

Green Institute Working Paper 1

Australia's national greenhouse accounts: land use, land-use change and forestry

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¹ This working paper was written to gain a better understanding of how Australia's greenhouse gas accounts are put together. Comments are welcome and should be sent to margaret.blakers@bigpond.com.

1. Introduction

Since 1996, the Intergovernmental Panel on Climate Change (IPCC), at the invitation of parties to the UN Framework Convention on Climate Change (UNFCCC), has developed guidelines for the measurement of greenhouse gas emissions by countries. The aim is to provide comprehensive and internationally comparable national accounts of anthropogenic (human-induced) greenhouse gas sources and sinks. Such information is essential to support policy and action to address the global climate crisis.

The development of the accounting system has been evolutionary, to avoid discontinuities in comparing data, and the guidelines offer alternative methodologies to suit countries with a wide range of conditions, capabilities and resources. The most recent guidelines were issued in 2006.² The most problematic sector of the accounts is that dealing with the living world: agriculture, land use, land-use change and forestry. The early methodologies were fairly rudimentary but the *Good Practice Guidance for Land Use, Land-Use Change and Forestry*, released in 2003 has considerably improved the consistency and reduced the uncertainties of these accounts.³

In the last few years it has been recognised that deforestation is a major source of greenhouse gases, accounting for at least 18% of global emissions according to the Stern Review.⁴ The UNFCCC through its Subsidiary Body for Scientific and Technical Advice is convening an ongoing discussion on ways to reduce emissions in developing countries from deforestation (clearing) and degradation (activities such as logging, burning and grazing which reduce the amount of carbon stored in a forest).

Globally, there is increasing recognition that carbon sequestration and biodiversity protection can be mutually reinforcing objectives for land management. Carbon trading and other financial mechanisms which can give effect to this are evolving rapidly. This poses a challenge for carbon accounting. If it does not provide a framework which supports biodiversity protection, then the opportunity to channel carbon sequestration funding for that purpose will be hindered, perhaps lost. Greenhouse gas accounts need to identify 'biodiverse carbon' separately and where possible distinguish activities which enhance or degrade biodiversity protection. 'Biodiverse carbon' is carbon in living systems with high value for biodiversity. This pre-supposes that biodiversity value can be independently measured and reported so that the two accounts can be linked. The need for biodiversity accounting is the subject of a separate paper.⁵

This paper reviews selected components of Australia's land use, land-use change and forestry (LULUCF) accounts which are of particular relevance to biodiversity conservation, especially forest conservation, these being the terrestrial ecosystems with the highest concentrations of carbon.

² IPCC 2006

³ IPCC 2003

⁴ Stern 2006

⁵ Blakers and McGregor, 2007

2. Australia's national greenhouse accounts

2.1 The accounts

Australia has two sets of greenhouse accounts. They are prepared by the Australian Greenhouse Office (AGO), one to meet the requirements of the Kyoto Protocol (Kyoto account) and one prepared for the UNFCCC (the UNFCCC account). The Kyoto account is the one which matters in achieving Australia's 2008-2012 target of holding emissions to 108% of 1990 levels.

Both accounts are drawn from the National Carbon Accounting System (NCAS) and use the same IPCC methodology but they differ in the treatment of land use and forestry. The Kyoto account covers only the subset of human-induced emissions and uptake defined in Articles 3.3 and 3.4 of the Protocol. Article 3.3, which is binding for developed (Annex 1) countries, relates primarily to land use change, either from forest to cleared land or from cleared land to forest. Specifically the Kyoto account includes: uptake ('sinks') resulting from post-1990 tree planting on previously cleared land (afforestation or reforestation depending how long the land has been cleared) and emissions resulting from post-1990 tree clearing (deforestation).⁶

The difference between the two accounts is substantial (Table 1) and has real implications for policy and action. Land uses and land-use changes which are not picked up in the Kyoto accounts are downplayed even when they are large causes of greenhouse gas pollution (such as native forest logging) or large sinks (such as native forest regrowth). The level of attention to data collection and accounting methodology is diminished for most non-Kyoto activities.

While recognising the intention to adopt more sophisticated methodologies in the future, it ought to be possible to understand the assumptions, data sources and methods which were used to create Australia's current accounts. But that turns out to be extremely difficult. It is necessary to read the Australia's methodology⁷ together with the IPCC *Good Practice Guidance* and even then it is frequently not clear.

2.2 Land use, land-use change and forestry (LULUCF)

The fundamental basis for the methodology rests upon two linked themes: i) the flux of CO₂ to or from the atmosphere is assumed to be equal to changes in carbon stocks in existing biomass and soils, and ii) changes in carbon stocks can be estimated by first establishing rates of change in land use and the practice used to bring about the change (e.g., burning, clear-cutting, selective cut, etc).⁸

In summary, the approach of the IPCC *Guidance* is to assign land to a set of defined land-use categories and estimate changes over time in the carbon stocks for each. Depending on the availability of data, countries can select from assessment 'tiers' of increasing rigour and specificity to carry out the accounting.

⁶ Article 3.4 of the Kyoto Protocol gives Annex 1 countries the option of claiming credits for additional carbon sequestered through the management of forests, grasslands and croplands since 1990. Australia has not taken up the option.

⁷ Australian Government 2007

⁸ IPCC 2003, p.3.15

There is a basic distinction between 'managed land', where emissions and uptake are taken to be 'human-induced' (and therefore covered by the Climate Change Convention), and 'unmanaged land' where emissions and uptake are not counted.

Managed land is defined as land where 'human interventions and practices have been applied to perform production, ecological or social functions'.⁹ This is divided into six primary categories: forest lands, croplands, grasslands, wetlands, settlements and other lands.¹⁰ These are further divided into land remaining in the same category and land converted from one category to another between one inventory year and the next. Within these sub-categories, subsets can be defined on a country specific basis, relating to activities, management regimes or ecological criteria. The over-arching requirement is for consistency, completeness and transparency.

Australia excludes parks and reserves from 'managed land' though this appears contrary to the *IPCC Guidance*. The 'managed forests' category therefore includes only forests available for wood production; these are further subdivided into native forests and plantations.¹¹

2.3 Carbon pools in terrestrial ecosystems

The *IPCC Guidance* defines five carbon pools for terrestrial ecosystems.¹² These are:

Biomass – above ground. All living vegetation above the soil, including stems, stumps, branches, bark, seeds and foliage.

Biomass – below ground. All live roots (other than fine roots).

Dead wood. All non-living biomass not contained in the litter, generally greater than 10 cm diameter (or another size specific to the country).

Litter. All non-living biomass greater than the size limit for soil organic matter (suggested 2 mm diameter) and smaller than the diameter selected for dead wood.

Soils. Soil organic matter, including fine roots, to a depth specified by the country.

These are the building blocks for estimating changes in carbon stocks for each land use category.

2.4 Carbon in harvested wood products

Harvested wood products do not need to be separately accounted for but, if they are, there are three accounting options.¹³

a) Assume that all emissions from harvested wood occur at the time of logging. This requires no analysis of the life span or ultimate destination of Australian-grown wood and excludes imported wood from the Australian account. This is currently the IPCC default approach.

b) Account for emissions of wood products grown in Australia, regardless of their final destination. The life span of wood products is assumed to be similar whether used in Australia or elsewhere. Imported wood products are excluded from the Australian account.

⁹ IPCC 2006, p.1.5

¹⁰ IPCC 2003, p.2.6

¹¹ In Australia, 'forests' are defined as vegetation (trees) at least 2 m in height, with minimum 20% crown canopy cover, and a minimum area of 0.2 ha (Australian Government 2007, p12)

¹² IPCC 2003, p.3.15

¹³ Richards et al 2007

c) Account for emissions of wood products stored in Australia. Locally produced and imported wood which is processed in Australia is accounted for. Exported wood is not included. This is the option used in Australia's UNFCCC account.

A considerable effort has been made to develop the models for harvested wood products in NCAS, even though this is not a category that can be counted towards meeting the Kyoto targets.

2.5 NCAS

The National Carbon Accounting System (NCAS) is progressively developing a comprehensive set of accounts in accordance with the methodologies recommended by the IPCC. The same data are used to generate separate reports for the Kyoto account and the UNFCCC account.

For the 2005 accounts, a fully spatially explicit (Tier 3) methodology has been applied only to land-clearing: that is, the 'forest to grassland' and 'forest to cropland' sub-categories.

The 'forests remaining forests', 'land converted to forests' and 'harvested wood products' categories use interim methods (Tier 1 and Tier 2).

As NCAS develops, the quality and reliability of the accounts is improving. However, it is the data currently available which is being used to inform today's policies, for example on the scope of Australia's promised carbon trading scheme. It is therefore important to understand the methodologies and their limitations. These are summarised in the appendix by reference to the 2005 greenhouse accounts presented in tables 1–3, accompanied by comments on the methodology.

3. Discussion and recommendations

The purpose of carbon accounts is inform policy and action to reduce greenhouse gas emissions, and to monitor the results. The following recommendations would make it easier to use the accounts and improve their transparency and policy usefulness.

3.1 Native forest data

The sophistication of the land use and forestry accounts has improved dramatically in the last decade and plans for continued development are acknowledged. However, the Australian inventory remains very uneven with the most effort having been devoted to assessing emissions from clearing native vegetation and post-1990 plantations (Kyoto account items), and to carbon storage in wood products. Emissions and uptake from native forests, and native vegetation more generally, have missed out and need to be brought rapidly to an equivalent level of sophistication.

The estimates for native forest growth, a very important carbon sink, are particularly poor. They are based on outdated figures for forest areas, age classes and growth rates, which have remained unchanged since 1990. The estimates of carbon losses from native forest logging are almost certainly much too low because they are based on log volume (rather than site specific estimates) and they omit losses of soil carbon.

Recommendation 1. Implement comprehensive, dynamic and spatially explicit methodologies for native forests and native vegetation as soon as possible. If this cannot be completed before

the next inventory, make it clear in all documentation that the estimates for 'managed native forests' are based on outdated figures and methods that under-estimate emissions from native forest logging.

Recommendation 2. Support research to improve the understanding of carbon storage and fluxes in native vegetation, especially old growth forests and other mature native vegetation, and especially that on productive sites. These will store the highest quantities of carbon.

3.2 Compatibility with biodiversity measurement

The opportunity to identify conflicts and synergies between carbon sequestration and biodiversity conservation requires adjustment of the carbon accounts (as well as development of a corresponding biodiversity accounting system). The land use categories and activities used to partition the carbon accounts should make it possible to measure carbon fluxes in biologically meaningful units. This should not need a major adjustment. Already native forests are distinguished from plantations; similar partitioning could be applied to grasslands to differentiate native grasslands and shrublands from introduced pastures. Their ecological significance suggests that wetlands should also be accounted for separately in future development of NCAS, as provided for in the IPCC methodology.

Recommendation 3. Work towards making the greenhouse gas inventory compatible with evolving methods for biodiversity accounting.

Recommendation 4. Account separately for native forest wood and plantation wood in the 'harvested wood products' category, consistent with the disaggregation of 'forests' into native forests (high biodiversity value) and plantations (crops).

3.3 Managed land

The IPCC definition of 'managed land' includes land managed for ecological and cultural, as well as economic, purposes. However, conservation reserves are currently excluded from Australia's inventory.

Recommendation 5. Include all managed land in future inventories, with conservation reserves reported separately.

3.4 Carbon stocks

Estimates for the total stock of carbon in forests, plantations and wood products are not reported systematically as part of Australia's inventory and appear to be inconsistent. For example, it seems improbable that wood products contain nearly 1% as much carbon as all of Australia's forests (see note 1 in the appendix).

Recommendation 6. Review the estimates for carbon stocks in the LULUCF category, including wood products.

3.5 Harvested wood products

The store of CO₂ in harvested wood products is increasing by about 5 Mt CO₂ per annum according to the modelled calculations. The amount in landfill is increasing by 2.5 times that rate. Modelling of stocks and flows of wood and wood products is highly complex and

necessarily imports major uncertainties into the accounts. Resources would be better directed to improving the data for native forests and plantations and accounting for all logging emissions at harvest, which is the IPCC default.

Recommendation 7. Adopt the IPCC default recommendation and account for all emissions associated with wood production at the point of harvest.

3.6 Transparency

The commentary in the appendix illustrates just how difficult it is to piece together an understanding of how Australia's greenhouse gas accounts are compiled. The description of methodologies is difficult to follow and has to be cross-referenced to the IPCC *Guidance*; there are data problems in some categories; and lack of critical information in others. This lack of transparency is contrary to the explicit intent of the IPCC guidelines. The methodology for each category should be presented in a standard format which identifies the carbon pools and land types covered, together with data sources, key parameters and equations. This could well be presented as a one page summary to accompany each item in the on-line accounts, which are an excellent innovation.

Recommendation 8. Publish the methodology for each land-use category and activity in a systematic format which clearly sets out the data sources and procedures. This could be linked to the relevant sections of the on-line greenhouse accounts.

Greenhouse gas emissions and uptake for each category or activity should be disaggregated as far as possible. Reporting net results obscures the information that is most relevant for policy and action.

Recommendation 9. Report emissions and uptake as disaggregated statistics to the most detailed level possible.

Table 1. Comparison of Australia's UNFCCC and Kyoto accounts for the year 2005.¹ By convention, uptake (sinks) are negative numbers, emissions are positive numbers.

No.	Account category	UNFCCC account Mt CO ₂	Kyoto account Mt CO ₂	Comment
1.	All energy	391.019	391.019	
2.	Industrial processes	29.462	29.462	
3.	Solvent and other product use	0	0	
4.	Agriculture	87.889	87.889	
5.	Land use, land use change and forestry	-3.218	33.667	The difference is because the Kyoto account includes only some LULUCF activities
5.A	Forest lands	-51.495	--	
5.A.1	Forest land Remaining Forest Land	-29.561	--	Includes sequestration from growth of native forests and plantations minus emissions from logging native forests and plantations. Excludes harvested wood (native forest and plantations).
5.A.2	Land converted to forest land	-21.933	-19.609	Plantations planted since 1990
5.B	Croplands	-4.571		Appears to include forest regrowth
5.C	Grassland	57.846		Primarily clearing of native vegetation
5.D	Wetlands	NE		
5.E	Settlements	NE		
5.F	Other lands	NE		
5.G	Other (harvested wood products)	-4.999		Includes additions to long term carbon storage in wood products in Australia (derived from both domestic and imported wood) Excludes exported wood products
6.	Waste	17.036	17.036	
	Total (net)	522.189	559.074	

NE = not estimated

Table 2. Carbon stocks in forests, plantations, wood products and landfill

Carbon store	Stock Mt C	Stock Mt CO ₂	Source	Notes (see appendix)
Native forests	10 460	38 353	BRS 2003	Note 1
Plantations	88	323	BRS 2003	
Wood products (2005)	96.5	354	Australian Government 2007	Note 10
Landfill (2003)	232.1	851	Richards et al 2007	

Table 3. Australia's UNFCC accounts for land use, land-use change and forests for the year 2005.¹ Each figure is the reported net change since the previous year (uptake is a negative number, emissions are positive numbers).

	Account category	Land-use category Mt CO ₂	Land-use sub- category Mt CO ₂	Activity Mt CO ₂	Notes (see appendix)
5.A	Forest land	-51.495			
5.A.1	Forest land Remaining Forest Land		-29.561		
	Managed native forests (net)			-43.476	Notes 2, 3, 4
	Plantations (net)			2.297	Note 6
	Fuelwood consumed			10.355	
	<i>5(V) Biomass burning</i>			1.263	
5.A.2	Land converted to forest land		-21.933		
	Grassland converted to forest land			-21.933	Note 7
5.B	Croplands	-4.571			
5.B.1	Cropland remaining cropland		0		
5.B.2	Land converted to cropland		-4.571		
	<i>5(V) Biomass burning</i>			0.620	
	<i>5(III) Disturbance associated with land conversion</i>				
	Forest land converted to cropland (net)			-5.191	Note 8
5.C	Grassland	57.846			
5.C.1	Grassland remaining grassland		0		
5.C.2	Land converted to grassland		57.846		
	<i>5(V) Biomass burning</i>			1.690	
	Forest land converted to grassland (net)			56.156	Note 9
5G	Harvested wood products	-4.999			
	Harvested wood products (net)			-4.999	Note 11
	5(I) N fertilisation			NE	
	5(II) Drainage of soils			NE	
	5(IV) Agricultural lime application			NE	

NE Not estimated

Appendix. Commentary on Australia's greenhouse gas accounts

The following sections outline and comment on the methodology used in Australia's accounts and comment on it. The focus is on forests, plantations and land use change. Where relevant, the sections are numbered according to the categories and subcategories in Tables 2 and 3. Both the Kyoto and UNFCCC accounts are on-line so that emission trends since 1990 are accessible (www.greenhouse.gov.au).

Note on conventions

The IPCC accounting conventions require emissions to be reported as a positive number and uptake (sinks) as negative. Generally amounts have been converted to CO₂ (3.667 x C) and are reported as Mt CO₂ (million tonnes CO₂).

The amounts in this commentary refer to the UNFCCC accounts for the calendar year 2005, unless otherwise specified.

Stocks and flows are separately identified. Stocks are the total quantity of CO₂ stored. Flows or fluxes are the change – emissions or uptake -- in a given time period.

5.A.1. Forest land remaining forest land: managed native forests

Note 1. Carbon stocks in native forests

Reported amount. 38 350 Mt CO₂ (10 460 Mt C)¹⁴

Methodology. There is no published methodology.

Forest areas. It is not clear whether private land or conservation reserves are included.

Carbon pools. The estimate is stated to include carbon in 'above-ground, below-ground, and forest floor biomass'; i.e. excluding soil carbon.¹⁵

Measurement. The data was supplied by the Australian Greenhouse Office (AGO) to the BRS and is assumed to be derived from remote sensing.

Comment. The relativities between the wood products, landfill and forest carbon stocks do not seem realistic: for example it seems improbable that wood products contain nearly 1% as much carbon as Australia's total native forest estate. The data and methods should be published.

¹⁴ BRS 2003, table 69, p.201

¹⁵ BRS 2003, p.200

Note 2. Net CO₂ flux in native forests

Reported amount (2005). -43.476 Mt CO₂ (net)

Methodology.

Forest areas. For uptake: public native forests available for logging. For emissions: logged public and private native forests.

Components. Includes uptake due to native forest growth (-57.3 Mt CO₂, see note 3 below); and emissions due to native forest logging. Excludes harvested wood removed off-site.

Carbon pools. For uptake: unknown. For emissions: excludes dead wood, litter and soil.

Measurement. See note 3 and note 4 below.

Comment. For transparency, emissions and uptake should be separately reported where possible.

Note 3. Uptake (carbon sequestered) through native forest growth

Reported amount. Not reported separately but calculated to be -57.3 Mt CO₂

Methodology. Very basic.¹⁶

Forest areas. Conservation reserves not included. Private forests probably not included, but this is not clear.

Carbon pools. The carbon pools included in the estimate are not reported.

Measurement. Uses average 'growth rates' (t CO₂ per hectare per annum for broad forest types and age classes) multiplied by area. Areas and growth rates are referenced to Australia's National Forest Inventory and the Resource Assessment Commission report (1991); the data have not changed since 1990 and neither has the calculated annual CO₂ uptake.

Comment. Using the AGO data (Tables 7.A1 and 7.A2 of the 2005 Inventory), it can be calculated that uptake due to native forest growth is -57.3 Mt CO₂ per annum. Apart from the fact that it is static, it is also likely to be low because conservation areas and (probably) private forests are excluded; and forests over 200 years old are assumed not to be growing. Rates of carbon sequestration would also be underestimated if deadwood, litter and soil are excluded.

Uptake of 57 Mt CO₂ by native forests makes a large contribution to Australia's greenhouse performance (it represents more than 10% of Australia's net emissions). It is extraordinary that such a significant item has been so neglected.

Note 4. Emissions from native forest logging

Reported amount. Not reported separately

Methodology

Forest areas. Logged public and private native forests.

Components. Includes on-site emissions (slash and roots). CO₂ in logs removed from the site is reported in the wood products or waste categories.

Carbon pools. Above ground biomass; probably below-ground biomass.

¹⁶ Australian Government 2005, Vol 2, p23

Measurement. The *IPCC Guidance* give an equation for estimating carbon stocks in living biomass (Equation 3.2.3) which takes the 'merchantable volume' of wood as the starting point, and applies estimates for above-ground tree biomass (biomass expansion factor) and below ground tree biomass (root to shoot ratio). The IPCC equation for carbon loss due to commercial fellings (Equation 3.2.7) takes the actual 'harvested volume' as the starting point and applies estimates for total above-ground biomass (below-ground biomass is not estimated).

Taking the parameters and default values stated to be used in Australia's model (Table 7.A4), it appears that CO₂ emissions due to native forest logging have been estimated as follows:

$$E = [H \cdot BEF \cdot D] \cdot (1+R) \cdot 44/12 \text{ where}$$

E = total emissions (on-site and logs) t CO₂

H = harvested roundwood volume m³

BEF = biomass expansion factor = 1.9

D = density of carbon in hardwood = 0.325 t C/ m³

R = Ratio of belowground weight to above ground weight = 0.25¹⁷

The model assumes that 'slash' decays linearly over seven years.

Comment. There is a significant data problem: the log volumes from native forests used to drive the calculations appear to include hardwood plantations as well as native forests. This can be seen by comparing ABARE¹⁸ figures for native forest and plantation logs with the data used in the UNFCCC account.¹⁹

Using ABARE data for native forests as the starting point, total emissions from native forest logging in 2005 were 27.7 Mt CO₂ (comprising on-site emissions of 16.0 Mt CO₂ and 11.7 Mt CO₂ in logs removed from the site).

However, if the carbon uptake from forest growth is -57.3 Mt CO₂ (note 3), then by subtraction the on-site emissions from native forest logging are 13.8 Mt CO₂. This is significantly lower than would be suggested by applying the formula above to either native forest alone (16.0 Mt CO₂ on-site emissions) or native forest plus hardwood plantations (12 967 m³ logs corresponding to on-site emissions of 21.2 Mt CO₂).²⁰

Without a more detailed explanation of the assumptions and calculations, these discrepancies cannot be reconciled.

In native forests, using harvested log volume as the primary data is likely to underestimate CO₂ emissions because, unlike a plantation, not all merchantable logs will actually be removed. This could cause severe underestimation especially in old growth forests.

¹⁷ This equation could be used to estimate emissions from logging any native forest where the expected or actual roundwood volume is known (recognising that it will be an underestimate).

¹⁸ ABARE 2007

¹⁹ The comparison is complicated by the fact that ABARE reports on financial years, while the UNFCCC accounts use calendar years. However, for the years 2000-2005 (financial years 1999/00—2004/05), when significant volumes of hardwood plantation logs come on-stream, the comparison is:

ABARE total native forest removals	61 514 m ³
ABARE total hardwood plantation removals	9275 m ³
ABARE total native forest and plantation	70 785 m ³
UNFCCC Inventory Report 'managed native forest' wood removals:	70 816 m ³

It seems clear that the Inventory Report combines native forest and hardwood plantation data

²⁰ Note: because slash is assumed to decay linearly over seven years and the logged volume has remained more or less constant since 1990, the discrepancy is not due to delays in emissions.

5.A.1 Forest land remaining forest land: plantations

Note 5. Carbon stocks in plantations (hardwood plus softwood)

Reported amount. 322 Mt CO₂ (88 Mt C)²¹

Methodology. Unpublished

Note 6. Net CO₂ flux in pre-1990 plantations

Reported amount (2005). 2.3 Mt CO₂

*Methodology*²²

Areas. Includes areas that were native forest or plantation in 1990 and are plantation in 2005. The plantation areas are derived from National Plantation Inventory establishment estimates, and discounted by estimated areas of second rotation plantations.

Components. Includes uptake resulting from plantation growth. Includes on-site emissions from logging. Excludes carbon in logs removed off-site.

Carbon pools. Above and below-ground biomass and litter. Soil carbon is not included.

Growth rates. Current annual increments of stem volume for each plantation type are recalculated from National Forest Inventory wood flow estimates (i.e. this is a computed average growth rate not measured annual growth).

Comment. Australia's mature plantation estate of plantations established prior to 1990 is progressively being harvested. The estate is a net emitter of greenhouse gas emissions in the UNFCCC account because CO₂ in harvested logs is not reported in this category. The complete carbon balance for mature plantations therefore depends crucially on what happens to the harvested wood.

5.A.2 Grassland converted to forest land

Note 7. Net CO₂ flux from post-1990 plantation establishment and growth

Reported amount (2005). -21.9 Mt CO₂

Methodology.

Areas. Includes areas that were grassland in 1990 and have since been converted to plantations.

Components. Includes uptake resulting from plantation growth. Includes on-site emissions from logging. Excludes CO₂ in harvested wood removed off-site.

Carbon pools. Above ground and below ground biomass and litter. Excludes soil carbon.

Growth rates. Current annual increments of stem volume for each plantation type are recalculated from National Forest Inventory wood flow estimates (i.e. this is a computed average growth rate not measured annual growth).

²¹ BRS 2003, p.201

²² Australian Government 2007, Vol 2, p13 and appendix 7B

Comment. As the accounts for pre-1990 plantations show (Note 6), plantations become net emitters of greenhouse gases when they mature (excluding logs removed off-site). It is the continued expansion in plantation area which results in this sub-category being a net sink.

This sub-category is similar to the Kyoto 'reforestation' category but there is a difference in the reported uptake: -21.9 Mt CO₂ for the UNFCCC account compared with -19.6 Mt CO₂ for the Kyoto account. This is something to do with the treatment of plantations in the initial years (UNFCCC 1990 = -2.0 Mt; Kyoto 1990 = 0) but otherwise requires clarification.

5.B.2 Forest land converted to cropland

Note 8. Net CO₂ flux from conversion of forests to cropland

Reported amount (2005). -5.191

Comment. It is difficult to understand how forest land converted to cropland could be a sink (reported as -5.9 Mt CO₂). It looks as if areas that were forest in 1990 and were subsequently cleared for cropping have remained in that category even if native forest subsequently regrows. Regrowth of cleared native vegetation does not seem to be accounted for elsewhere.

5.C.2 Forest land converted to grassland

Note 9. Net CO₂ flux from conversion of forests to grassland

Reported amount (2005). 56.156

Comment. This is probably a net figure which include some regrowth of native vegetation offsetting continued clearing.

5.G Harvested wood products

Harvested wood remains in products, and therefore stores carbon, for varying periods of time. The treatment of harvested wood products in national accounts has not finally been determined by the UNFCCC.²³ Australia has applied considerable resources to develop this component of the UNFCCC accounts, though the annual increase in stocks is relatively small (-5 Mt CO₂ in 2005).²⁴

Note 10. Stocks of CO₂ in harvested wood products

Reported amount (2005). -354 Mt CO₂ (96.5 Mt C)

Comment. This compares with the reported stock of carbon in native forests which is 38 350 Mt CO₂ (10 460 Mt C) and plantations which is 322 Mt CO₂ (88 Mt C). See note 1.

Note 11. Change in stocks of CO₂ in harvested wood products

Reported amount (2005). -4.999 Mt CO₂

Methodology. The change in carbon stocks in harvested wood products is determined by calculating domestic consumption (domestic production plus imports minus exports) and

²³ IPCC 2003, p.1.11

²⁴ There are data problems. Table D4 in the Methodology should be identical to Table 7.D4 in the Inventory, but it is not. As well, the 2005 figures in Table 7.D4 do not add up.

partitioning it amongst product pools with various life spans. The balance is degrading, burnt or sent to landfill. Exported wood products are not included;²⁵ emissions from the processing and consumption of these products are the responsibility of the importing country.

Comment. The methodology for harvested wood products is extraordinarily complex. Multiple products are assigned to five pools each of which is further disaggregated into three age classes. Assumptions have to be made about product lifespans, rates of decomposition, rates of recycling and re-use, and the method of final disposal. In round terms, for a given volume of logs (native forest and plantation together), 20% of CO₂ is quickly lost through burning and decay, 55% contributes to a net increase in landfill and 25% contributes to a net increase in carbon stored in wood products.²⁶ It is questionable whether the cost of tracking CO₂ in wood products is justified when only 20% of the log volume contributes to a store other than landfill.

If wood products continue to be tracked as a separate category, native forest wood, plantations and imports should be reported separately (imports should also be further disaggregated into native forest and plantation wood). This would maintain consistency with other sections of Australia's UNFCCC account and ultimately enable the complete carbon balance for plantations and native forests to be clarified.

In relation to native forest wood, it is likely that the stock of carbon stored in products is declining because the volume used in domestic production has declined and exports of woodchips have increased. Native forest wood may not meet the UNFCCC requirement for stocks of harvested wood products to be increasing before they can be counted separately, which would mean that all emissions should be accounted for at harvest.

²⁵ Australian Government 2007, Vol 2, p116

²⁶ Calculated from Richards et al 2007

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Acronyms

ABARE. Australian Bureau of Agricultural and Resource Economics

AGO. Australian Greenhouse Office

IPCC. Intergovernmental Panel on Climate Change

LULUCF. Land use, land-use change and forestry

Mt CO₂. Million tonnes of carbon dioxide

NCAS. National Carbon Accounting System

UNFCCC. United Nations Framework Convention on Climate Change