Principal Economics

Potential for carbon sequestration in Australian plantations forests to contribute to Australia's 'net Zero by 2050' target

Report prepared for the Australian Forest Products Association

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1. Introduction and context

Principal Economics has prepared this report for the Australian Forest Products Association to examine the carbon sequestration associated with potential plantation forestry expansion in Australia.

As Australia seeks to meet its Paris Climate Accord commitments to reduce carbon dioxide emissions to net zero by 2050, sequestration from plantation forestry activities could provide a significant contribution in meeting our national emissions target. The purpose in this report is to better understand the potential size of that sequestration contribution based on assumptions about industry growth and where plantation expansion might occur.

It should be noted that the estimates of carbon sequestration presented here are not those that might be accrued under currently established methods under the Emissions Reduction Fund. Rather, they are estimates of 'what the atmosphere would see' should the new long rotation plantations be established on an ongoing basis and a methodology introduced which accounted for all the carbon stores associated with the activity.

Once fully established, 400,000 ha of new ongoing radiata pine plantations have the potential to sequester between 309 and 388 Mt CO_2e, depending on the forest management regime given the underlying assumptions. New plantations of this magnitude could make a contribution to meeting Australia's 2050 Paris commitments of between 150 and 210 Mt CO_2e depending on the time of initial establishment.

2. Sequestration potential from plantation forestry expansion

Forestry is one of the simplest and most cost-effective land-based sequestration option to implement, in terms of both feasibility and verifiability, in Australia, New Zealand, Canada and the United States.

It is against this backdrop, and the need to promote further expansion of plantation forestry resources in Australia to meet future wood fibre demand, that the carbon sink capacity of new radiata pine plantations at selected locations across Australia has been estimated.

2.1 Methodology

Various agencies within the Commonwealth have invested extensive time and resources in developing toolkits for modelling carbon sequestration, as part of Australia's verification requirements under our international climate commitments. The main tool used for this purpose is FullCAM, currently maintained by the Department of Industry, Science, Energy and Resources.

The FullCAM model and documentation is available at https://www.industry.gov.au/data-and-publications/full-carbon-accounting-model-fullcam. The model accesses the Department's extensive climate, soil and vegetation databases to provide the base data for modelling terrestrial sequestration projects including forestry projects. It allows the user to specify the region (via latitude and longitude) for the project area requiring carbon estimation. To forecast abatement outcomes, the tool utilises input data on planned silvicultural management activities. Information required includes the period over which the project will run, the plantation species, and the regime under which the species will be managed.

For the purposes of this report FullCAM has been utilised to estimate the carbon sequestration potential of additional plantations under the assumptions outlined below.

2.1.1 Assumptions

The key purpose of this exercise is to establish an estimate of the sequestration potential of further plausible plantation forestry expansion in Australia. Given softwood plantations make up approximately 90 per cent of Australia's long-rotation plantation estate, for the purpose of this report it has been assumed that new plantings will be of radiata pine.

Some prime areas where radiata pine thrive and are most commonly cultivated in Australia are located in the Green Triangle, the Murray Valley and Central Tablelands regions of NSW, and in Tasmania. As such, we have examined the implications of planting an additional 57,000 hectares of plantation forests in each of these key regions as well as several other important forestry regions. These assumptions bring the total plantation forestry expansion examined in this report to 400,000 hectares.

For the purposes of demonstrating carbon sink potential, we adopted a time frame commencing in 2023 and running beyond 2100. We also assumed that Pinus radiata plantations would be grown on land previously used for pasture and grown in either a 30 or 40-year rotation for sawlogs.

We examined the sequestration profiles across seven different forestry regions as set out below. Where quoted, statistics on plantation areas have been sourced from the *Australian plantation statistics and log availability report 2021* (https://daff.ent.sirsidynix.net.au/client/en_AU/search/asset/1032742/0) and earlier editions of that report.

2.1.2 Green Triangle

The Green Triangle is Australia's largest collective plantation and wood processing zone and disparately covers an overall land area of 6 million hectares in south east South Australia and south west Victoria. The forest industry in the Green Triangle is a major contributor to the regional economy, is strongly supported by State and local governments, and plantations occupy some 10 per cent of the region.

2.1.3 Gippsland

Gippsland in Victoria is home to the Latrobe Valley, an important forestry region comprised of Latrobe City, Baw Baw and Wellington Shire Councils. In 2012, 89 per cent of the Gippsland region's forest plantations were located in the Latrobe Valley, representing around 90,000 hectares of plantation estate.

2.1.4 Riverina

The Riverina region in southern NSW covers an area from the Snowy Mountains through to the Murrumbidgee River catchment zone. ABARES estimates the total plantation area in the Riverina at 96,000 hectares, comprised almost entirely of radiata pine. It should be noted that approximately 40 per cent of the softwood estate was burnt in the Black Summer fires but that the state government agency is fast - tracking replanting of those areas and expects to fully restore the estate in 8 years. This report is predicated on new areas being added to those which are already slated for post-bushfire replanting. There are significant plantation timber processing facilities at Tumut, Tumbarumba.

2.1.5 Central Tablelands

The Central Tablelands forestry region is concentrated around Oberon, Orange, Bathurst and Lithgow. In 2017, the NSW Government purchased an additional 7,000 hectares of existing pine plantation and plantable land around Oberon and Tumut, adding to its state softwood plantation portfolio of around 200,000 hectares.

The predominant plantation species in the area is Pinus radiata. Forestry activity employs around one fifth of workers in the region, with processing facilities located in Oberon, Bathurst and Burraga.

2.1.6 North Coast NSW

The North Coast region of NSW covers the coastal area from Newcastle to the Queensland border. In 2019-20, the total plantation area was just over 69,000 hectares. This forestry area is predominantly hardwood species, however some radiata pine is also grown in the region.

2.1.7 Tasmania

The majority of Tasmania's plantation forests are located in the north of the State, with processing facilities and ports in the Tamar Valley and Burnie. An area of around 78,000 hectares is planted under radiata pine in Tasmania, and another 199,500 hectares is dedicated to hardwood species.

2.1.8 South-West Western Australia

The South-Western forestry area of Western Australia extends from Esperance along the coastline to Perth, and as far inland as Jingalup. The total plantation estate of Western Australia was just under 310,000 hectares in 2019-20. In the same year, softwood plantations comprised just under 98,000 hectares and were predominantly radiata pine.

2.2 Caveats

The carbon sequestration estimates presented in the following section represent FullCAM's estimates of the average amount of carbon that would be sequestered after the forest system reaches equilibrium and includes an estimate of the additional soil carbon that would result from converting the land from pasture to an ongoing plantation forestry regime.

The estimates presented here do not represent the amount of Australian Carbon Credit Units that might be allocated under any existing Emissions Reduction Fund (ERF) project method. The Association may wish to explore with the federal government the potential for the introduction of new approaches under the ERF that might better reflect the opportunity to sequester carbon under plantation forests and more truly measure 'what the atmosphere sees'.

Finally, in this report no attempt has been made to calculate the forest management regime that would maximise the net joint return from timber and carbon credit unit sales. The returns from carbon credit sales will depend crucially on the carbon price but it is almost certainly the case that at high carbon prices the economically optimal forest management regime would be different from current practice.

3. Results

For the purposes of this report two sets of simulations were run for the seven plantation regions listed above, one representing the establishment of an ongoing plantation regime with a 30-year rotation and the second based on a 40-year rotation. The results for these simulations are presented in Table 3-1 and Table 3-2.

Once fully established, 400,000 ha of new radiata pine plantations have the potential to sequester between 309 and 388 Mt CO_2e, depending on the forest management regime given the underlying assumptions. These numbers represent an estimate of the average increase in carbon that could be sequestered once the ongoing plantation regime of plant, harvest, replant reached equilibrium. Sequestration in any particular year will depend not only on the plantation site characteristics and the forest management regime but also on the stage of a given rotation and management practices.

To put these numbers into context Australia's annual emissions for the year to December 2020 were 499 Mt CO_2e with agriculture's contribution estimated at 73 Mt CO_2e. It follows that the establishment of new plantations of the size discussed in this report has the potential to offset between 4 and 5 years' worth of agricultural emissions at current levels. If, as projected, in the federal government's recently released climate modelling, emissions fall substantially as we approach 2050 then the size of the contribution of new plantations to reaching net zero would also become much more significant.

Sequestration from plantation forestry has the potential to provide a significant contribution to our international climate commitments. However, the establishment of new plantations of the total size discussed in this report in Australia over the next few years is unlikely to occur without significant new policy decisions. In addition, as pointed out previously, current methodologies do not completely acknowledge all the sequestration which would occur in new plantation development. This would require rule changes or possibly legislative changes before sequestration levels of the magnitude revealed in this modelling could be completely recorded in Australia's greenhouse gas inventory.

Table 3-1. Average net tonnes of carbon sequestered in trees, debris and soil by site over 3 rotations

Assumptions:	Forest type, Pinus Radiata, 30 year rotation
	Start and end date: 1/1/2023 and 30/6/2115
	Simulation, monthly
	Planting events: 1/6/2023, 1/1/2054, 1/1/2085, 1/6/2115

Site	tC / ha trees	tC / ha debris	tC / ha soil	tC / ha total	tCO2e / ha trees	tCO2e / ha debris	tCO2e / ha soil	tCO2e / ha total
Green triangle	131	58	72	261	480	213	264	957
Gippsland	147	57	29	233	539	209	106	854
Riverina	89	37	57	183	326	136	209	671
Central Tablelands	119	48	88	255	436	176	323	935
North Coast NSW	87	37	21	145	319	136	77	532
Tasmania	101	40	11	152	370	147	40	557
South West WA	123	61	61	245	451	224	224	898
Average net carbon sequestered by 400,000 ha plantation assuming equal area planted in each region (Mt)	46	19	19	84	167	71	71	309

Notes:

1. The estimates represent net additional carbon sequestration in the long term from converting agricultural pasture land to a permanent forest plantation.
2. Actual sequestration in any particular month of the simulation will depend on the stage of the forest rotation and whether soil carbon levels have reached long term equilibrium.
3. Sequestration estimates will vary depending on plantation location and the forest management regime adopted but the above estimates are likely to be representative for each region.
4. These estimates do not reflect the carbon that could be credited under any existing ERF method.

Table 3-2. Average tonnes of carbon sequestered in trees, debris and soil by site over simulated period

Assumptions:	Forest type, Pinus Radiata, long rotation
	Start and end date: 1/1/2023 and 2/1/2123
	Simulation, monthly
	Planting events: 1/6/2023, 1/1/2064, 1/1/2105

Site	tC / ha trees	tC / ha debris	tC / a soil	tC / ha total	tCO2e / ha trees	tCO2e / ha debris	tCO2e / ha soil	tCO2e / ha total
Green triangle	152	69	138	359	557	253	506	1316
Gippsland	170	67	50	287	623	246	183	1052
Riverina	106	46	81	233	389	169	297	854
Central Tablelands	138	57	115	310	506	209	422	1137
North Coast NSW	103	45	35	183	378	165	128	671
Tasmania	120	49	32	201	440	180	117	737
South West WA	133	67	78	278	488	246	286	1019
Average net carbon sequestered by 400,000 ha plantation assuming equal area planted in each region (Mt)	53	23	30	106	193	84	111	388

Notes:

1. The estimates represent net additional carbon sequestration in the long term from converting agricultural pasture land to a permanent forest plantation.
2. Actual sequestration in any particular month of the simulation will depend on the stage of the forest rotation and whether soil carbon levels have reached long term equilibrium.
3. Sequestration estimates will vary depending on plantation location and the forest management regime adopted but the above estimates are likely to be representative for each region.
4. These estimates do not reflect the carbon that could be credited under any existing ERF method.