Submission to the Garnaut Climate Change Review

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Climate change and forests

Forests cover 30 percent of the earth's land surface and forest ecosystems (including live trees, dead trees, logs and litter, understorey and soil) are a significant component of the cycle of carbon dioxide (CO_2) and other greenhouse gases. Since rising atmospheric CO_2 was first observed in the 1970's scientists have recognised the contribution of deforestation as one of the main historical causes of increased CO_2, and discussed the potential for forests to offset emissions from burning fossil fuels by increasing forest area, managing forests and wood products for increased carbon stocks and using wood from sustainably-managed forest as a substitute for fossil fuel energy.

While generally supported by scientific evidence, including forest 'sinks' toward greenhouse gas emission targets became contentious in Kyoto Protocol negotiations.

Opponents of forest sinks felt they were distraction from the 'main game' of reducing fossil fuel emissions and that benefits were difficult to measure. There were physical, technical, social and economic limits on the use of sinks and concerns were raised about the permanence of forest sinks in the longer term under future changes in climate.

Proponents considered that reducing deforestation, better managing forests and products and establishing new forests were a relatively low cost of ways of reducing emissions and that these activities would have conservation and environmental benefits. They argued that including the use of forests in emission targets would provide an incentive to improve measurement and provide early benefits that would 'buy time' until technological developments in the energy sector become more widely adopted (Keenan 2002).

This debate still continues, with some arguing that offsetting emissions from burning fossil fuels, using new plantings or avoided deforestation, is inherently risky and ineffective (Downie 2007). The forest industry, many scientists and a growing base of firms marketing emission offsets argue that full carbon accounting and investment in new forests, better forest management and forest retention need to be part of considerations for climate change mitigation and adaptation.

In this submission I discuss some of the key scientific and policy issues relating to forests and climate change and present evidence from recent research from the School of Forest and Ecosystem Science at the University of Melbourne.

Mitigating Greenhouse Gas Emissions Using Forests in Australia

Australia has 163 million ha of native forest, meeting the national definition and 1.8 million ha of plantations. The area of native forest has declined by about 5.5 million hectares between 1990 and 2005 and the area of plantation has increased from just over 1 million hectares in 1990 to 1.8 million hectares in 2006. Probably 80% of the plantation area established since 1990 can be considered 'Kyoto forest' (that is, meeting the requirement of establishment on land that was not forest in 1990).

Reducing deforestation and carbon sequestered in new plantations have provided the main contribution to Australia's greenhouse gas emission targets to date, significantly offsetting increases in emissions from stationary energy and transport. These have largely been achieved with little deliberate policy emphasis on greenhouse benefits. Policies to reduce land clearing in Queensland were largely focused on achieving conservation objectives. Plantation establishment has largely been driven by private investors taking advantage of the taxation arrangements associated with investment in forest plantations.

Important issues to resolve in relation to the use of forests for greenhouse emission reduction are addressed below.

Avoided deforestation

Reducing rates of deforestation will limit the capacity for avoided deforestation to make a major contribution to emission reduction targets in future. Clearing of native forest dropped from about 534,000 ha per year in 1990 to 250,000 ha per year. 'Lagged' emissions associated with decay of woody material from even higher rates of clearing during the 1970's and 80's will also drop. Clearing will decrease further by 2010 and the capacity to offset emissions from other sources through reduced deforestation will decline as future clearing is restricted to regrowth and small patches.

New forests

2005 uptake of greenhouse gases from 'Kyoto' plantations were 19.6 Mt CO2-e, offsetting 34% of emissions from land clearing (53.3 Mt CO2-e). A significant proportion of the 'Kyoto' forest is grown on short (10-15 year) rotation for pulpwood. Because there was a significant peak in new planting in the late 1990s and early 2000s, a significant proportion of these plantations will be harvested in the 2008-12 first commitment period of the Kyoto Protocol. It is unclear how this might impact on carbon sequestration during this period. Australia was successful in having the 'credit-debit' sub-rule included in the Marrakech Accords. This means a country does not have to report emissions due to harvesting timber from Kyoto plantings when it has not received a credit from previous carbon sequestration. However, harvesting in plantations means that net growth across the estate will decline to some extent because it can take 12 months to replant following harvesting.

Maintenance of carbon uptake in plantations will depend on the rate of establishment of new plantations. Rates of new planting are beginning to decline in some regions due to uncertainty over investment arrangements, increasing land costs, competition for land in higher rainfall regions and uncertainty about the future market for hardwood pulpwood. However, a continuation of the current planting rate of 78,000 ha in 2006 is sufficient to achieve the Government-Industry 2020 Vision of 3 million ha and can maintain carbon current carbon uptake rates in Kyoto plantations until at least 2030.

The technical potential for further plantation development is high (eg. Bugg et al. 2002a). However, realisation of this potential will depend on the availability land and capital and suitable policy settings. Availability of land will depend on price, profitability of existing agricultural land uses. Other things being equal, from a carbon sequestration perspective, plantations of longer rotations (>20 years) of softwoods or hardwoods are preferable to shorter rotations, as these have a higher average carbon stock across an estate. If higher rates of CO_2 removals are sought in the short term then it is preferable for plantations to be established on sites with higher rainfall and faster growth.

Scientific understanding and measurement capacity for forest plantation based carbon sinks (including environmental plantings) has improved considerably over the last 10 years and Australia now has effective standards and measurement protocols. One of key issues to address is the scale of assessment. Great efficiencies in sampling and assessment can be achieved if these are undertaken over larger areas. For example, a study in mixed species plantations in north Queensland indicated that similar levels of sampling intensity are required to report on carbon stock in 10 ha of plantations as are required to report on 2000 ha. Thus, pooling for accounting or trading purposes can provide considerable reductions in assessment costs per hectare (Keenan et al. 2000).

Methane (CH_4) and nitrous oxide (N_2O) are two other important greenhouse gases that contribute up to 25% of Australia's greenhouse gas emissions. Recent research in the School of Forest and Ecosystem Science at the University of Melbourne shows that native forests and plantations can reduce emissions of these other greenhouse gases compared to other land uses. For example, measurements in mature *E. delegatensis* and *E. regnans* forests in NSW and Victoria indicate that methanotroph bacteria in undisturbed forest soils can remove between 100 and 200 kg CO_2-equivalents of methane per ha per year.

N_2O is produced naturally in soils through two main processes: nitrification in well-aerated, dry and moist soils and denitrification in compacted or wet to saturated soils. Tight nutrient cycling in these mature eucalypt forests also means little N_2O is produced (<500 kg CO_2-e ha per year) in comparison to intensive, fertilized agricultural systems in Australia (up to 2000 kg CO_2-e ha per year).

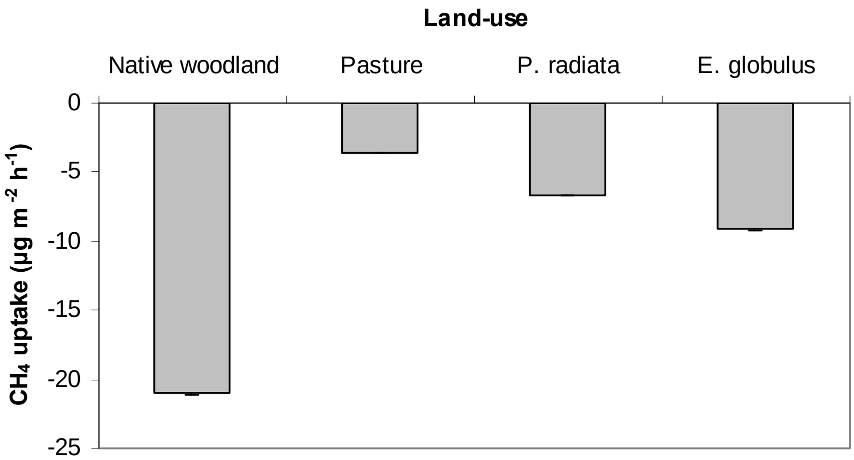

Fig. 1 Soil methane uptake in an undisturbed native woodland and following land-use change to grazed pasture (1950's), and subsequent re-afforestation to *Pinus radiata* (1987) and *Eucalyptus globulus* (1998) near Albany, Western Australia (Livesley and Arndt, School of Forest and Ecosystem Science, the University of Melbourne, pers. comm)**.**

It is also possible that establishing forest plantations on previously-cleared agricultural land will increase the ability of soil to take up methane, whilst reducing the production of nitrous oxide. This can occur because trees improve nutrient cycling compared with crops or grasses, nutrient inputs (through fertilizer and animal excreta) are reduced and soils become drier. Recent field measurements in Western Australia indicate that soil methane uptake in eucalypt and pine plantations established on previously legume-grass pastoral land is more than double and approaching levels in undisturbed E. marginata woodland (Fig. 1). N_2O emissions are also considerably lower.

Changing forest management

Forest management options, such as forest rehabilitation, changing species, longer rotations, fertilisation, forest conservation, reducing harvesting impacts have been proposed internationally as mechanisms for reducing greenhouse gas emissions. An analysis of options in 2000 (AGO 2000, Keenan et al. 2000) indicated that most of these have relatively limited capacity for application or offsetting greenhouse gas emissions in Australia.

Suggestions that stopping timber harvesting would result in immediate greenhouse benefits are misguided. We would continue to use wood products sourced from other regions, or use more concrete, steel or plastics in construction with the likelihood of more greenhouse gases resulting from their production than from the production of timber.

About 90 percent of Australia's 164 million hectares of native forest and woodland is not subject to harvest. There are areas of regrowth areas from past harvesting or clearing that are now in conservation reserves with increasing carbon stocks. Land management practices such as grazing or fire and cycles of drought death and regeneration are having an unknown impact on carbon stocks. The carbon balance across the estate is therefore unclear.

Impacts of timber harvesting in native forests are a matter of considerable debate. Current analysis suggests that conversion of old growth or mature forests to regrowth stands results in a net release of carbon to the atmosphere over the longer term, even accounting for storage in wood products. This type of harvesting is now relatively limited in Australia. Most native forest harvesting is in regrowth forests that are largely in carbon balance over the longer term, with emissions from timber harvesting balanced by forest regeneration.

Probably the biggest unknown is fire. Bushfire results in a release of carbon from the burning of leaves, branches and understorey but Australian forests are well-adapted to fire and generally regrowth is rapid. Changing fire management practices, particularly seasonal burning patterns across large areas of northern Australia and reducing the impact of the large scale fires that have recently occurred in south eastern Australia, may have greater capacity to reduce greenhouse gas emissions. However, we have little robust data on changes in carbon stocks over time across the forest estate. Comprehensive monitoring, incorporating the type of satellite remote sensing now used to monitor deforestation combined with robust ground measurement is required to establish a definitive picture.

Storage of carbon in wood products

Wood products (including solid wood, reconstituted wood panels and paper) represent a significant pool of carbon (Skog and Nicholson, 1998; UNFCCC, 2003) and this pool may be increasing globally by about 140 million tonnes per year (Winjum et al 1998).

The pool of wood products in building structures is a major part of the total pool of wood products in use and potentially provides the greatest opportunity for extension of carbon storage beyond that in forests due to long life spans of many wood products. In Australia, it is estimated that the residential construction sector accounts for over 70% of the total volume of sawn timber consumed in Australia and that this sector accounts for 74% of the sawn timber market followed by non-residential construction, furniture and others which share approximately equal proportions (8-9%) of the sawn timber market (ABARE, 2005; BIS-Shrapnel, 2000). In addition, wood products can substitute for materials such as concrete and steel which involve higher fossil fuel consumption in their production (Broadmeadow and Mathews, 2003). Due to the building techniques for residential dwellings in Australia, large quantities of locally produced and imported wood products are consumed by the housing sector and potentially provides the greatest opportunity for extension of carbon storage function beyond that in forests.

Recent research by a PhD student in the School and Forest and Ecosystem Science at the University of Melbourne (Mishek Kapambwe) has indicated that about 0.17-0.25 Mt of carbon dioxide equivalent was stored in Victorian dwellings every year between 1990 and 2004 and that this amount was increasing at a rate of 24% per annum (see figure below).

There was a general downward trend in timber use per square metre of floor area of dwellings in Victoria despite a general upward trend in dwelling size, mainly due to substitution of wood products by non-wood and preferences of certain building materials attributes by builders, building material specifiers, and dwelling owners. Landfill from house construction and demolition was the main method used to dispose of wood waste. However, the waste was not reported separately by source (e.g., how much from house construction or demolition) and this would make analysis of carbon dynamics difficult. Although wood waste was recycled, the proportions of recycled wood waste from either house construction or house demolition were not clarified. However, it was found that wood discarded to landfill was in long-term storage so that the impact of wood waste from residential buildings that was placed in landfills on global warming could be negligible.

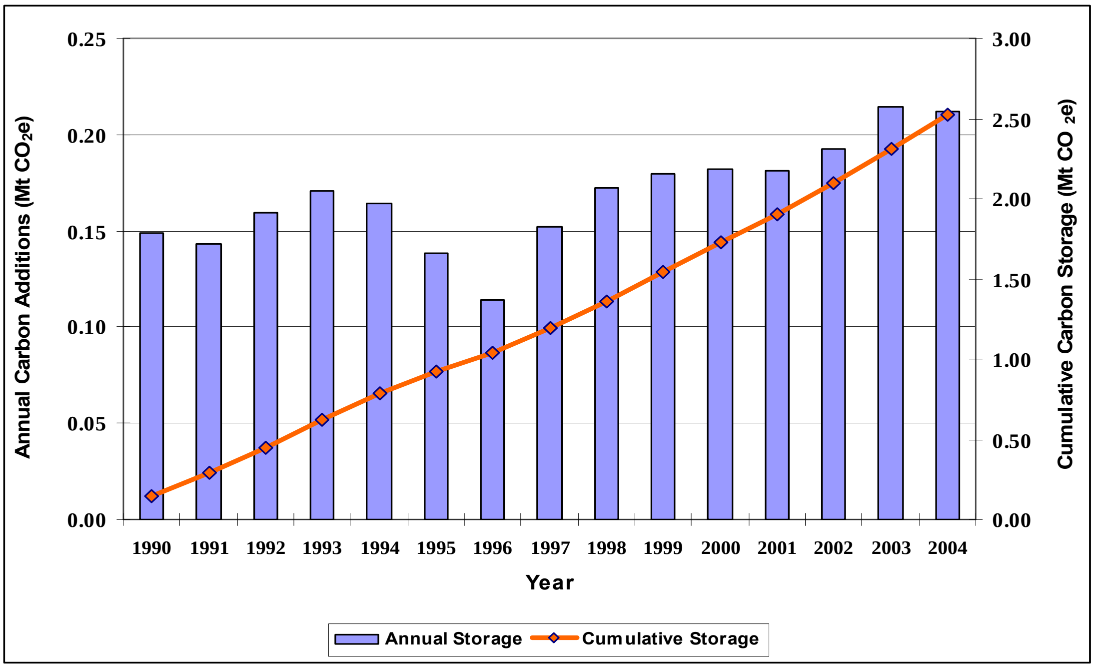

Fig. 2 Estimated annual and cumulative net carbon sequestered in Victorian dwellings, 1990 to 2004 (Kapambwe 2007, PhD thesis, University of Melbourne)

In essence, the dynamics of carbon stocks in housing can be influenced by the number of dwellings completed, the mix of dwelling types, the size of dwellings, the amount of wood products used compared to non-wood products, longevity of dwellings (and wood products), and the amount and fate of construction and demolition wood waste. Further research funded by Forest and Wood Products Australia will focus on improving the estimates of these variables which are key to developing improved models of carbon stocks and dynamics in the Australian housing sector.

Attributing benefits from assessed increases in carbon stocks in wood products in an emissions trading scheme presents some challenges. There are 3 possibilities:

1. the grower receives a payment or benefit
2. the processor receives a payment or benefit
3. the consumer receives a payment or benefit

Under option 1, the forest grower might effectively receive a benefit through a reduction in the estimated emissions at the time of forest harvest by some a calculated amount based on the intended usage of the harvested timber. This would encourage greater investment in planting new forests for timber and carbon benefits.

The other options would have different impacts on the economics of production that require further analysis. Accounting approaches for carbon in wood products will be linked to aggregrate figures of timber harvest and production of different products and it will be difficult to disaggregate and apportion the emission reduction benefits to particular firms or sections of the supply chain. Rather than incorporate the emission reductions associated with the use of wood products into an emissions trading scheme, it may be preferable to explore other types of policy options that recognise that many wood products can represent a long-term carbon store (an in some cases, ultimately act as a substitute for fossil fuel energy) and that encourage the use of wood in construction.

Mitigating Greenhouse Gas Emissions Using Forests: international issues

Avoided deforestation

The 2005 UN Global Forest Resource Assessment indicated that about 13 million hectares of forest are cleared each year and converted to other land uses. This contributes an estimated 20% of current annual human-induced greenhouse gas emissions to the atmosphere. At the same time, the Intergovernmental Panel on Climate Change estimates that forests remove the equivalent of about 25% of total greenhouse gas emissions from atmosphere due to increases in forest area and forest growth in parts of Europe, north America and in Asia, particularly in China.

Negotiations in Bali aim to develop mechanisms through which countries with greenhouse emission reduction targets pay those that can reduce deforestation to help achieve emission reduction targets. Forest clearing is mainly occurring in South America (Brazil), Africa (Sudan, Zambia, Tanzania, Nigeria, Congo and Zimbabwe) and in parts of Asia (mainly Indonesia). There is relatively little forest clearing in Papua New Guinea and the Solomon Islands.

Causes of forest clearing are complex but, in general, forests are currently worth more when they are felled and converted to agriculture than used sustainably for production or conservation.

Many different groups have an interest in this issue. Environmental NGOs see new money for forest protection to conserve biodiversity, forest agencies see funds for improved monitoring and management, poor rural people see funds for community development, Treasury economists in developing countries see much-needed revenue for health and education services and some politicians might see an opportunity to increase their personal bank balance. The Australian government, at least until recently, saw a relatively cheap way to offset greenhouse gas emissions from our energy intensive industries.

Can payments for reduced deforestation satisfy all these different interests? That remains to be seen, but if they are to be effective, there are a number of difficult issues to resolve.

The first is to establish an appropriate baseline against which to compare reduction in forest loss. This could be based on past clearing rates. However, countries with high past rates of forest clearing may not necessarily have high rates in the future. Drivers for deforestation vary considerably between countries and technical analysis is required to determine future rates of clearing under different scenarios. Setting an appropriate baseline will ensure that emission reductions are genuine compared with those that might occur under business-as-usual.

The second issue is ‘leakage’. One country may introduce successful measures to reduce forest loss but this may simply result in more deforestation in neighbouring countries or elsewhere. Understanding fully cross-border and international economic linkages and ensuring effective monitoring to deal with leakage is a major challenge.

The third issue is assigning ownership to carbon stored in forests and ensuring it remains stored in the long term.

In Australia in the late 1990s, a number of states introduced legislation to separate the ownership of carbon from the ownership of the trees and land to facilitate trading in carbon associated with new plantations. This enabled forest growers to sell the carbon rights in new plantings.

On the other hand, the New Zealand government nationalised forest carbon rights. Consequently, a number of forest growers saw little future benefit in trees and converted significant areas of pine plantation to dairy land. This made New Zealand’s Kyoto target difficult to achieve and the decision was recently reversed. Getting the market arrangements and incentives right for forest retention and sustainable management is critical to achieving effective emission reduction objectives.

In developing countries, Treasuries, governments, forest agencies, politicians, communities or individuals could all claim ownership of forest carbon with very different effects resulting from the allocation of property rights. Transferring rights to forest carbon to foreign entities will also have implications for future economic development options and for forest management.

A carefully structured system of assessment, analysis, monitoring and property rights can ensure genuine emission reductions from reduced deforestation, with payments benefiting those most dependent on forests for their livelihoods and in need of development, while providing resources for effective forest management.

New forests

While deforestation is major international concern, there has been a considerable increase in forest area in some countries. Despite the large rate of forest loss in Indonesia, there has been a net increase of forest cover in the Asia Pacific since 2000, mainly due to reforestation for desertification control and catchment management in China and revegetation in Vietnam. Forest cover in Europe has expanded since 1990. Thus, the net loss of forest cover has decreased from 8.9 million hectares per year in the 1990s to 7.3 million hectares per year between 2000 and 2005 (FAO 2005).

This has largely been due to the abandonment of agricultural land, rather than deliberate policies to expand forest cover. However, a number of countries have set national goals to increase forest cover. For example, China aims to increase forest cover to from 20.6 to 23 percent of land area by 2020 (an increase of 23.5 million hectares), India from 20.6 to 33 percent by 2012 (an increase of 41 million hectares) and Vietnam from 39 to 43 percent by 2010 (an increase of 1.7 million hectares)

(Wilkie, M. 2007, presentation to The Future of Forests in the Asia Pacific, Outlook to 2020 conference, Chiang Mai, Thailand, 16-18 October). If these new forest areas can be maintained and managed effectively they will have significant carbon sequestration benefits.

Changing forest management

Reducing degradation associated with many current timber harvesting operations in tropical forests could have significant benefits for reducing greenhouse gas emissions associated with forest operations (Smith and Applegate .

Storage of carbon in wood products

The inclusion of wood products as a pool for greenhouse gas emissions targets has been an issue of considerable controversy in climate change negotiations. Much of the debate was over the attribution of carbon in wood products that are traded internationally. While large timber producing countries (USA and New Zealand) were actively seeking the inclusion of this pool. Significant timber importing countries, such as Japan, were concerned about their liabilities.

There are challenges ahead in getting international agreement on assessment methodologies and in resolving issues with attribution of emissions from wood products traded between countries. This is becoming even more critical in relation to wood transferred across borders for bioenergy production.

Wood for energy

Wood still the major source of energy in the developing world, with wood forming over 80 percent of total energy supply in Bhutan, Cambodia, Myanmar and Laos and other countries in the Asia Pacific, such as Nepal, Sri Lanka and Vietnam heavily dependent on fuelwood for cooking and heating (Perley, C. 2007, presentation to The Future of Forests in the Asia Pacific, Outlook to 2020 conference, Chiang Mai, Thailand, 16-18 October). Globally, bioenergy (including transport fuels from agricultural products and heat from agricultural waste) supplies about 10% of total energy demand (IEA Bioenergy 2007).

With economic development and urbanisation of the population, the trend has been historically for the use of wood for energy to decrease and the use of fossil fuel energy to increase (for example, the share of wood in total energy in China is now about 10% and India about 25%). If this substitution continues, then there could be greater net emissions from energy use in the future, although this depends on the extent to which fuelwood collection results in forest degradation rather than being produced from sustainably-managed forests.

The current total global commercial energy demand is about 467 EJ per year. This is projected to reach 800 to 1400 EJ per year by 2050 (IEA Bioenergy 2007). In Europe, pelletised wood is now widely used in domestic and commercial heating and small-scale energy production. This is causing increased demand for timber and forcing up the price of pulpwood quality material. There is significant scientific development in the production of liquid fuels from wood through pyrolosis or hydrolosis. IEA Bioenergy (2007) suggests that biomass could supply 200-400 EJ per year by 2050 with appropriate investment in research and development and policy settings to set an appropriate price for energy.

There are also significant quantities of material potentially available for wood energy from Australian forests with an estimated 6.5 million tonnes per year of residues and unallocated timber (Bugg et al 2002b).

Adaptation

Implication of climate change for forests

Projected changes in climate as a result of human activities include increased temperatures, changes in precipitation and increased frequency and intensity of extreme events such as storms and bushfire. These changes will influence forest ecosystem resilience directly and indirectly via changes in the frequency and intensity of natural disturbances and changes in regeneration potential of different species. Despite the growing public awareness and profile of climate change in political debate there has been little scientific analysis of the impacts of climate change on Australian native forests and little evidence that forest managers are considering the potential impacts of climate change in management planning.

Future research

Responding to climate change is a major challenge facing our society. Challenges facing the forest managers and the forest production sector are greater than many other areas of the environment and the economy. Trees are long-lived organisms, forest ecosystems have many complex interactions and forest industries are capital intensive, requiring long-term sustainability of resource supply to support investment. While other natural resource sectors might adapt to climate change by shifting production to different crops or new regions this is generally not a short term option for forests.

Decisions on forest use and production will have implications for ecosystems and society well into the future. Forest management therefore requires long-term planning and deeper consideration of the potential effects of climate change. In contrast to short rotation systems (e. g. in agriculture) it is difficult to obtain reliable data on the responses of forest ecosystems to climate change and on the effectiveness of management adaptation. There is much less experimental evidence available for forest ecosystems worldwide, let alone Australian forests. Any long-term predictions are therefore based on an insecure foundation. An effective adaptation strategy requires three elements: understanding, impact analysis and response mechanisms. These are discussed further below.

Understanding Forest Ecosystem Responses to Climate Change

Understanding the response of natural and plantation forest ecosystems to potential future changes in temperature regimes, CO_2 and water availability at individual, species and ecosystem levels is critical to determining potential future impacts and responses to climate change. To investigate these responses we need sound understanding of fundamental physiological and reproductive processes and to maintain and analyse long-term historical records of responses to past change.

Key questions:

- What are the potential impacts of future climate scenarios on the productivity, biodiversity, and distribution of forest ecosystems?
- How does the combination of stress factors (e. g. drought/warming; drought/malnutrition; etc.) affect vitality, productivity, resistance to additional stressors, and longevity of the biological forest resources, i. e. Australian forest species?
- How will climate change affect processes such as flowering, pollination, seed set, seedling establishment, soil biology, decomposition, nutrient cycling, and other aspects of reproductive biology or ecosystem function?
- What are the potential feedbacks in relation to the cycling and storage of carbon and other non-CO2 gases?
- What are the effects of future climate scenarios on forest fire frequency and intensity?
- How will these changes affect important forest ecosystem services such as water yield and quality, soil and erosion protection, recreation, visual amenity

Other important issues

- Monitoring longer-term acclimation to elevated CO_2. This would require regular physiological (photosynthesis and water use) measurements
- Exploring interactions with increased CO_2 and reduced water availability. This would require setting up artificial irrigation and rainfall exclusion experiments and analysis of changing water use efficiency using stable isotope techniques.
- Effects of elevated CO_2 on foliar chemistry and impacts of defoliation by insects or susceptibility to disease.
- Analysis of higher CO_2 effects on wood quality, density and long-term carbon accumulation.
- Response of soil biota and soil processes
- Interactions with non-CO_2 gases
- Genetic variation in responses to elevated CO_2

To address these questions we need major investment in science, for example:

- Large scale ecosystem manipulation experiments in Australian forest ecosystems using combinations of climate change factors/potential management options to address the lack of evidence based understanding of climate change effects on Australian forest ecosystems.

- Network of experimental approaches to address the question of climate factor combinations on Australian forest ecosystem resources (chamber experiments on single species/"mesocosm" experiments etc).

Potential impacts on the forest sector

Given potential changes in productive capacity, species distribution, susceptibility to additional stressors, plantation site suitability and disturbance regimes, there is a need to assess the implications of climate change for forest production, management and processing and the supply of ecosystem services in urban and regional and urban environments.

Secondary impacts are also important. There is a need to understand the impacts of changes in transport and stationary energy demand and price, demand for biofuels, water resource availability, urban development and construction and demographic trends.

Key questions:

- What will be the impacts on timber yield of potential climate change scenarios and changes in disturbance regimes in different regions?
- What are the potential changes in product quality?
- How will changes in energy price impact on the profitability and viability of the forest sector?
- How might longer term changes in water resource availability affect the forest processing sector?
- What are the implications of increasing carbon storage in forest and forest products or the use of biofuels (as climate change mitigation strategies) for traditional processing sectors?
- How will changes in urban design and construction methods impact on the demand for forest products and forest ecosystem services?

Managing for future climate impacts

Ensuring the forest sector has the resilience to respond to climate change will require new approaches to policy, management, marketing and processing of forest resources and values.

Key questions:

- What are the appropriate policy arrangements for ensuring effective management responses to climate change?
- What are effective management strategies to adapt to climate change and how can we ensure they will be successful?
- What are suitable indicators for climate change effects on forest ecosystem components and how can they be used to identify “hot spots” to prioritise management attention?
- What are the most appropriate indicators of sustainable forest management that can inform managers and policy makers of fundamental changes in ecosystem functioning and industry?
- What is the most effective method for monitoring these indicators and provide early warning signals of likely future impacts?
- What are the most effective risk management strategies to ensure that the worst impacts of climate change can be avoided and that a combination of effects (eg. timber production, changing disturbance and climate change) do not impact on the productive or conservation capacity of the forest land base?
- What are the appropriate genetic conservation strategies to ensure that the current range of genetic diversity in tree and understorey species is available for future production, conservation or revegetation purposes?

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