Plantations and sustainability science: the environmental and political settings

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Summary

In this paper we aim to convey the importance of understanding the prospects for plantations within the physical, cultural and political context of contemporary Australia. Prospects for Australian plantations will depend on how well forestry as an industry and a profession handles a series of critical relationships including:

- relationships between vegetation management at a landscape scale, catchment hydrology, streamflows and water quality;
- relationships between forest and plantation design and management and the delivery of environmental services (habitat, carbon, runoff, recharge) at a landscape scale;
- relationships between plantation design and management, industry structures and regional development (planning, demography, rating, roads, schools and services, etc.); and
- relationships between sources and modes of investment in plantations, and community engagement in and acceptance of large-scale plantation developments.

The emerging context for plantations will require greater engagement between the forestry profession and forest industries and other sectors of society than even the environmental debates of the last three decades have demanded.

Drawing on R&D funded by Land & Water Australia, RIRDC and other investors through the Joint Venture Agroforestry Program (JVAP) and other initiatives over the past decade, we argue that the prospects for plantations will be abundantly improved if plantation-related policies support landscape restoration through multifunctional forestry. We seek to improve Australia's capacity to develop plantations that produce more than wood fibre — notably, landscape sustainability. But much more needs to be done.

Keywords: forest plantations; forest policy; environmental policy; land use; landscape conservation; investment; incentives; Australia

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Perceiving: land-use choices are symbolic and political

It is a truism, but nonetheless worth stating, that all plantations occur in, or are, definable parts of landscapes, relating to many other social and biophysical processes. Furthermore, all Australian landscapes are cultural — they have been fashioned by the numerous choices of countless generations, including ours. These landscapes are interpreted and reinterpreted through the lens of our culture. Both belief and physical landscapes are formed by cultures working on or with nature (and nature working on culture), and understood through frameworks of belief and cultural understanding that continue to evolve and adapt.

Australia's vegetation, our landscapes and our creatures are defining features of our sense of national identity, our culture and our values. They figure prominently in our history, our dreaming and our stories. Even our national symbols — our money and coat of arms — display them. But it is in our visual arts that Australian landscapes are most powerfully displayed, from ancient rock galleries at least 40 000 years old to the central desert dot painting; through Bouvelet and Von Guerard celebrations of nature's awesome grandeur, to the impressionists capturing fleeting moments of Australia's changing and brilliant light. Albert Namatjira immortalised the outback. Boyd, Tucker, Nolan, Williams and Olsen and others helped to reinterpret our myths and our landscapes after World War II. Recent international interest in Aboriginal art emphasises the importance of art instilled with meaning — symbols connected to nature and culture. In September 2000 the world watched, literally, as our landscapes and its potent symbols featured in the Olympic ceremonies.

Given that plantation forestry powerfully reshapes landscapes, we should be giving more thought to the community, cultural and ecological impacts, as well as to efficient commodity production. Yet are the cultural and landscape contexts adequately taken into account in plantation site selection, design or layout? Why are these not considered as serious features of plantation planning today?

In our complex, multi-cultural, post-modern Australia, culture, belief and values, and therefore an understanding of landscape,

are far from homogeneous. Landscapes and the choices made about them are experienced in different, distinctly personal ways. The diverse relationships people have with landscapes — what they see, understand, interpret and value — are not only dynamic, but culturally, historically and privately determined by a combination of belief, values, understanding and political and economic ideologies (Alexandra 2001a).

Any given landscape can be a confusion of moral universes, clashing ideologies and conflicting perceptions. Community outrage and conflict over major land-use choices, including the wholesale transformation of regions by plantation development, should not be surprising. While some people simply do not like change, there are better ways of providing information for public debate.

Information for debate: making informed choices

Most Australians live in the temperate forest and woodland zones close to the coast, because, according to Taylor (1940), Australia's settlement patterns are determined by environmental constraints, including the discomfort experienced in the vast, inhospitable hot, dry bulk of the continent. The temperate forest and woodland zones are, by comparison, relatively well watered and amenable to European-style settlement. Most of the country's agricultural development has occurred here, and in the wetter margins the recent expansion of hardwood plantations has been spectacular.

Both these waves of land development — the removal of vast tracks of 'scruffy', idiosyncratic native vegetation and the installation of parcels of vigorous, uniform fibre farms — have been sponsored by government decisions to provide favourable taxation treatment to primary production. Agricultural development was supported by generous taxation deductions for clearing. Likewise, establishing plantations is also deemed to be in the national interest. The massive investments in plantation expansion have occurred because of the tax-effective nature of plantation schemes designed to reduce tax liabilities by achieving 'primary producer' status for the investors (JVAP 2002). The significant influence of tax is demonstrated by a reduction of two-thirds in the area planted after the abolition of the 13-month rule. (In 2000, 125 000 ha were planted, while 2001 plantings are estimated to be 30 000–40 000 ha (JVAP 2002).)

Clearing throughout much of the 20th century and plantation development in the 1990s are examples of choices Australian society has made to support and to allocate financial resources to specific activities and their resultant impacts in the landscape.

Society defines and allocates resources and places differential value on different land uses and industries through political processes. Australian governments continue to allocate substantial subsidies either directly, via tax foregone or through subsidised use of environmental and natural resources (Environment Australia 1996; Industry Commission 1996; ABC Radio 2002). 'Corporate welfare' is estimated at many billions of dollars and only rarely are the choices and the criteria for making them made explicit and transparent (ABC Radio 2002).

Perhaps the closest Australia has come to well-informed and well-structured processes, where the full range of values at stake is transparently on the table, is in the Regional Forest Agreement (RFA) process and land-use planning by Victoria's Land Conservation Council (LCC). Both of these processes focused overwhelmingly on public land, and guided decisions about allocation and management of publicly owned resources. The RFA and the LCC processes were both established after politically damaging conflicts; the RFA after loggers blockaded Federal Parliament and the LCC after disputes about clearing Victoria's Little Desert (Watson 2002).

Choices about land use and the where, how, what of plantations, and who pays for them, continue to be inherently political.

Some people argue that politics gets in the way of rational decisions, but when it comes to making choices about landscapes, more politics, not less, is needed to sort out the contested, long-term values. To ensure that knowledge guides policy towards informed decisions, we need more of the well-structured, informing or umpiring processes like the RFAs and the LCC. If we are to see sustainability science at work guiding policy, and policy changing landscapes, we must equip the informing processes by establishing effective institutions capable of proper consultation, quality research and excellence in knowledge management.

As a nation we need better political processes, and broader, more structured debates about the kinds of landscape and land-use policy choices we make (ACF 2000). We need to organise explicit and transparent choice-making processes that are guided by the best available science, because sustainability is fundamentally about the values and choices society makes, and the fortitude to implement them (Industry Commission 1999). Sustainability is inherently political, in the sense that politics is where the big debates and choices about values occur or should occur (Watson 2002).

Sustainability science is far more than developing technical fixes or technological innovations, because it demands integrated, and at times radical, approaches to complex problems. Sustainability science plays critical roles in articulating preferred futures and in developing smart ways to create these futures. It can inform us of the impacts and tradeoffs inherent in the policies and technologies we adopt.

Recent plantation policy choices

An examination of recent history in Australia makes it clear that much has happened since the 1989 National Conference *Prospects for Australian Forest Plantations* (Dargavel and Semple 1990). In the years following the conference, there was a flourish of activity in the form of Commonwealth inquiries and strategies, such as the National Plantation Advisory Committee (Commonwealth of Australia 1991) and the National Forest Policy Statement (Commonwealth of Australia 1992a), the Resource Assessment Commission's Forest and Timber Inquiry (Commonwealth of Australia 1992b) and the Industry Commission Inquiry (1993). These were followed by a range of initiatives including the Wood and Paper Industry Strategy

(Commonwealth of Australia 1995), the *2020 Vision* (DPIE 1997), and Farm Forestry Program which pumped $63 million into facilitating farm forestry (JVAP 2002) and established the Regional Plantations Committees, and numerous related State initiatives. There have been changes in international markets for wood and fibre products — including a declining Australian dollar. By the late 1990s the trade deficit in wood products equalled the value of the entire wool clip. There have also been innovations and refinements in plantation genetics and technology. However, the most potent innovation has been creative investment arrangements which turned plantations into very tax effective investments (JVAP 2002).

The last decade has seen a huge increase in industrial plantations — well above any predictions of the late 1980s — mostly eucalypts for pulpwood in the wetter margins of southern Australia. Since 1994, the plantation area has expanded by an average of 70 000 ha y^{-1}, ranging from 30 000 ha in 1994 to 125 000 ha in 2000 (JVAP 2002). Apparently, in 1989, no one was predicting this. With the benefit of 2020 hindsight we briefly review the two contrasting 'industry plans' presented in 1989 (Dargavel and Semple 1990).

The *Wood and the Trees* (Cameron and Penna 1988) and the Australian Conservation Foundation proposed a phased reduction in native forest logging and a marked increase in hardwood plantations. They called for a total of 17 000 ha of eucalypts to be planted per annum on cleared land using a combination of leases, joint ventures, etc. On the other hand, the Forest and Forest Products Industry Council (FAFPIC) plan proposed adding a total of more than 500 000 ha of radiata pine to the existing pine estate of 857 000 ha. As well, 65 000 ha of eucalypts were to be added, and all the existing area of native forests were to be continued, to supply 55 new 'world class' mills — 9 pulp and paper mills, 12 panel mills and 34 sawmills requiring 11 billion dollars of additional investment (Dargavel and Semple 1990). History shows that both plans contributed to a vital ongoing debate. Both have been proven to be way off the mark. ACF's bold plantation plan (Toyne 1990) has turned out to be surprisingly modest. It picked the right directions — growth in hardwood plantations on cleared private land — but it greatly underestimated their scale. FAFPIC clearly failed to interpret community sentiment and international markets or was making an ambit claim on Australia's forests to achieve the industry's oft-stated desire for resource security. Neither predicted the importance of tax incentives in accelerating plantation investment (JVAP 2002).

While the importance of tax minimisation as a motivater cannot be overstated, the underlying merit of the policies is questionable. The justification for these distortionary public subsidies is doubtful, on both environmental and economic grounds (Chenoweth and Macken 2002).

The *Plantations 2020 Vision* (DPIE 1997) called for an (apparently arbitrary) tripling of plantation area. Policies supporting this goal have facilitated rapid expansion of plantations in regions with high and reliable rainfall, relatively cheap land and access to ports. However, this expansion — fuelled by the taxation rulings — has also generated a litany of criticism. It has resulted in incompetent and inappropriate clearing, including the destruction of the habitat in western Victoria of the endangered red-tailed black cockatoo. Other criticisms claim that plantations have been poorly sited and are based on large-scale monocultures; that they have mostly displaced rather than been integrated with agriculture; that growth rates and income projections have been overstated; and that they have affected rural communities, reducing school and community viability. There are also ongoing concerns about stream flow and groundwater systems, pesticides and the use of 1080 to poison wildlife (Chenoweth and Macken 2002).

We are rapidly moving out of an era where planting lots of trees is viewed uncritically as 'a good thing'.

Blunt taxation incentives have been unable to maximise sustainability outcomes. We need new approaches to sponsoring plantations that better integrate environmental and economic outcomes and stimulate new kinds of forestry where Australia most needs reforestation. A decade of plantation expansion has had a minuscule impact in the vast areas of medium- and low-rainfall country that desperately requires reforestation to reduce salinisation and restore landscapes (MDBC 1999, 2000, 2001 and Nambiar *et al.* 2000).

More than a decade ago, Campbell (1990) challenged the Australian forestry profession to

> shift our sights down the rainfall scale, away from public land and towards slower growing, more durable, higher value species. Tackling land degradation with a significant reforestation effort on hungry sites is the best way to do this.

With an estimated 17 million ha at risk from salinity (NLWRA 2001), now, more than ever, foresters need to turn their professional skills to the pressing national need for reforestation in the medium- and low-rainfall regions. We must work out how to direct billions of dollars of investment and forestry expertise to the big-picture challenges of salinity mitigation and landscape restoration. Not only is this a professional responsibility, it is also a growth frontier for the profession. Landscape restoration will almost certainly be employing the next generation of forestry graduates — but only if they are equipped to operate away from the wetter margins of the continent, and to deal with complex community and environmental relationships. Unless foresters move into tackling the big sustainability challenges the profession risks becoming ever less relevant (Campbell 1990).

Today's foresters have choices about the scope and direction of Australian forestry and its contribution to society. They can choose to serve narrowly defined needs — satisfying the demand for cheap and abundant wood fibre — or they can play a wider role in helping to reshape how we live and work in Australia's magnificent and diverse landscapes as part of the ongoing quest for sustainability (Dargavel 1995; ACF 2000).

A forester's vision of future landscapes

Rob Youl — a distinguished (at least within the landcare movement!) Australian forester — has articulated a bold, big-picture vision of forestry's part in creating Australia's future landscapes. Here is an extract from his recent feature in the *Australian Forest Grower* where, looking back from 2050, he

describes Australasian forestry and its contribution to reshaping and restoring the landscape in the first half of the 21st century (Youl 2002):

> As farming became much more intensive, forestry's supporting role grew. The community now sees the regenerated foothills from the Grampians to southern Queensland as a giant belt of forest protecting the high-production agricultural zones in the Murray, Murrumbidgee and other catchments of the Murray-Darling Basin.
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> From Stawell through Wagga Wagga and Canberra to Tamworth, a substantially complete belt of foothill box-ironbark forest exists, studded with residential clusters of environmentally friendly housing, pockets of intensive agriculture, especially vineyards, and small, not always serious, rural enterprises. Vineyards and other intensively managed sites are inevitably well protected by very wide zones of trees to their rear and flanks, with man-made wetlands down slope to modify run off. In the south there are also extensive well-managed plantations of sugar gum, utilised for firewood, charcoal, biomass energy and utility timber production, as are many commercial stands of box-ironbark forest.
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> The scene was different at the turn of the century, with wool production expiring on steeper country, and the region suffering from overclearing, salinity, erosion, fragmentation of bushland reserves and opportunistic and badly planned subdivision.
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> Revolutionary landcare plans, developed by the regional community with technical help from government and industry, recognised that the landscape was in transition from farming to farm forestry, recreation, residential opportunities, conservation, tourism and niche farming. The community seized on the changing rural economy, the influx of city-based landowners with their capital reserves and altruism, and the nation's realisation in the early 2000s that, only by facilitating massive adoption of perennial crops, could we conquer salinity.
>
> National and regional government, with catchment management authorities, provided seeding funds, with generous investments from several philanthropists, to develop new community enterprises. Municipalities played their part, enforcing concomitant environmental protection wherever intensive industries established, and ensuring subdivision for recreation and rural-residential developments included substantial direct-seeding with indigenous tree species.
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> Over the next decade, the initially reluctant forestry investment industry changed tune, and, in conjunction with some leading global finance houses and ethical investors, joined the community businesses. Together they initiated an environmental forestry program that led the world for a decade, making the most of emerging markets for greenhouse credits and biodiversity, salinity and water catchment bonds.
>
> People smile recalling Benalla's early Regent honeyeater program, initiated by Ray Thomas. Regent honeyeater numbers in this beautiful landscape have risen manifold, as has the population of grey-crowned babblers. The secret: numerous new farm forests, with understorey, have linked bushland fragments and waterways and multiplied bird habitat.

From vision to reality

Education and innovation

Much of what Rob Youl describes is occurring — individuals and communities are mobilising, catchment committees and local authorities are planning, and agriculture is changing fundamentally. But most of the innovation and integration in revegetation and farm forestry has been happening outside the forestry profession, alongside the industrial plantations, and outside most of the formal research and education processes.

Developing innovation and education systems capable of engaging the diversity of industry and community stakeholders and enabling them to work with the 'elite' researchers and educators is critical. Melbourne University's Master Tree Grower Courses exemplify a new 'adult learning' approach that has now been run in nearly every tree-growing region of Australia (Reid and Stephens 2000). These courses are catalysing the formation of 'dynamic networks' of research, education and industry innovation that operate in direct contrast with the linear technology transfer models that have proven so inadequate for complex issues such as sustainability at a landscape scale (Industry Commission 1996).

Landscape change

Enhancing delivery of landscape change is a major prospect for Australia's plantations. Landscape change is emerging as a concept to describe fundamental land management change undertaken on a major scale to improve landscape health and to address problems such as salinity, declining water quality and loss of biodiversity. Consensus on the scale, urgency and nature of the natural resource management (NRM) challenges, and the interconnectedness of biodiversity, vegetation, and ecosystem function or catchment health, is emerging slowly and patchily. There is less clarity about the policy, technical and investment options for achieving the desired outcomes (Alexandra 2002).

The CSIRO has called for a 'revolution in land use' to control dryland salinity (Stirzaker *et al.* 2000). Research funded by Land & Water Australia has been instrumental in advancing understanding of the nature of leakage from conventional agricultural systems based on annual crops and pastures. The Redesigning Agriculture for Australian Landscapes (RAAL) program has quantified leakage from agricultural systems in comparison with native vegetation (Price and Williams 2001). It is now widely accepted that control of dryland salinity requires significant reduction in leakage by increasing plant water use across the sheep–wheat belt (Walker *et al*. 1999; MDBC 1999, 2000; Stirzaker *et al*. 2000).

In most of the sheep–wheat belt, pasture and grain systems are simply not able to use the available water. In many situations the revolution will therefore require using the 'heavy artillery' of deep-rooted woody vegetation to effectively increase water use. The same trees could provide environmental services like storing atmospheric carbon and producing high-value structural and furniture timbers (Alexandra 1992; CSIRO *et al.* 2001).

Plantation systems are required that can cost-effectively deliver multiple environmental and production outcomes. Developing integrated agro-industrial systems capable of generating multiple products and services will involve detailed catchment planning, sound knowledge of environmental processes, new silvicultural systems, new technologies and new approaches to financing, establishing and managing multi-purpose 'forests'. New processing and harvesting technology will play critical roles in creating viable industries. Much more work needs to be focused on new conversion systems for solid wood, such as radial sawing technology (Andy Knorr *pers. comm*.). We also require efficient machines for harvesting thinnings for firewood and on-going work on biomass energy options.

Much of the landscape in which change is required currently generates low returns on capital, and farm businesses have little internal capacity to invest in change. The low rates of return, however, mean that alternative land uses have a low return hurdle to overcome. There are therefore opportunities for generating income via a combination of conventional products and payments for environmental or ecosystem services such as improved water quality (Alexandra and Hall 1998; Binning *et al.* 2002). Cost-sharing arrangements negotiated to pay fairly for a mixture of products and services could ensure the viability of plantations in areas currently regarded as uncommercial (AACM 1995; Binning *et al.* 2002). Recent JVAP work further develops policy and investment options for multiple-outcome farm forestry (JVAP 2002).

Understanding and designing for complexity

Plantations have many complex and site-specific relationships with other landscape features and processes such as remnant native vegetation management, fauna, catchment hydrology, stream-flows and water quality (see for example Nambiar and Brown 2001). Working out how plantations can generate positive landscape change in specific catchments is challenging. A decade of high quality and strategic R&D provides us with indications of the scale and complexity of these relationships and has begun to provide guidance on intelligent design options (Stirzaker and Vertessy 2000; Stirzaker *et al.* 2000, 2002; Lindenmayer 2002).

Achieving multiple outcomes from plantations is dependent on design capacity which can address complex landscape relationships and interactions. For example, not all trees or locations generate similar benefits for catchment health. Understanding where to place trees in the landscape is required if salinity or other outcomes are to be achieved (Stirzaker *et al.* 2002). We stress that we are not suggesting a future in which experts 'design' landscapes remotely. Landscapes will continue to be socially constructed as individuals, families, firms and industries respond to signals — especially those of public policy and markets. However, at least one, and possibly both, of those great drivers can and should be informed by science in linking the placement of commercial plantations in various configurations in the landscape to different landscape outcomes. The JVAP design guidelines provide a synthesis of general design principles, but catchment- and site-specific planning is still required (Stirzaker and Vertessy 2000).

R&D for new reforestation options

Commercial and semi-commercial plantations are now understood to be a critically important part of the landscape change 'tool-box', particularly in the 450–700 mm rainfall zones (CSIRO *et al*. 2001). JVAP has funded investigations of large-scale revegetation options for the sheep–wheat belt. Options being investigated include numerous plantation species and systems suited to different climatic zones, traditional and new products such as oil mallees, and short-rotation crops for energy (Bioenergy Australia 2000; JVAP 2000, 2002; CSIRO *et al.* 2001). Finding new options is particularly important in those landscapes generally deemed too dry for traditional plantations (e.g. $<$700 mm y^{-1}).

JVAP has supported investigation into potential forestry and revegetation options, but much more work is needed if we are to create commercial drivers for reforestation in the low- and medium-rainfall zones (JVAP 2000, 2001; CSIRO *et al.* 2001). Integrated systems are needed which generate returns from timber and fibre products, non-timber products like energy and oil, catchment and environmental health outcomes and carbon-credits, or combinations of all of the above. Commercial opportunities include:

1. expanding the range and extent of existing plantation-based industries — for example, bluegum and pine plantations in suitable areas;
2. developing new forms of commercial and semi-commercial forestry using a wider range of species suited to drier areas such as ironbark and sugar gum;
3. developing new short-rotation woody land uses — for example, oil and biomass crops;
4. traditional dryland forest industries — for example, durable timbers, charcoal and firewood; and
5. environmental forests — establishing new forests by revegetating and encouraging natural regeneration primarily for environmental outcomes.

Lowering costs of revegetation/reforestation

Increasing vegetation cover is a recognised priority for much of the Murray-Darling Basin (Nambiar *et al.* 2000; MBDC 2002; MDBC and CSIRO 2002). Any rudimentary financial modelling demonstrates the importance of cost-effective revegetation, especially where there are limited prospects of commercial outcomes. Further innovation in reforestation is required to develop low-cost, low-risk reforestation techniques suited to the range of conditions. For example, in the Goulburn-Broken Catchment there are $>$30 000 ha of cleared land with slopes $>18^{o}$ and $>$700 mm y^{-1} rainfall (Alexandra 2002). This is clearly unsuited to traditional plantation establishment techniques. More R&D should focus on opportunities such as improving direct seeding in arable landscapes; mixing direct seeding of pioneer species with precision planting of preferred plantation species in alternate rows or blocks; improving techniques for enhancing natural regeneration; aerial seeding of steeper slopes; and aerial 'bombardment' with seedlings using spear-tube technology.

Finding new investors

The National Action Plan for Salinity and Water Quality (NAP) and Natural Heritage Trust (NHT) are both major public sector sources of funds of NRM activities, but due to the scale of change required, additional sources of investment are needed. We must get new woody industries and new investors if we are to achieve salinity mitigation targets. Estimates of the extent of revegetation required to reduce risk of salinity vary greatly, but in some catchments more than one-third of the cleared land may need to be revegetated. Some funds may come from commercial investors in farm forestry ventures such as oil mallee or firewood — if and when the necessary industry development and commercialisation steps are taken. JVAP supports the development of this kind of farm forestry industry, but so far few new commercial woody industries are in the late stages of commercialisation (JVAP 2000, 2001). The community clearly supports the idea of restoring rural environments. Furthermore, it is easy to imagine that future plantations will have multiple objectives including well-defined biodiversity targets, and that the costs of ensuring these are met will be shared equitably (AACM 1995; Productivity Commission 2002).

Protecting biodiversity

Public or private investment in environmental restoration plantings is obviously required for reasons of salinity and water quality. Further, if we are to avert imminent threats of extinction of up to half of our woodland bird species, many parts of the Australian landscape need major restoration efforts (Seddon *et al.* 2001). We cannot undo the clearing of the past, but we can reduce its adverse effects through major reforestation efforts. If reforestation is done insensitively, however, it also could threaten important species, communities and habitats. New, more sensitive approaches to designing plantations are required. Assuming that plantations start to play a bigger role in the medium- and lower-rainfall agricultural landscapes, those designing and siting them will confront many issues with regard to their relationships to existing vegetation.

Multiple-purpose forestry will need to be more sensitive to the value of remnants, for even individual remnant trees as well as small stands have value as habitat (Lindenmayer 2002). Secondly, the issues of 'weed trees' and genetic pollution must be confronted. The very features of preferred plantation species — vigour, resilience and adaptation to conditions — are what make them potential weeds. Thirdly, it is important to recognise that the new plantations will be growing in already stressed landscapes exhibiting trends which are frightening in their magnitude and implications — rising water tables and the loss of species of immeasurable value. The extinction debt in the sheep–wheat belt is huge. Some ecologists predict the extinction of up to half of the woodland birds (Reid 2000; Seddon *et al.* 2001). Loss of plant species due to salinity is also predicted to increase dramatically, and many small mammals are already extinct or threatened. The medium-rainfall woodlands that remain are some of the rarest and most vulnerable vegetation communities in Australia (Hobbs and Yates 2000).

Making choices: burning heirlooms of evolution?

Each autumn and winter, in wood yards throughout Australia, large stacks of dried and split billets await eager consumers preparing for their cosy winter fires. Few people realise as they sit by a fire — perhaps with a good red and a good book— — that their warming fuel is the dismembered bodies of ancient woodland trees, the habitat of rare and endangered species, or the icons of the inland — the paddock tree. Even a cursory investigation of the source would reveal the pitiful state of much of the temperate woodlands and their unique flora. This wood is currently gleaned from up to 400 km from the southern cities by wood cutters and merchants who would willingly supply firewood from plantations — if it were there.

Fuelwood consumption by Australian households is estimated to be about 5 million t y^{-1} (Bhati 2001). Currently plantation-sourced fuelwood is almost negligible, yet throughout the world Australian tree species are being used as preferred species for fuelwood. A deeper irony is that the harvesting of fuelwood from public lands is sanctioned by government agencies many of which are responsible for salinity and other landscape conservation efforts, while they invested virtually no effort in establishing or promoting a plantation firewood industry. If governments induced scarcity by reducing access to native woodlands (VNPA 2000) the business of growing fuelwood would be encouraged. Demand for thinnings from the new salinity-mitigation plantations would be enhanced and a carbon-neutral heating fuel produced.

Informed policy choice could create such demand for thinnings from lower-rainfall plantations or from dedicated firewood plantations in the drier, more salinity-prone areas that desperately need economic drivers for revegetation. The nature of the conflicting relationships between government as supplier and government as regulator in the industry have been observed repeatedly. For example:

> If the royalties from native forests (particularly slow growing durable species) reflected their replacement value (or even approached it), plantations and privately grown forests would be far more attractive to growers. Private forest establishment would be stimulated on small and large scales (Campbell 1990).

The explosion in *Eucalyptus globulus* plantations in south-western Western Australia and western Victoria is a graphic illustration of the power of public policy to change landscapes.

Tax rulings on plantations have been very effective at priming the pump to expand plantation resources. New, better-targeted incentives could as easily be used to shift investment into the medium- and lower-rainfall zone on the basis of public benefits that could be achieved.

Shifting our sights up and out

Sustainability demands that we shift our sights up and out — to the global, to the long term — to the big picture. Australian forestry has much to offer the world.

Australia's gifts to the world include trees that grow prolifically on soils such as mine-overburden, withstanding fire and drought and producing timbers hard and strong like steel; timbers that burn like coal, and are durable like concrete. As if this is not enough they are also rich, colourful and well endowed with features (Alexandra 2001b). Evolving out of countless millennia of fire-stick farming, and growing on the least fertile and driest continent, the eucalypts, acacias and casuarinas are a treasure trove of forest tree genetics — the genetic basis for the most widely planted forestry species.

There is still much to be learnt about the trees of the great southern land and the numerous ways of using their productivity. In addition to the few species favoured for industrial plantations, there is much inherent potential in those species yet to be commercially exploited. New and emerging technologies can fundamentally alter the conversion of trees into products and the kinds of products produced: for example potentially important non-wood products such as biodegradable pesticides and industrial solvents. There is scope for delivering many ecological benefits in terms of salinity and catchment health.

Sustainability science can help to expand Australia's expertise in land repair, environmental restoration and natural resources planning and management. As a nation, we must lift our sights out of the quagmire of conflict over public native forest policy that has dominated environmental policy for the past decade, and beyond simple obsessions with fast growth. Australian plantation forestry has the opportunity to mature and consolidate its reputation for excellence and innovation in natural resource management. This is potentially a big earner for us because many of the challenges we face domestically have global dimensions and relevance.

References

AACM International (1995) *Cost Sharing Frameworks for On Ground Works*. Murray-Darling Basin Commission, Canberra.

ABC Radio (2002) 'Corporate welfare'. *National Background Briefing*. Australian Broadcasting Commission July 2002.

ACF (2000) *Natural Advantage a Blueprint for a Sustainable Australia.* Australian Conservation Foundation, Melbourne.

Alexandra, J. (1992) Realising the potential of a farm-based forestry sector. In: *Catchments of Green*: *A National Conference on Vegetation and Water Management*. Volume A. Greening Australia, Canberra.

Alexandra, J. (2001a) Life-fulfilling ecosystem services. In: Binning, C. *et al.* (eds) *Natural Assets, an Inventory of Ecosystem Goods and Services in the Goulburn Broken Catchment*. CSIRO, Canberra. 136 pp.

Alexandra, J. (2001b) International Centre for Accelerating Forestry Innovation — prospectus. Unpublished consultants report to the Shire of Hepburn.

Alexandra, J. (2002) Accelerating landscape change in the Goulburn Broken Catchment. Unpublished consultants report.

Alexandra, J. and Hall, M. (1998) *Creating a Viable Farm Forestry Industry in Australia — What Will It Take?* Rural Industries Research and Development Corporation (RIRDC), Canberra. Publication No. 98/74, 131 pp.

Bhati, U.N. (2001) *Firewood.* ANU Forestry Market Report — June 2001. ANU Forestry, Canberra.

Binning, C., Saker, B., Meharg, S., Cork, S. and Kearns, A. (2002) *Making Farm Forestry Pay: Markets and Incentives for Ecosystem Services.* Joint Venture Agroforestry Program. Rural Industries Research and Development Corporation (RIRDC), Canberra. Publication No. 02/005, 64 pp.

Bioenergy Australia (2000) *Biomass: Energy and Products.* Bioenergy Australia, Sydney. 5 pp.

Cameron, J. and Penna, I. (1988) *The Wood and the Trees.* Australian Conservation Foundation, Melbourne.

Campbell, C.A. (1990) Get back to the bush — a challenge to forestry and to foresters. *Australian Forest Grower* **13**(1)**,** 19–21.

Chenoweth, N. and Macken, J. (2002) The battle over Gunns and trees. *Australian Financial Review*, 20 July, p. 24. Fairfax, Sydney.

Commonwealth of Australia (1991) *National Plantations Advisory Committee Reports.* Department of Primary Industries and Energy, Canberra.

Commonwealth of Australia (1992a) *National Forest Policy Statement.* Australian Government Printing Service, Canberra.

Commonwealth of Australia (1992b) *Forest and Timber Inquiry Final Report.* Resource Assessment Commission, AGPS, Canberra.

Commonwealth of Australia (1995) *The Wood and Paper Industry Strategy.* Australian Government Printing Service, Canberra.

CSIRO (2001) *The Heartlands Initiative Five Year Plan 2001–2005.* CSIRO, Canberra. http://www.per.clw.csiro.au/heartlands/

CSIRO, ANU Department of Forestry, RIRDC, Olsen & Vickery and Hester Gascoigne & Associates (2001) *The Contribution of Mid to Low Rainfall Forestry and Agroforestry to Greenhouse and Natural Resource Management Outcomes: Overview and Analysis of Opportunities.* Australian Greenhouse Office and Murray-Darling Basin Commission, Canberra.

Dargavel, J. (1995) *Fashioning Australia's Forests*. Oxford University Press, Melbourne.

Dargavel, J. and Semple, N. (1990) *Prospects for Australia's Forest Plantations*. Centre for Resources and Environmental Studies, Australian National University.

DPIE (1997) *Plantations for Australia — The 2020 Vision.* Standing Committee on Forestry, Department of Primary Industries and Energy, Canberra.

Environment Australia (1996) *Subsidies to the Use of Natural Resources in Australia*. Environmental Economics Research Paper No. 2, Environment Australia, Canberra.

Hobbs, R.J. and Yates C.J. (eds) (2000) *Temperate Eucalypt Woodlands in Australia.* Surrey Beatty and Sons, Sydney.

Industry Commission (1993) *Adding Further Value to Australia's Forest Products, Final Report*. Commonwealth of Australia, Industry Commission, Melbourne.

Industry Commission (1996) *State, Territory and Local Government Assistance to Industry Draft Report.* Commonwealth of Australia, Industry Commission, Melbourne.

Industry Commission (1999) *Implementation of ESD by Commonwealth Departments and Agencie*s. Commonwealth of Australia, Industry Commission, Melbourne.

JVAP (2000) *Emerging Products and Services from Trees in Lower Rainfall Areas*. Joint Venture Agroforestry Program. Rural Industries Research and Development Corporation, Canberra. Research Update Series No. 2, Publication 00/171, 22 pp.

JVAP (2001) *Agroforestry and Farm Forestry: JVAP Completed Projects in 2001 and Research in Progress as at June 2001.* Joint Venture Agroforestry Program. Rural Industries Research and Development Corporation, Canberra. Publication 01/066, 72 pp.

JVAP (2002) *Environmental and Commercial Outcomes through Agroforestry: Policy and Investment Options*. Joint Venture Agroforestry Program. Rural Industries Research and Development Corporation, Canberra. Publication 02/057, 78 pp.

Lindenmayer, D. (2002) *Plantation Design and Biodiversity Conservation*. Rural Industries Research and Development Corporation, Canberra. Publication No. 02/019, 56 pp.

MDBC (1999) *The Salinity Audit of the Murray-Darling Basin: A 100-year Perspective*. Murray-Darling Basin Commission, Canberra.

MDBC (2000) *Basin Salinity Management Strategy 2001–2015*. Murray-Darling Basin Commission, Canberra.

MDBC (2001) *Integrated Catchment Management in the Murray-Darling Basin.* Murray-Darling Basin Commission, Canberra.

MDBC (2002) *Environmental Challenges in the Murray-Darling Basin.* Murray-Darling Basin Commission, Canberra.

MDBC and CSIRO (2002) *Heartlands Newsletter, Autumn Edition.* Murray-Darling Basin Commission and CSIRO, Canberra.

Nambiar, S., Cromer, R. and Brown, A. (eds) (2000) *Restoring Tree Cover in the Murray-Darling Basin.* CSIRO Forestry and Forest Prducts, Canberra. 60 pp.

Nambiar, S. and Brown, A. (eds) (2001) *Plantations, Farm Forestry and Water — Proceedings of a National Workshop.* Rural Industries Research and Development Corporation, Canberra. Publication No. 01/20, 62 pp.

NLWRA (2001) *Australian Dryland Salinity Assessment 2000. Extent, Impact, Processes, Monitoring and Management Options.* National Land and Water Resources Audit: a program of the Natural Heritage Trust.

Price, P. and Williams, J. (2001) Review of the RAAL program's achievements. Unpublished report. Land and Water Australia, Canberra.

Productivity Commission (2002) *Creating Markets for Ecosystem Services*. Productivity Commission, Melbourne.

Reid, J.W. (2000) *Threatened and Declining Birds in the NSW Sheep–Wheat Belt*. 2. CSIRO Sustainable Ecosystems, Canberra. 67, 52 pp.

Reid, R. and Stevens, P. (2000) *A Farmer's Forest — Multipurpose Forestry for Australian Farmers.* Rural Industries Research and Development Corporation, Canberra. Publication R01/33, 167 pp.

Seddon, J., Briggs, S. and Doyle, S. (2001) *Birds in Woodland: Remnants of the Central Wheat/Sheep Belt of NSW.* Report to the Natural Heritage Trust, NSW National Parks and Wildlife Service, Sydney. [62] pp.

Stirzaker, R. and Vertessy, R. (2000) *Agroforestry Design Guidelines to Balance Catchment Health with Primary Production*, Joint Venture Agroforestry Program, Canberra, Pub. No: CSM-4A.

Stirzaker, R., Lefroy, T., Keating, B. and Williams, J. (2000) *A Revolution in Land Use: Emerging Land Use Systems for Managing Dryland Salinity.* CSIRO Land and Water, Canberra. 24 pp.

Stirzaker, R., Vertessy, R. and Sarre, A. (2002) *Trees, Water and Salt: An Australian Guide to Using Trees for Healthy Catchments and Productive Farms.* Joint Venture Agroforestry Program, Rural Industries Research and Development Corporation, Canberra. Publication 01/086, 159 pp.

Taylor, G. (1940) *Australia — A Study of Warm Environments and Their Effect on British Settlement.* Methuen and Co., London.

Toyne, P. (1990) ACF conservation plan for forests. In: Dargavel, J. and Semple, N. (eds) *Prospects for Australia's Forest Plantations.* Centre for Resources and Environmental Studies, Australian National University, Canberra.

VNPA (2000) *National Firewood Conference Proceedings*. Victorian National Parks Association, Melbourne.

Walker, G., Gilfedder, M. and Williams, J. (1999) *Effectiveness of Current Farming Systems in the Control of Dryland Salinity*. CSIRO Land and Water, Canberra.

Watson, D. (2002) *Recollections of a Bleeding Heart*. Knopf Publishing, Sydney.

Youl, R. (2002) Private forestry vision 2050: a sustainable Australia achieved. *Australian Forest Grower* **25**(1)**,** special liftout, 8 pp.