



## Research paper

# An estimate of carbon stocks for harvested wood products from logs exported from New Zealand to China

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## ABSTRACT

In 2015 New Zealand exported 10.5 Mm<sup>3</sup> of logs to China. A model has been developed to quantify the carbon stocks of harvested wood products (HWP) manufactured in China from these logs and the life cycle of the HWP produced. The model allows the aggregate decay curve of the HWP carbon stock to be estimated together with the 95% confidence interval. Overall, the HWP produced in China from New Zealand logs are short-lived with an aggregate half-life of just under two years. Some 46% of the HWP is lumber and plywood used for temporary construction while 13% is used for packaging which is also short-lived. There is a long tail in the carbon decay curve with 10% of HWP still in use after 23 years. Longer lived products are the 9% of HWP used for appearance products including furniture as well as panel products produced from a proportion of sawmill and plymill residues.

Logs have been exported to China annually since 1987 and at levels exceeding 5 Mm<sup>3</sup>/year since 2010. The total HWP carbon stock from historical log exports is estimated to be 22.7 Mt CO<sub>2</sub> at the end of 2015 with a 95% confidence interval of 19.1–26.4 Mt CO<sub>2</sub>. The annual increase for 2015 is estimated to be 1.9 ± 0.5 Mt CO<sub>2</sub>.

The model developed will support New Zealand in meeting UNFCCC carbon reporting and Kyoto Protocol carbon accounting requirements. The analysis highlighted the importance of certain model inputs on which future effort should be focused.

## 1. Introduction

New Zealand undertakes carbon reporting under the UNFCCC (United Nations Framework Convention on Climate Change) and carbon accounting under the Kyoto Protocol [1]. Recent changes in international guidance and protocols mean that harvested wood products (HWP) should now be included in both carbon reporting and carbon accounting. This has implications for New Zealand given the limited data available on the HWP produced from the majority of the harvest volume that is exported in log form. In 2015 New Zealand exported 10.5 Mm<sup>3</sup> of logs to China. In the same calendar year FAO reported that New Zealand exported a larger volume of logs than any other country. This paper provides new data on the HWP manufactured from these logs and their life cycle.

Harvested 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, of for energy”. ([2], p5). HWP includes all wood material (including bark) that leaves harvest sites ([3], p12.5). There are similarities between the carbon reporting of HWP for UNFCCC and carbon accounting of HWP under

the Kyoto Protocol. However there are also differences. For example, whereas carbon reporting requires all CO<sub>2</sub> released from HWP to be included in the AFOLU (Agriculture, Forestry and Other Land-Use) Sector ([3], p12.6), Kyoto Protocol accounting requires the exclusion of HWP used for energy purposes as well as HWP used in solid waste disposal sites ([4], p 2.109).

### 1.1. UNFCCC reporting

The 1996 IPCC Guidelines ([5], Vol III, p5.17) recommended as a default, based on the perception that global HWP stocks were not changing, “that all carbon biomass harvested is oxidised in the removal year”. It was recommended 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”.

In contrast the IPCC 2006 Guidelines ([3], p12.6) recognise that “inputs do not in general equal outputs and that carbon can remain stored in HWP for extended periods of time”. Consequently IPCC now provides guidance on reporting HWP. If the annual change in HWP

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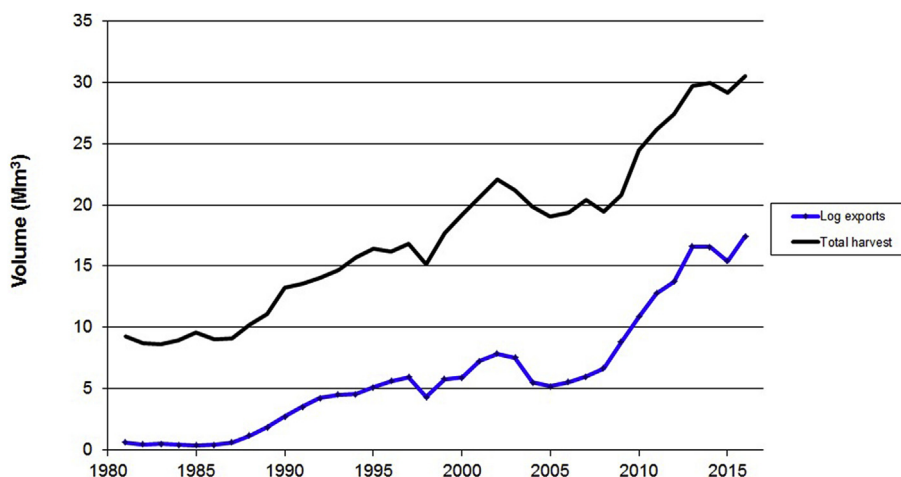


Fig. 1. Volume harvested from New Zealand plantations and volume exported as logs. (Source MPI)

stocks is insignificant then the HWP contribution can be reported as zero. Otherwise a country can select one of three tiers to make estimates:

- Tier 1 uses default methods and data.
- Tier 2 uses default methods but country-specific data.
- Tier 3 uses country-specific methods and data.

IPCC (2006) provides the first-order decay function:

$$C(i+1) = e^{-k} * C(i) + [(1 - e^{-k})/k] * Inflow(i)$$

Where

- $C(i)$  and  $C(i+1)$  are the carbon stock at time  $i$  and one year later.
- $Inflow(i)$  is the additional carbon added during the year.
- $k$  is the decay rate ( $= \ln(2)/\text{half-life}$ ).

Default half-lives of 30 years and 2 years are provided for solidwood products and paper products respectively.

New Zealand is reporting HWP under the UNFCCC from the 2013 reporting year in the National Inventory Report [6]. IPCC [[3], Annex 12A.1] describes four different approaches: stock-change approach, atmospheric flow approach, production approach, and simple decay approach. However it does not prescribe the approach to be used to report HWP. New Zealand has adopted the production approach which “estimates changes in carbon stocks in the forest pool (and other wood producing lands) of the reporting country and the wood products pool containing products made from wood harvested in the reporting country. The wood products pool includes products made from domestic harvest that are exported and stored in uses in other countries” [[3], p12.29]. Although New Zealand has adopted the production approach for the National Inventory Report, in line with IPCC [3] the variables used for the other approaches are also reported.

New Zealand has adapted the default HWP model [3] and used a Tier 2 method, which involves using country-specific activity data and parameters. Currently New Zealand's GHG inventory reporting assumes that exported raw materials are converted into products and consumed at the same rate as domestic production.

### 1.2. Kyoto Protocol accounting

Instant oxidation of HWP was assumed for commitment period 1 of the Kyoto Protocol. IPCC [4] still allows this as Tier 1 where transparent and verifiable data on HWP are not available. However when transparent and verifiable data are available, changes in the HWP pool are to be accounted for using the first-order decay function. Tier 3 applies

when country-specific half-lives and/or methodologies are available. Otherwise Tier 2 applies. When Tier 2 is applied, default half-lives of 35 years, 25 years and 2 years are to be used for sawn wood, wood panels and paper respectively.

Although New Zealand did not sign up to the second commitment period, New Zealand continues to apply the Kyoto Protocol framework of rules in tracking progress towards its 2020 target set under the UNFCCC. Consequently, New Zealand, intends to report changes in the harvested wood products pool from 2013 using Kyoto Protocol rules. New Zealand has developed a Tier 3 method to report HWP, based on the production approach and default Tier 2 methodology, as described in the guidance [4], and uses some country-specific activity data and parameters where available. Separate accounting is required for different activities:

- HWP from post-1989 forests harvested from 1990.
- HWP from pre-1990 forests harvested from 2013.
- HWP from deforestation (instantly emitted).

Between 2013 and 2015, little information was available on the conversion of export logs to products and their expected half-lives. Therefore, exported raw materials were excluded from New Zealand's Kyoto Protocol HWP pool estimates and HWP from this source were treated as an instantaneous emission.

### 1.3. New Zealand log exports

The volume harvested from New Zealand's plantations has increased from 9.7 Mm<sup>3</sup> in 1981 to 30.5 Mm<sup>3</sup> in 2016. Much of the increase has been exported as logs (Fig. 1). In 2016, log exports accounted for 57% of the total harvest volume. Over the last 35 years the most important market for New Zealand logs has changed from Japan to South Korea to China (Fig. 2). The increase in demand from China over the last 10 years has been dramatic. Log export volume from New Zealand to China was 12.2 Mm<sup>3</sup> in 2016, some 70% of New Zealand's log exports and 40% of New Zealand's harvest volume.

The scale of New Zealand's log exports means that they, and the products produced from them, are a key component of New Zealand HWP under the production approach adopted for UNFCCC reporting and Kyoto Protocol accounting. Consequently in 2015 the Ministry for Primary Industries (MPI) commissioned a project to quantify the material flow of New Zealand logs for each of the major overseas markets including the life cycle of HWP. The objective was to evaluate whether verifiable and transparent estimates could be made of the HWP produced from log exports. This paper reports the findings of this project

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