative impact than the stock-change approach for most of the selected countries, in particular the net importing countries. Under the production approach, carbon stored in exported wood products is accounted by the producer country. The highest estimated net removal was for Finland with 5.8 per cent compared to the base year emissions; the highest estimated net source was for Japan with 0.4 per cent compared to the base year emissions. Fewer countries produce wood products than consume them.

8. The most divergent results are related to the atmospheric-flow approach; estimated impacts result in a net removal of 30.6 per cent for Finland and a net source of 3.3 per cent for Denmark compared to the base year emissions. Based on the study, countries such as Canada, Finland, New Zealand and Sweden would account for a large removal from wood products. The results are consistent with a theoretical analysis, as the net exports dominate the carbon removals of the above exporter countries giving a large credit to their national carbon balance. On the other hand, large excess emissions would be allocated to Denmark, Spain, Netherlands, Japan and the United Kingdom.

9. The trade of forest products is an important factor when applying the atmospheric-flow approach. The following section contains an analysis on the role of trade and impacts to selected Annex I Parties and non-Annex-I Parties.

5. Role of trade under the atmospheric flow approach

10. The importance of the trade flux term in the atmospheric-flow approach is illustrated in table 2. The net exports of wood products (indicated as negative imports) result in a substantial removal for leading exporter countries. Countries such as Canada, Finland, New Zealand and Sweden could, in principle, comply with their emission limitation commitments under the Kyoto Protocol by exporting wood products, should the atmospheric flow approach be adopted.

6. Implications between Annex I and non-Annex I Parties

11. Different approaches may have different implications for importing and exporting countries depending whether a country has quantitative emissions limitation or reduction targets (Annex I Parties) or does not have such targets (non-Annex I Parties). As described in section IV.G of the present document, the atmospheric-flow approach may have most dramatic implications on trade in wood products. An indicative analysis for selected Annex I and non-Annex I Parties in Kyoto Protocol accounting is presented in tables 3 and 4. The trade flows in these tables are expressed in United States dollars, not as carbon fluxes. For the purposes of this study, it is assumed that the monetary numbers have strong correlation with the true carbon fluxes in wood products.

12. Of the big exporters of wood products among Annex I Parties, Finland and Sweden are examples of countries exporting mainly to other Annex I Parties. Their wood products imports are smaller than exports. Although these countries would get a large credit of their net carbon export under the atmospheric-flow approach, the advantage is questionable due to the potential penalties for their wood products imports into other Annex I Parties.

13. Canada's position as a large net exporter might be different. Most of its exports (94 per cent in monetary value) are also to Annex I Parties, but the share of the United States is more than 80 per cent. Should the United States not ratify the Kyoto Protocol, it would be in the same position as the non-Annex I Parties. Canada could benefit from its wood products exports to USA as a national carbon removal with no essential penalties for its wood products exports. Thus, the atmospheric-flow approach could be favourable for Canada, at least in the short-term, if the United States were not ratifying the Kyoto Protocol. New Zealand also seems to export a large part of its wood products to non-Annex I Parties.

Table 2. Net imports of wood products in 2000 converted to CO_2 flows and compared to base-year emissions

Country	Net imports in 2000 (Gg CO_2)	% of base-year emissions
Australia	1 617	0.4
Austria	–267	–0.3
Belgium	2 785	2.0
Canada	–82 303	–13.6
Denmark	4 179	6.0
Finland	–21 201	–27.5
France	3 712	0.7
Germany	4 118	0.3
Greece	2 127	2.0
Ireland	654	1.2
Italy	20 262	3.9
Japan	31 029	2.5
Netherlands	5 758	2.7
New Zealand	–8 205	–11.2
Norway	–689	–1.3
Portugal	–1 544	–2.4
Spain	13 361	4.7
Sweden	–17 346	–24.6
United Kingdom	18 501	2.0
United States	32 269	0.5

Note: + means that the country is net importer, – that it is net exporter.

Table 3. Exports to Annex-I and non-Annex-I Parties from some specified countries

	Value of exports (thousands of US$) to:				
	Annex I Parties		Non Annex-I Parties		
Exporter	Thousands of US$	Fraction (%)	Thousands of US$	Fraction (%)	Total
Australia	158 092	22	551 461	78	709 553
Canada	23 818 518	94	1 651 182	6	25 469 700
Finland	9 581 482	88	1 343 918	12	10 925 400
France	4 920 512	87	763 468	13	5 683 980
Germany	8 535 002	86	1 388 978	14	9 923 980
Japan	538 949	31	1 190 911	69	1 729 860
Netherlands	2 331 920	86	374 550	14	2 706 470
New Zealand	757 543	58	546 007	42	1 303 550
Norway	1 599 041	87	232 709	13	1 831 750
Sweden	8 646 911	89	1 073 979	11	9 720 890
United Kingdom	1 758 536	80	433 534	20	2 192 070
United States	8 628 956	58	6 154 444	42	14 783 400
Brazil[a]	1 835 190	71	744 590	29	2 579 780
Indonesia[a]	2 040 332	43	2 670 698	57	4 711 030
Malaysia[a]	1 568 470	50	1 546 470	50	3 114 940

Source: FAOSTAT

[a] Non-Annex I Parties.

Table 4. Imports from Annex-I Parties and non-Annex-I Parties to some specified countries

	Value of imports (thousands of US$) from:				
	Annex I Parties		Non Annex-I Parties		
Importer	Thousands of US$	Fraction (%)	Thousands of US$	Fraction (%)	Total
Australia	1 172 939	77	350 251	23	1 523 190
Canada	3 614 031	96	163 349	4	3 777 380
Finland	846 267	95	41 224	5	887 491
France	6 531 815	88	899 055	12	7 430 870
Germany	10 247 902	95	528 998	5	10 776 900
Japan	6 755 587	55	5 592 713	45	12 348 300
Netherlands	4 361 673	76	1 344 057	24	5 705 730
New Zealand	264 016	85	46 828	15	310 844
Norway	947 112	94	62 738	6	1 009 850
Sweden	1 568 710	97	46 930	3	1 615 640
United Kingdom	8 306 280	92	677 190	8	8 983 470
United States	23 054 156	97	666 944	3	23 721 100
Brazil[a]	546 766	67	265 157	33	811 923
Indonesia[a]	572 472	61	366 478	39	938 950
Malaysia[a]	533 422	53	467 058	47	1 000 480

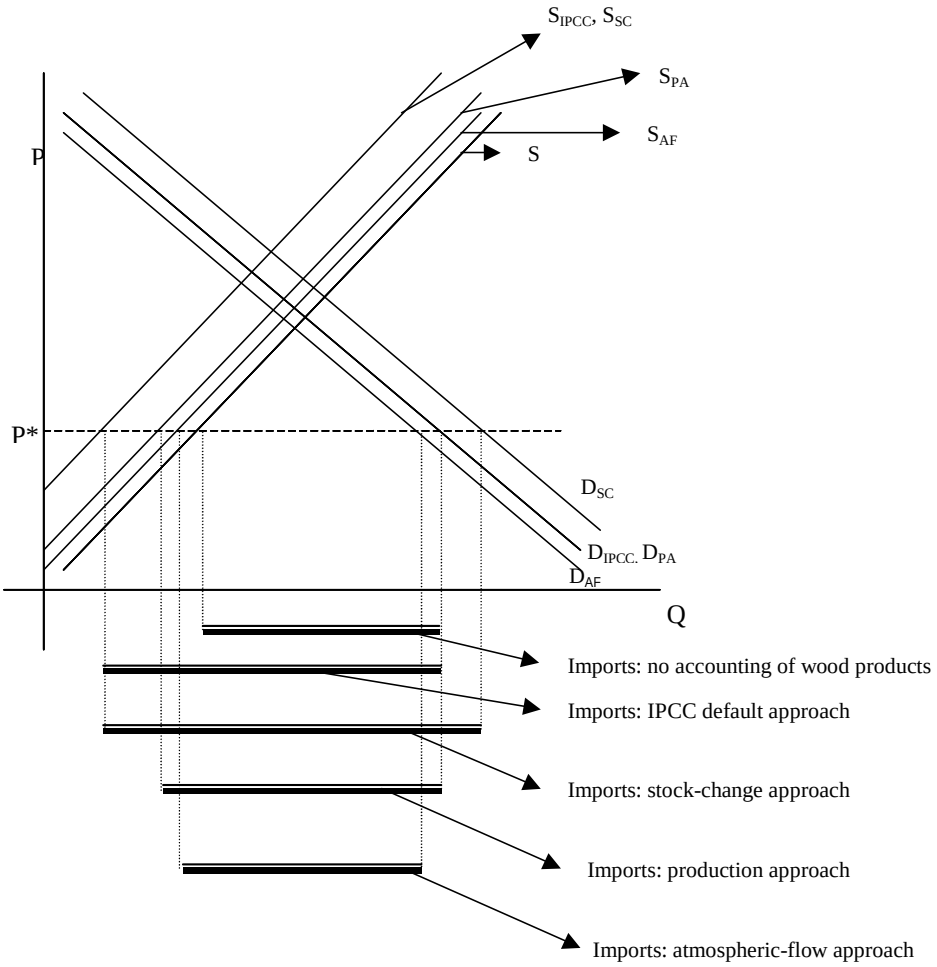
Source: FAOSTAT

[a] Non-Annex-I Parties.

Annex IV

Comparison of the application of the different approaches from a market perspective

The following figure compares the consequences on imports of the application of the four approaches. From the net importers' perspective, imports occur when the market price for wood is lower than the national price. An importing country will import those wood products which are cheaper than its marginal costs of production. The figure is based on the assumption that, after the application of any of the approaches, the market price of wood does not change. The lines drawn below the figures represent the imports of a country, calculated as the total quantity demanded minus the total quantity produced.



D= Demand
S = Supply
P* = Market price
P= Price
Q= Quantity

IPCC = IPCC default approach
SC= Stock-change approach
PA= Production approach
AF= Atmospheric-flow approach

Annex V

Possible classification of wood products under the UNFCCC

First-order classification of wood products	Second-order classification of wood products	Third-order classification of wood products
Wood products	Industrial roundwood	Coniferous industrial roundwood
		Non-coniferous industrial roundwood
	Fuelwood and charcoal	Fuelwood; coniferous
		Fuelwood; non-coniferous
		Charcoal
	Sawnwood	Coniferous sawnwood
		Non-coniferous sawnwood
	Wood-based panels	Veneer sheets
		Plywood
		Particle board
		Hardboard
		Medium density fibreboard
		Insulating board
Paper products	Pulp	Wood pulp
		Other fibre pulp
	Paper and paperboard	Newsprint
		Printing and writing paper
		Household and sanitary paper
		Wrapping and packing paper and paperboard
		Other
Other secondary products	Other secondary products (furniture)	Furniture
		Other secondary processed wood and articles of wood
Other fibre products	Other fiber products (bamboo and rattan)	Bamboo
		Rattan
		Other
Carbon from wood products stored in landfills	Carbon from wood products stored in landfills	Carbon from wood products stored in landfills
Carbon from paper products stored in landfills	Carbon from paper products stored in landfills	Carbon from paper products stored in landfills

Source: Based on the FAO (2000)

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