FOREST CARBON BALANCE

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Forests are one of the most important natural resources we have for helping Australia to meet its emissions reductions target through carbon capture and storage[1]. Embracing sustainable forest management to maximise carbon outcomes is essential to mitigate climate change[2]. Younger actively growing forests absorb more carbon from the atmosphere than old forests[3], while large trees represent the greatest carbon stock in forests (~50-70% of carbon at a site)[4]. However, carbon in forests is never stable and, as they age, forests can also become a source of carbon as trees die and the vegetation changes through natural mortality and disturbance events such as bushfires[5].

Further carbon benefits from forests are achieved through use of wood products that provide long-term carbon storage in place of high emission alternatives[6]. Sustainable use of renewable forest resources provides solutions to climate change through enabling bio-economies based on biomass and timber[7].

Estimating total forest carbon is complex, requiring measurement of both aboveground carbon (large trees, small trees, tree ferns, shrubs and understory, stumps, coarse woody debris, litter) and below-ground carbon (soil, tree roots)[8]. There are often high levels of uncertainty around forest carbon stocks because it is difficult and complex to measure all these variables accurately, and they can vary significantly across the landscape depending on forest type, topography, site history, season, local conditions and climatic variability[9]. In addition, the carbon dynamics of wood production significantly impacts the overall forest carbon balance[10]. For example, estimates in Ash eucalypt forests have ranged from 233 to 1,819 Mg C ha[14]. How, what and when a scientist measures above- and below-ground carbon, and accounts for stocks and flows due to management, can significantly influence results, which explains why there are varying reports.

A best-practice approach requires a full Life Cycle Analysis (LCA) framework to estimate forest carbon balances and the effects of different management regimes that may be implemented[11]. Management can include protection and conservation, timber harvesting, fire mitigation activities, ecological thinning and forest restoration, and a host of other active and passive management approaches[12].

A full LCA approach accounts for:

- temporal changes in on site carbon stocks following management
- emissions from management
- emissions from wood transport and processing
- carbon stored and released by wood products in use and in landfill
- avoided emissions where fossil fuels are displaced
- substitution benefits when wood replaces more carbon intensive materials (e.g. steel, aluminium, concrete), and
- the carbon footprint of imported products if domestic wood production is foregone.

All this adds up to determine whether management decisions are carbon positive, neutral or negative[13].

In all Australian states over the last 10 years, the land use, land use change and forestry (LULUCF) sector has predominantly been strongly negative, attributable to regrowth from past bushfires, regrowth from native forest timber harvesting and expansion of the plantation estate[11]. These factors have directly enabled the State of Tasmania to achieve negative net emissions since 2013[12]. In Australia and globally, sustainable forest management can support forests to sequester more carbon than they emit[13].

Fuel reduction burning can also reduce carbon loss and mitigate greenhouse gas emissions in forests at high risk from wildfire, while greatly improving the chances of firefighters extinguishing fires on the milder days[14]. The carbon emissions from the high frequency of burning required to maintain fuel reduction effectiveness can be offset by lower emissions and avoided carbon losses from the consequent reduction in wildfires in ecosystems where wildfire risk is high[15]. Using silviculture to mechanically reduce fuel loads and help grow bigger trees quicker through thinning can also assist with

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managing fire risk and enhancing resistance of trees to fire[16]. Silviculture can also offset drought impacts, improve forest resilience and buffer forests from climatically driven carbon losses[17]. In these ways, sustainable forest management can work to protect and enhance carbon stocks, lower greenhouse gas emissions and contribute to forest adaptation and risk mitigation[18].

Although taking actions to protect carbon dense forests is critical to maximising forest carbon in the landscape, forest reservation does not result in greater carbon mitigation benefits when compared to sustainable active management regimes in many Australian native forests[19]. The benefits of a preservation approach rely on carbon in the reserved forests remaining relatively secure[20]. However, forests are not static systems, they are dynamic and subject to multiple processes of carbon loss to the atmosphere. Wet Ash eucalypt forests, for example, transition to rainforests in the absence of disturbance resulting in loss of carbon to the atmosphere as the forest type changes[21]. Australia is already seeing a pervasive increase in tree death and carbon loss across landscapes, the risk of which is only increasing as threats to forests from climatic changes, wildfires and lack of capacity for active management increase[22]. Further, forest carbon flux in an 'average' year can become essentially irrelevant following one major fire season[23]. Wildfires are the largest cause of variability in emissions from forest land - the 2019/20 bushfires alone represented 35% of all Australia's greenhouse gas emissions in 2020 and burnt 112.3 billion kilograms of biomass[24].

Forest reservation can also lead to wood products being substituted for more energy-intensive, non-renewable and fossil fuel-based materials, forgoing the carbon storage and emissions reductions benefits of using locally and sustainable sourced wood[25]. Avoiding the substitution effect is one of the biggest climate change mitigation benefits of managing forests for sustainable timber production[26]. By replacing steel and concrete with timber products, for instance, embodied carbon can be reduced by up to 75%[27]. Facilitating the use of wood residues as biochar and biofuels is also a major opportunity to assist hard to abate sectors, such as transport, to lower their emissions profiles[28].

The reporting rules of the United Nations Framework Convention on Climate Change (UNFCCC) require that emissions associated with imported products are reported by the country which emits them, not the country that uses the product[29]. As a result, reducing local sustainable timber harvesting and thus increasing our reliance on timber imports may help to make Australia's carbon balance look good, but will not genuinely help combat climate change. Creating genuine carbon benefit can only occur where policy decisions do not just shift carbon and emissions activity elsewhere (known as leakage)[30]. Reductions in local timber production may cause significant leakage from Australia to other countries, potentially in the order of ~70%[31].

Well managed forests are crucial to Australia meeting its emissions reductions targets. With the right policy settings, Australia can maximise this opportunity by:

- Conserving forests through cross-tenure wildfire prevention activities and protecting them from deforestation
- Increasing forest cover by using carbon payments and incentives to establish new biodiverse plantings and encouraging plantation expansion on cleared land
- Appropriately using native forest and plantation silviculture to promote tree growth, mitigate fire risk, reduce drought impacts and to restore degraded forests
- Sustainably sourcing and using wood in place of non-renewable products
- Meeting Australia's wood needs locally, minimising 'product miles'; and ensuring that products do not come from jurisdictions with higher emission profiles

Forestry Australia is a not-for-profit, independent professional association representing more than 1,100 scientists, practitioners and farm forest growers who manage, study and care for our forests. Our members are individuals who operate across all aspects of forest, fire and land management, farm forestry and tree growing throughout Australia. They have high levels of scientific expertise and extensive operational experience in forest, fire and landscape management.

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