Regional prospects for integrated forestry

The following section presents prospects for integrated forestry in six regions across southern Australia: south-west WA; south-west Victoria and south-east SA; northern NSW; central-west NSW; Murray western slopes/Murrumbidgee NSW and northern Victoria, and Hunter NSW.

The regional statements that follow specifically refer to the 450–750 mm rainfall zone rather than any broader area; but aspects of the wider regional context are discussed where relevant, especially where regional prospects are linked to neighbouring forest resources and industries. Common names for the species mentioned in this section can be found at the end of the document.

PHOTO: ©ITC Limited

Many species are trialled to determine best regional options

PHOTO: ©ITC Limited

South-west Western Australia

Background

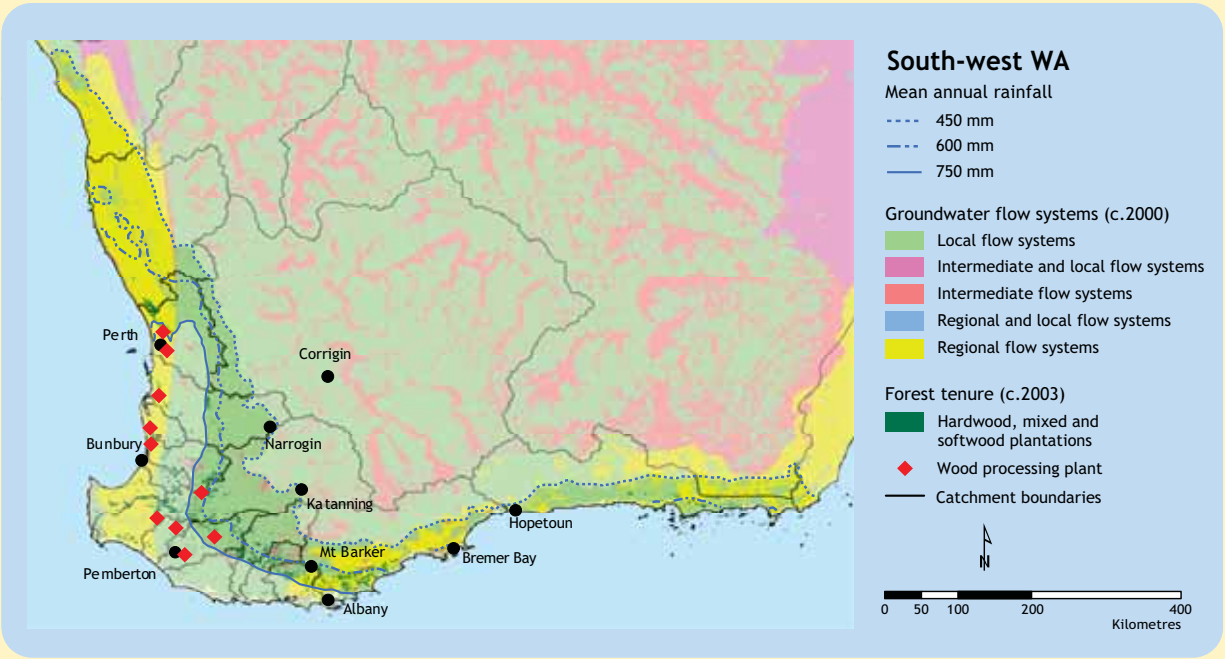
South-west WA (450–750 mm rainfall zone) forms a wide band of about 62,000 km^2 through parts of the Northern Agricultural, Avon, South-West and South Coast regions (see Figure 6). The landscape is more undulating to the west and south where rainfall is higher, with broader and flatter valleys to the east. It is characterised by deep lateritic regolith soils derived from weathered granite with soils that are mostly duplex with sandy surface horizons, often with high gravel content and high clay content at depth. These soils contain large salt stores, which are mobilised by rising groundwater.[46]

Agriculture is the dominant rural industry in this region, with about 50% grazing and 45% cropping. Most farms are economically viable and managed by landholders aged 50–55 years, on average. The 450–750 mm rainfall zone is part of a broader region recognised internationally as a biodiversity 'hot spot'. Many biodiversity assets are already affected by or at significant risk from salinity, including inland lakes (such as the Unicup/Muir lakes) and coastal wetland systems fed by salt-affected waterways. Up to 450 species, primarily riparian-based, are at risk of extinction. Forestry and other forms of revegetation have a role to play in their protection through slowing or reversing the process of land salinisation.[47]

Land salinisation is a major problem arising after clearing and most river systems now have high salt concentrations, with rehabilitation of salinised waterways a high priority for water supply catchments. Secondary (dryland) salinity caused by shallow groundwater (85% of which is in local systems) currently affects 5–10% of cleared catchments in the 450–750 mm rainfall zone, with up to 30% (depending on local conditions) having a salinity hazard.[48]

The area affected by salinity in the more steeply incised, higher rainfall zone (600–750 mm) where land was cleared more than 50 years ago is almost at equilibrium. Further water table rise in these areas is likely to result in increased rates of saline discharge rather than significant expansion of the area affected. Salinity is still developing down-slope of land cleared more recently. Hydrologic equilibrium will not be achieved for a further 50–100 years in the 450–600 mm rainfall landscapes and flatter areas to the east, and will result in 20–30% of the landscape being affected by shallow water tables if annual rainfall continues at the 1975–2000 levels.[47]

FIGURE 6: South-west WA showing 450-750 mm rainfall zone, groundwater flow systems and existing plantation resources



Integrated forestry prospects for managing land and water salinity

Plantation forestry currently comprises about 5% (250,000 ha) of the 450–750 mm zone. Almost all of this resource is *E. globulus* (Tasmanian blue gum), which has been established in the 600–750 mm rainfall zone during the past 15 years for the export woodchip market. About 10,000 ha of new *P. pinaster* plantations have been planted on agricultural land in the Gingin-Dandaragan-Moora area, and about 7000 ha of other tree species have been established.[49]

There is limited forestry infrastructure within the 450–750 mm rainfall zone, although considerable harvesting and processing infrastructure exists in adjacent higher rainfall areas. Manufacturers of medium density fibreboard (MDF), laminated veneer lumber (LVL) and particleboard are within reasonable transport distance, together with eight softwood and 12 hardwood sawmills. Albany and Bunbury have multiple hardwood chip and port facilities, essential for an export market.[50] Only a small proportion of this estate has been specifically targeted for salinity management to date.

The expansion of plantation forestry in the rainfall zone receiving more than 600 mm during the past 15 years indicates that plantation forestry is considered at least as profitable as agricultural production in this rainfall zone, but is much less profitable where rainfall is less than 600 mm.

Best species prospects are *C. maculata*, *E. cladocalyx*, *E globulus*, *E. saligna*, *P. radiata* and *P. pinaster* on non-saline land. Further identification of suitable species that will survive and grow well, underpinned by detailed productivity information, will better enable potential investors to assess profitability.

Extensive, highly-dispersed alleys or well-placed blocks present the best prospect management systems in terms of both groundwater control[32] and tree productivity, but more work is needed by researchers, landholders and industry to further improve tree growth and agricultural productivity.

The greatest opportunity for integrated forestry to impact on groundwater recharge and salt mobilisation lies in the steeper western and southern margins of the region. Integrated forestry can play a role in two categories of catchments in the 450–750 mm rainfall zone:

PHOTO: ©ITC Limited

E. globulus is widely used where rainfall exceeds 600 mm

(i) salinity recovery catchments where water can be made potable through reforestation of the cleared upper reaches with annual rainfall greater than 600 mm; and (ii) severely saline catchments (rainfall <600 mm) which are likely to remain so in the foreseeable future.

Recovering potable water supply in saline catchments in the region (such as the Collie, Kent and Warren-Tone River subcatchments) is utilising large scale engineering complemented by reafforestation activity. Achieving the required salinity outcomes through revegetation alone would require at least 50% of the land to be reforested.[51] As an example, the Denmark catchment requires as much as 90% vegetation cover, either as retained native forest or as reforestation to reduce stream salinity to acceptable levels. In the Collie catchment it is predicted that, in the absence of engineering approaches, 80% reforestation would be required to return the Wellington Dam salinity to potable levels. This scale of land-use change would have significant implications for existing enterprise profitability, redundancy of agricultural infrastructure, and the sustainability of social structures. While climate and soils are challenging for commercial forestry production, the rapid expansion of the blue gum industry in the 600–750 mm portion of this zone during the past 15 years indicates rapid change can be achieved with the correct economic incentives.

While landholders have shown interest in adopting revegetation (especially through the National Action Plan for Salinity and Water Quality) in the 450–600 mm rainfall areas, there is little current interest in further tree planting in the higher rainfall recovery catchments, such as the Collie. Following a long history of tree planting, there is little scope for further expansion of forestry as an alternative to more profitable agricultural land-use options unless supported by significant incentives or policy changes.

In the drier areas landholders are adopting publicly funded planting schemes, especially in the large recharge and low agricultural productivity sandy ridge areas. Here tree-based incentive payments encourage adoption and provide an opportunity for revegetation with perennial species suited to such locations. *P. pinaster* is a species which prospers in these situations and could provide an alternative crop. Some on-site recovery of salinised land is possible. Containment or 'buying time' may be possible by reafforesting areas of future salinity hazard in the lower rainfall zones.

Constraints to adoption of integrated forestry in this rainfall zone could include: (i) uncertainty about species choice; (ii) high salt stores and groundwater salinities that could further restrict or limit growth; (iii) transportation costs and lack of infrastructure access; and (iv) the need for incentive payments to achieve the scale of land-use change needed. Paradoxically, the public to private benefit ratio from salinity control is likely to be less in this rainfall zone, where the salinity problem is greatest.[51]

In summary

Prospects for south-west WA are greatest in the 600–750 mm rainfall zone, where large-scale, targeted plantings have the potential to supply products to existing markets, compete with traditional agriculture and restore potable water supplies. Integrated forestry in the 450–600 mm rainfall zone is less promising, being more distant from existing infrastructure and markets, currently less profitable than traditional agriculture, and less likely to result in off-site land and water salinity recovery benefits.

PHOTO: Timber 2020

Albany and Bunbury have multiple hardwood chip and port facilities

South-west Victoria and south-east South Australia

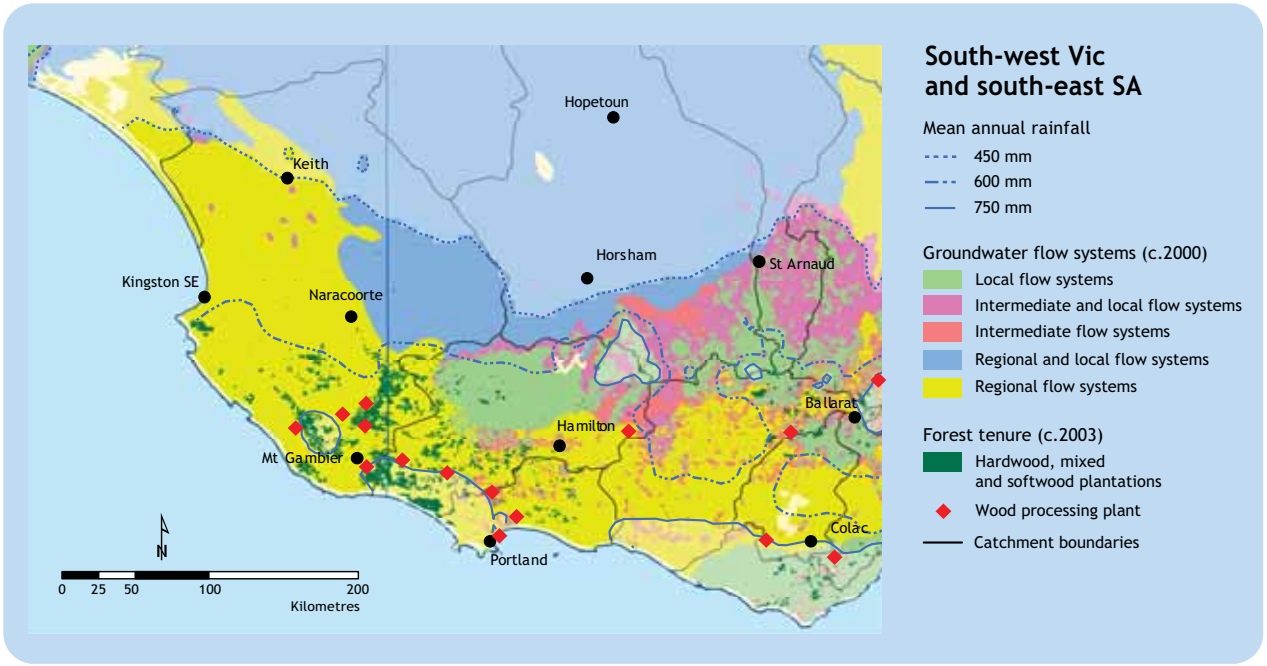
Background

South-west Victoria and south-east SA (450-750 mm rainfall zone) comprises parts of the Glenelg, Hopkins, Corangamite, Portland Coast and Wimmera catchments in Victoria and the upper and lower south-east areas of SA (see Figure 7). Rainfall is winter dominant and annual evaporation generally far exceeds annual rainfall. The landscape in south-west Victoria is characterised by widespread undulating basalt plains with scoria cones and stony rises prominent in the east. The coastal zone features limestone, alluvial deposits and sand dunes. More than 80% of soils in the Glenelg and Hopkins catchments have chemical or physical limitations that affect the growth of plants. The Grampians and Langi Ghiran ranges form mountainous landscapes in the north-east, giving way to infertile and highly erodible sandplains and sandhills, which dominate in the Millicent Coast area in the west.

The traditional economy of the region is dryland agriculture, including livestock grazing and cereal and legume cropping, with small areas of irrigated agriculture. Greater enterprise diversification has taken place during the past few decades, including the expansion of dairy and raised bed cropping industries. The development of extensive softwood plantations, especially in the lower south-east of SA (near Mt Gambier) started during the early 1900s and eucalypt plantations have been developed more recently.

The population of rural areas and smaller towns has been declining at the expense of larger cities (such as the Ballarat-Geelong corridor) and this is expected to continue in the foreseeable future.

FIGURE 7: South-west Victoria and south-east SA showing 450-750 mm rainfall zone, groundwater flow systems and existing plantation resource



Through a soil-landscape mapping program carried out at the 1:100,000 scale during the early 1990s, the area of salt-affected land in the upper south-east of SA was estimated to be about 220,000 ha (almost exclusively in regional groundwater flow systems). Since that time, a major dryland salinity and flood mitigation scheme has been undertaken in the area. The estimates of the area of salt-affected land in 2050 do not take into account the predicted impact of this scheme, which is in its final implementation stages. Groundwater quality is generally good in the lower south-east (including the area around Mt Gambier) and in high demand for domestic and agricultural purposes.

Scattered occurrences of land salinisation in the Glenelg, Hopkins and Corangamite catchments in Victoria, representing more than 35,000 ha, are primarily in local groundwater flow systems and are more amenable to recovery through revegetation strategies. In-stream salinity levels here can be high.

Integrated forestry prospects for salinity management

Forestry is a substantial part of the broader regional economy, with significant plantation areas surrounding Mt Gambier, Portland and Hamilton in the 'Green Triangle' area. Here the existing softwood (*P. radiata*) plantings cover more than 160,000 ha, with a further 140,000 ha of eucalypt (*E. globulus*) hardwoods. While some of these plantings are located on farms they are industrial in scale and planted and managed by forest industries. The area where these plantings are located is dominated by regional groundwater flow systems that do not exhibit significant salinity hazard or risk. About a further 4000 ha of forestry is planted and managed by landholders, of which half is located in SA receiving less than 600 mm rainfall.

The prospects for integrated forestry are greatest in the 600–750 mm rainfall zone, where existing plantings are substantial and infrastructure supports further expansion. Portland provides deep-water port facilities and substantial chip/pulp processing infrastructure underpins the hardwood industry. Regional processing facilities (sawn timber and veneer, roundwood and chip/pulp) are located in some of the major towns such as Mt Gambier, Millicent and Portland to support the softwood industry.

PHOTO: CSIRO Land and Water

Forestry is part of the broader regional economy

Current integrated forestry plantings have been established in anticipation of improved processing infrastructure for hardwood sawlogs or for portable sawmills. Currently there is a lack of infrastructure for hardwood specialty products (such as for flooring, furniture and panelling), which could come from *Corymbia* spp., *E. cladocalyx*, *E. saligna* and *E. globulus*. Firewood production and high-value cabinet woods present further opportunities. However, the potential for integrated forestry plantings to significantly impact on land and water salinity in the near term is mostly confined to the upper parts of the Glenelg and Hopkins catchments, where local groundwater flow systems dominate (see Figure 7).

The prospects for integrated forestry in the 450–600 mm zone are best in the southern part of this zone where the rainfall is highest and processing facilities are located nearby. The existing 2100 ha of plantings on 135 properties comprises more than 85% *P. radiata*. Although the regional groundwater flow systems that dominate this environment are characterised by high salinity hazard and risk, north and west of Naracoorte, it is unlikely the scale of planting required to impact on salinity will eventuate.

There are opportunities for tree planting in the areas south of Naracoorte where groundwater levels are often shallow but not too saline. Integrated forestry in the 450–600 mm rainfall zone to the east, mainly in the Wimmera catchment, is constrained by rainfall and infrastructure.

Some alley farming exists in the western Wimmera, but is small-scale and salinity benefits are confined to places where local groundwater systems overlay regional systems. Detailed comparative economic analyses carried out for the various integrated forestry options in the north-west of Victoria indicate the variation in internal rate of return.[52] Species with commercial potential for this rainfall zone include *E. cladocalyx*, *E. camaldulensis*, *E. occidentalis*, *E. tricarpa* and *Melaleuca uncinata*.[53] Other possible species include *Acacia implexa* and *E. camaldulensis* x *E. grandis* hybrids. Species suited to saline areas include *E. occidentalis* and *Casuarina obesa*.[54]

There is a long history of tree planting both for production and conservation in the broader region, especially around Mt Gambier and Hamilton. The role of tree planting and other perennial vegetation in reducing groundwater recharge in areas where dryland salinity is a problem is generally recognised although uptake has been limited. Central Victorian Farm Plantations (CVFP) promotes the incorporation of tree planting with multiple benefits and includes Corangamite and parts of Glenelg and Hopkins catchments.

For landholders, integrated forestry is not their core business and despite a decade of solid promotion the area of integrated forests managed directly by landholders remains small. Recent tree plantings have been strongly driven by managed investment schemes, resulting in large-scale plantations on farmland purchased by forest companies.

While the perception of forestry across the region is generally positive, there are some strong detractors. Around Hamilton, the regional community has expressed concern about the impacts of extensive plantings on in-stream water yields, groundwater resources, landscape amenity, demographic changes, fire management and more. A recent report has highlighted potential impacts of catchment water yields in south-west Victoria.[55]

The region also would benefit from further support structures, such as brokers and cooperatives, to assist small growers marketing and selling their wood as an alternative option to leasing land to the larger forest industry enterprises.

In summary

Regional groundwater flow systems dominate in south-east SA, with the upper south-east having extensive areas with saline groundwater and soils. Prospects for forestry are mainly limited to the 600–750 mm rainfall zone, with good quality groundwater nearest to Mt Gambier (though in prescribed water resources areas, such as in the lower south-east of SA, forestry could require a water allocation permit) but could be extended further north where relatively good quality groundwater is available. Integrated forestry can play a role in managing dryland salinity in the upper south-east but the average annual rainfall is 400–600 mm. Integrated forestry in south-west Victoria, especially in the local groundwater flow systems of the Glenelg and Hopkins catchments, presents opportunities for more rapid salinity benefits. The close proximity of existing infrastructure to these areas is beneficial. Landscape-scale change in this environment by landholders is moderately to highly dependent upon incentive payments. Careful assessment and management of water yield impacts and social concerns are needed at the planning stage.

PHOTO: CSIRO Land and Water

Recent tree plantings have been strongly driven by managed investment schemes

Northern New South Wales

Background

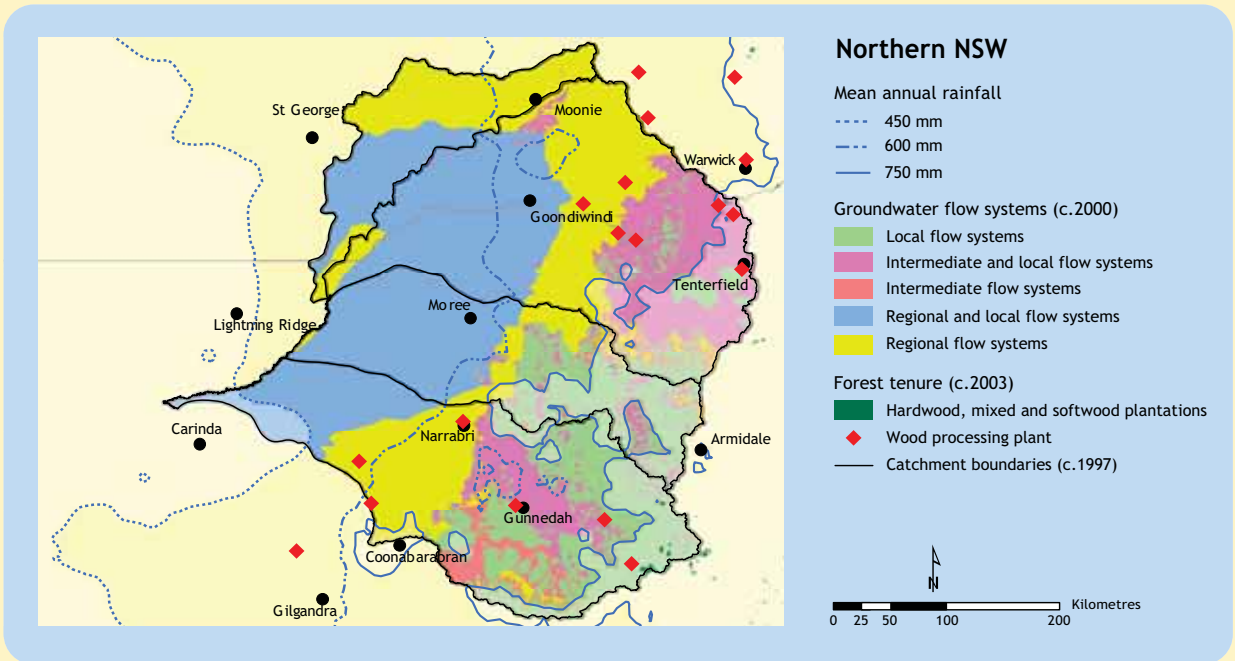
Northern NSW (450–750 mm rainfall zone) comprises the western parts of the MacIntyre/Border Rivers, Gwydir and Namoi catchments (see Figure 8). Rainfall generally increases from west to east towards the ranges. The region is largely undulating to hilly, except for some rugged areas around Narrabri, the plains of Mungindi (north-west of Moree) and the Liverpool Plains (west of Tamworth). Rainfall is summer dominant, with about 60% occurring during November–March. Rainfall does not exceed evaporation, even during the winter months.

Agriculture is the most extensive industry, mainly for grazing (46%) and cropping (17%), and forests occupy about 16% of the land area.[56] Most farms are large enough to be economically viable and are managed by landholders aged more than 50 years, on average.

Salt loads in rivers in the region are high and show an increasing salinity trend. For example, salt export from the Namoi River to the Darling River is predicted to reach about 150,000 t/yr by 2100, compared with 60,000 tonnes per year in 1998.[56]

Dryland salinity outbreaks are generally localised, and are most prominent on agricultural land in the south-east of the region. About 3200 ha of land shows marked salinity impacts, with outbreaks occurring mostly in local and intermediate groundwater flow systems (GFS). The local GFS covers 21% of the region and intermediate and local GFS covers 13% of the region.[57] About 7000 ha of land are at risk (water table within 2 m of surface);[58] these include: (i) areas of black vertosols within the Liverpool Plains where water table depth is within 2 m of the surface; (ii) along the base of the Liverpool Ranges where the heavy soils of the plains meet the lighter soils of the ranges; (iii) the Pilliga outwash south of Narrabri; and (iv) areas identified with high salt store along the New England uplift from Tamworth to Gravesend.[59]

FIGURE 8: Northern NSW showing 450–750 mm rainfall zone, groundwater flow systems and existing plantation resource



Integrated forestry prospects for salinity management

The main existing forest industry is the harvesting of *Callitris* spp. (cypress pine) for sawlogs from native forests to the drier western and south-western part of the region. Up to 57,000 m^3/yr of cypress pine is harvested from the public and private forest estate, which covers about 1.3 Mha extending into the central-west NSW (discussed in the next section). Cypress pine is slow growing, with a rotation length of more than 80 years, although a commercial thinning is likely to occur earlier. There are more than 150,000 ha of predominantly eucalypt private native forests largely to the east of the region (with an average annual rainfall of 790 mm), some of which is harvested under permit. There are 2000 ha of hardwood plantations (*E. nitens*) established on private agricultural land and 15,000 ha of softwood plantations near Walcha in the east.[60] Sawmills operate throughout the north-west including around Tamworth and Walcha.

The local and regional impacts of tree planting on hydrology are not yet well understood, nor are the broader biophysical, social and economic impacts of large-scale tree planting. At least one modelling study suggests that trees planted on vertosol soils do not significantly reduce recharge compared with improved pasture in the 550–750 mm rainfall zone,[63] although trees are most likely to be planted on the lower value upland sites rather than on the vertosol cropping soils. Tree planting on the lighter, duplex soils on ridges and slopes, to intercept lateral sub-surface flow, is a potentially effective option for managing the spread of salinity on the vertosol plains. Trials are underway to further assess the water balance impacts of tree planting.[61]

Species with the greatest potential for timber in the drier parts of the region include *E. camaldulensis*, *E. camaldulensis x grandis*, and *E. sideroxylon*, based on site suitability, establishment, growth rates, form, market recognition and availability of genetic material. Other potentially suitable species include *Casuarina cunninghamiana*, *Corymbia maculata/variegata*, *E. argophloia*, *E. fastigata*, *E. nobilis*, *E. viminalis*, and *E. saligna*. Ongoing species selection and product evaluation are needed to support the development of integrated forestry in the region, together with detailed information on management practices suited to lower rainfall environments. Potential growth rates and products for 25 tree species are currently being investigated for many end uses.

PHOTO: Ensis

Callitris glauca native forest in the drier south-west of the region.

The prospects for significant expansion of integrated forestry for timber in the region are relatively low although some market prospects exist for both firewood and honey. Rainfall limitations coupled with frosts and extreme temperatures (sometimes higher than 40ºC during summer and as low as -6.1ºC during winter), result in slow tree growth rates (mean annual increment of stem volume less than 6 m^3/ha/yr for the 500–750 mm rainfall zone) and uncompetitive financial outcomes for timber. A modelling study showed that under the best scenario the economic return (net present value) for farm forestry in the Liverpool Plains is less than half of the return from grazing and much less than cropping.[62] Low relative returns are compounded by the risk and uncertainty of operating in markets that lack transparency and accessibility. Existing forestry plantings on farms tend to be small-scale and located on the poorer red or shallow soils.

In summary

Targeted tree establishment offers the potential for effective recharge control in northern NSW. While species and product options are being investigated and some industry infrastructure exists in the east, achieving widespread plantings will necessitate moderate to high incentive payments to compete with more lucrative options and to offset real and perceived risks. Therefore, the current prospects for extensive uptake of integrated forestry are limited.

Central-west New South Wales

Background

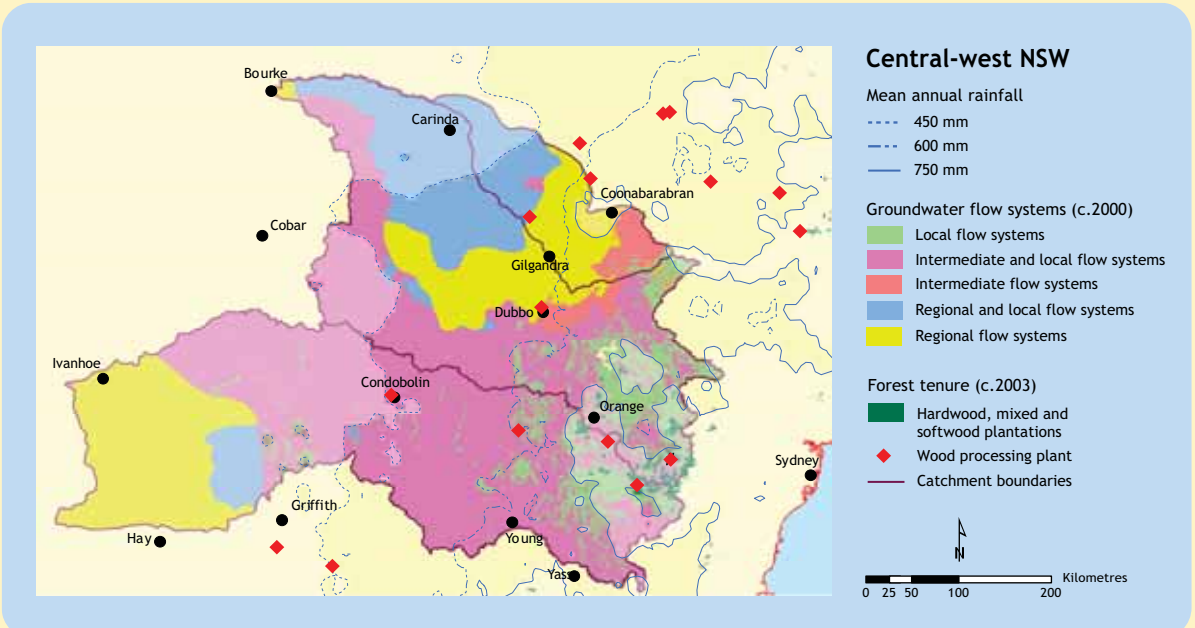
The central-west region (annual rainfall between 450 and 750 mm) is 86,010 km^2 [57] and comprises parts of the Castlereagh, Macquarie and Lachlan catchments[63] (see Figure 9). Rainfall increases from west to east. In the far north, rainfall tends to be summer dominant and evaporation is greater than rainfall throughout the year, while towards the south, rainfall varies from uniform to more winter dominant, with monthly average rainfall exceeding evaporation during June and July.

The landscape varies markedly from east to west. The uplands are undulating to hilly cleared lands, graduating to flatter areas, with some pockets of remnant vegetation. The plains are characterised by broad flat landscapes and the occasional rocky range outcrop. Wetlands and rich alluvial river flats feature to the west. Soil types are highly variable throughout the region, ranging from durable to fragile.

Agriculture is the dominant land-use, comprising 75% grazing and 19% cropping. Less than one third of farming households have a disposable income exceeding $50,000/yr and landholders managing properties generally average 48–55 years of age.[64] Other significant industries include viticulture, horticulture and mining for gold, copper and base metals.

Central-west NSW is among the areas of the state most at risk to salinity. Areas of high salinity hazard or risk form a wide belt from Dubbo in the north to Young in the south. The groundwater flow systems (GFS) in this region consists of 51% intermediate and local, 5% intermediate, 15% local, 10% regional and local, and 19% regional.[57] The region is characterised by high salinities in waterways including those supplying large urban centres.[65] The median salt load at Dubbo is about 75,000 t/yr while Forbes has a rising median salt load at 127,000 t/yr and river water is sometimes unsuitable for human consumption with salinity (electrical conductivity) of 800 µS/cm.[66]

FIGURE 9: Central-west NSW showing 450-750 mm rainfall zone, groundwater flow systems and existing plantation resource



Integrated forestry prospects for managing land and water salinisation

A small area of the region is forested, some of which is harvested for wood products. Forestry industries are largely based on softwood plantations in the highlands to the east and native hardwood (*Callitris* spp. mainly white cypress) stands on the lower rainfall plains. Radiata pine is grown for construction and paper products and cypress pine mainly for multi-purpose building timber and for domestic flooring. Cypress is harvested predominantly from government-controlled natural regrowth forests, about 348,000 ha of which are designated for community conservation.

Modelling work in the Macquarie catchment suggests a 10% increase in tree cover in the catchment's headwaters will reduce in-flows to Burrendong Dam by 17%, with a further 5% reduction by 2030 predicted from a 0.5°C temperature increase from global warming.[25] Modelling and economic analyses for the Boorowa (Lachlan) and Little River (Macquarie) subcatchments and for the region as a whole show that salinity and economic benefits can result from targeting tree planting on lighter textured, high recharging soils in local groundwater systems with high salinity.[67] Non-strategic planting could lead to reduced water yield, increased stream salinity and economic disadvantages. Better spatial and productivity data are required to better predict local and regional impacts of tree planting.

Prospects for establishing cypress on farms are low because of its slow growth rates (80-year rotation). Reasonable growth can be achieved for *Pinus radiata*, in areas of above 600 mm rainfall. Other species identified as having rapid establishment and growth, and end product use for a range of soil types and climates, based on many trials and demonstrations (>100 ha) across 10–15 years include: *A. mearnsii*, *A. stenophylla*, *E. camaldulensis*, *E. occidentalis*, *E. sideroxylon* and *E. viminalis*. Other prospective species include *E. melliodora* and *C. cunninghamiana*.[68] Considerable knowledge is available on species and provenance suitability to different soil conditions, including salinity. Local species identified as suitable for timber production in the southern part of the region are *E. albens*, *E. blakelyi*, *E. conica*, *E. melliodora*, *E. microcarpa*, *E. populnea* and *E. sideroxylon*.[69]

Greater knowledge about low rainfall management systems, together with access to improved seed, are prerequisites to developing industries based on these and other species. Integrated forestry expansion is further constrained by inadequate infrastructure to support forest industries, long distances to port and other facilities and slower growth rates as rainfall decreases. Markets are a limiting factor in securing investment in forestry enterprises and where markets are present for timber, both access and transparency are lacking. Risk and uncertainty for investors are further highlighted by the changing regulatory environment.

PHOTO: ©ITC Limited

Silvaculture practices underpin profitable intergration of forestry onto farmland

The Central West Catchment Management Authority (CWCMA) has a target of establishing and managing 2000 ha of forestry plantings, in addition to environmental plantings, for salinity control.[70] Prospects for uptake of integrated forestry at this scale for salinity management are limited without incentive payments to make it financially viable and to offset the cost of providing public benefits that tree planting can provide. The multiple benefits of integrated forestry for income (such as carbon sequestration payments or wood), the environment (for example, salinity management, biodiversity) and society (such as community prosperity) require better definition.

In summary

Tree planting is a potentially effective salinity management strategy in parts of central-west NSW, but can be a significant threat to water yield if not well targeted. Prospects for integrated forestry are greatest in areas of above 600 mm rainfall, but reducing risk and uncertainty is critical to industry development. Market development, infrastructure and incentive payments are prerequisites to extensive adoption. As with northern NSW, current prospects are limited.

Murray western slopes/ Murrumbidgee NSW and northern Victoria

Background

Murray western slopes/Murrumbidgee NSW and northern Victoria (450–750 mm rainfall zone) is a large region comprising parts of the Upper Murray, Ovens-Kiewa, Goulburn-Broken and Loddon-Campaspe catchments in Victoria, and the Murrumbidgee and Murray-Riverina catchments in NSW (see Figure 10).

Topography varies from about 150 m above sea level on the plains to the west and north-west, to greater than 400 m above sea level at the foothills of the Great Dividing Range in the central, east and north-east. Soil types are highly variable throughout the region, ranging from heavier clays on the plains to more acidic, duplex soils towards the east.

Much of the region is cleared for agriculture and urban settlements. Broadacre cropping and grazing represent the main land-uses and forestry is a small but significant use in the higher rainfall areas. While irrigated agriculture occupies a small part of the region, it is a major contributor to the regional economy. To the south, close to Melbourne, there is a significant increase in rural residential development with fewer people living on commercial agricultural properties and a growing population of urban and rural residential dwellers. Rural sub-division is increasing and sub-economic properties (<400 ha) are unable to expand as the value of the land exceeds that of agricultural production. An increasing proportion of land managers here earn significant off-farm income and the median age of landholders is steadily increasing.

FIGURE 10: Murray western slopes/Murrumbidgee NSW and northern Victoria showing 450-750 mm rainfall zone, groundwater flow systems and existing plantation resource

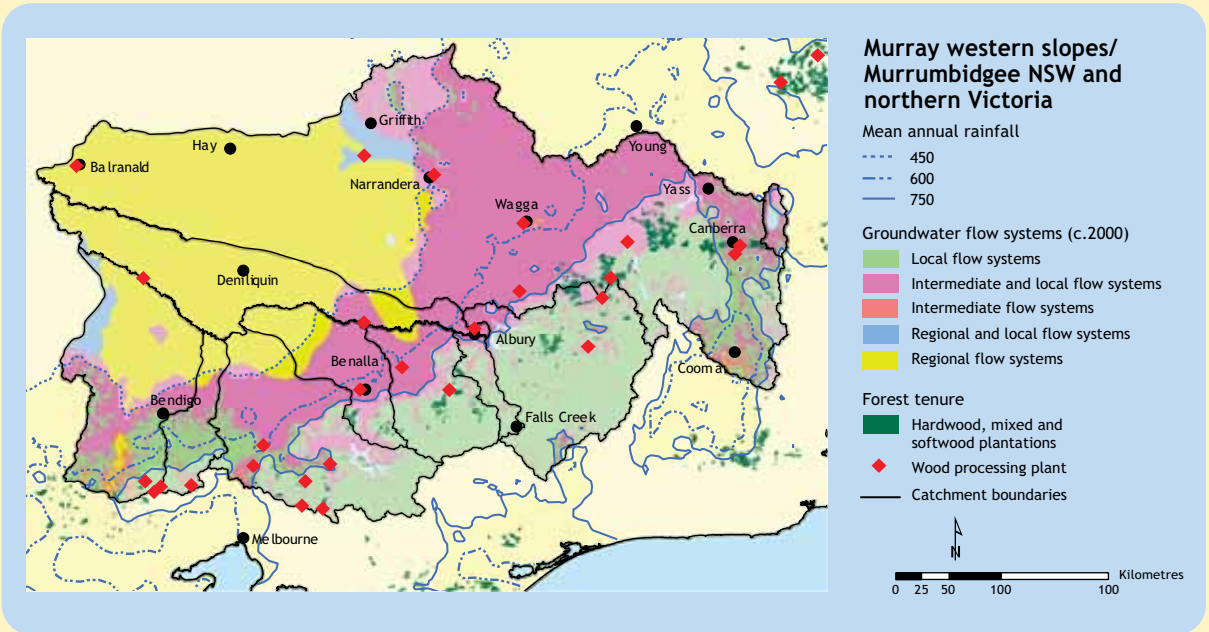


PHOTO: Forests NSW

Tumut has a large-scale Kraft pulpwood plant supporting local softwood forestry production

Land and water salinisation are extensive throughout the region in dryland, irrigated and wetland environments. A salinity audit of the Murray-Darling Basin identified the Loddon and Campaspe catchments as the most at risk in the region for future salt loads and salinities.[71] Most of the land salinisation is probably driven by groundwater discharge. However, there are significant areas where surface expression of salinity is more related to development of perched water tables than rising groundwater, with subsequent discharge of salts near the surface.[72]

Integrated forestry prospects for salinity management

About 10% of this region is forested, some of which is harvested for wood products.[4] Forestry is a significant industry in this region and the surrounding higher rainfall areas, especially in the catchments of the Murray-Riverina, Murrumbidgee and Goulburn-Broken. Softwood production is the main forest industry, with a smaller area of hardwood (eucalypt) production from native forests and woodlands, plantations and farmer plantings. The total area of plantation forestry is estimated at about 20,000 ha in the 600–800 mm rainfall zone.[4]

Integrated forestry is a potentially effective tool to reduce land and water salinisation in the region, as local and local-intermediate groundwater flow systems dominate (at 15% and 75% respectively). Modelling studies for some catchments in this region indicate the need to target specific areas in order to best generate significant stream salinity benefits without compromising stream water yield unduly.[73] Impacts on stream water yield from afforestation increase with rainfall above 600 mm.[74] Tree plantings are best directed to areas where near-surface flows or more saline groundwater can be intercepted before reaching streams.

Significant softwood forestry production takes place in neighbouring higher rainfall (> 750 mm) regions, especially near Tumut, Tumbarumba, Hume, Holbrook and Gundagai, and has potential to expand further into somewhat lower rainfall environments. This forest estate supports the full suite of value added industries — solid and reconstituted wood products and paper. Tumbarumba is home to the largest softwood sawmill in Australia and nearby Tumut has a large-scale Kraft pulpwood plant.

The gross value of the output of the plantation sector in this broader area was estimated at $574M during 2003/04.[75] Sawmills and wood processing facilities from small-scale family to capital-intensive value-added plants support industries based on native forest and hardwood plantation resources. Hardwood woodchips for export from sawmill residue and from maturing plantations are transported to Geelong. Small-scale eucalyptus oil, charcoal, firewood and apiary industries operate in the Riverina.

A few species have demonstrated economically viable mean annual increments (MAIs) of above 10 for the higher end of this rainfall zone including *P. radiata*, *E. cladocalyx*, *E. globulus*, *E. grandis* and *E. saligna*. For the 600–750 mm zone, *C. maculata* and *E. muelleriana* have prospects for posts, poles and sawlogs, while *P. brutia*, *P. radiata*, *Grevillea robusta*, *A. decurrens* and *A. mearnsii* have potential for sawlog, veneer and specialty logs.[76] For the 450–600 mm zone, *E. camaldulensis*, *E. cladocalyx*, *E. microcarpa*, *E. sideroxlyon*, and *Allocasuarina* spp. have prospects for posts, firewood and specialty timbers. A network of species evaluation trials was established during 2001/02 through the *Heartlands Initiative* and these are being monitored.[77] Clonal hybrids are also being evaluated and a number of other species and progenies are being trialled to determine the most appropriate species for timber and other uses.

Infrastructure to support forest industries is strong, although parts of the region are distant from facilities, especially ports. High haulage costs add to establishment, management and harvesting expenses and the long lag time to any return on investment. Regulatory impediments imposed by non-uniform codes governing forestry activities on farmland are a barrier to investment, together with access to and transparency of markets. The potential for increased turnover of farm properties could present an opportunity for entry by forestry-based industries in the region. However, the increasing amenity value of land poses a major barrier to industry expansion.[78] At present, substantial incentive payments are required for landholders and companies to agree to participate in forestry on farms for commercial and environmental benefit. Payments to landholders participating in large-scale projects (such as the *Heartlands Initiative*) and catchment management authority afforestation activities typically range from $400 to $1000/ha. Further development of carbon trading markets could assist plantation expansion by industry and landholders.

In summary

Targeted tree planting is a potentially effective strategy for salinity management in some parts of Murray western slopes/Murrumbidgee NSW and northern Victoria. Modelling studies have emphasised the importance of targeting in order for stream yield impacts not to outweigh salinity benefits. The greatest prospects for extensive integrated forestry are for agricultural land closest to neighbouring higher rainfall forest industries. Smaller-scale industries based on wood and non-wood products have market prospects, especially near Melbourne and regional centres, but competition for land and increasing prices are likely to fuel demand for significant incentive payments.

PHOTO: CSIRO Land and Water

Studies emphasise the importance of targeting tree planting to minimise stream yield impacts

Hunter New South Wales

Background

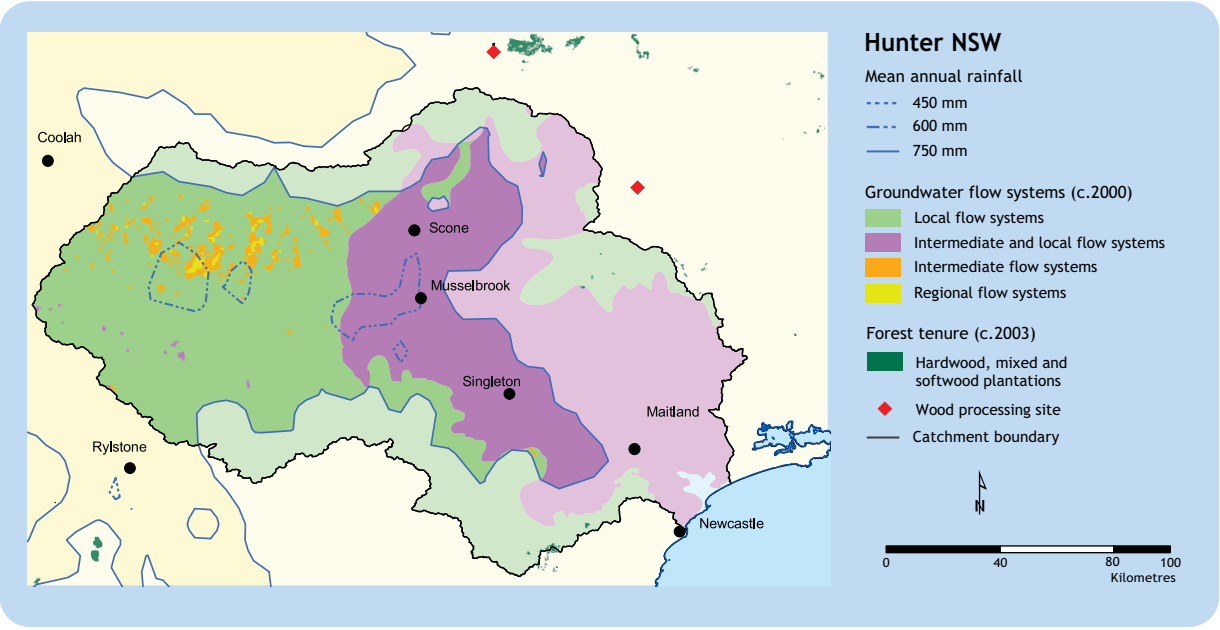
The Hunter catchment (600-750 mm rainfall zone) comprises about 10,000 km^2 to the west (refer Figure 11) of mainly undulating country, with annual rainfall increasing from west to east. The soils of the Hunter River floodplain to the east are mainly alluvial, podsolic and cracking clays. The Goulburn River corridor has lighter sands and earths, while the central-northern valley has variable podsolic-type soils derived from carboniferous rocks.

Mining is the most significant industry in the area. While the area of active mining is less than 5%, a larger area is subject to mining leasehold and exploration lease. Beef cattle production is the primary extensive land-use, with a much smaller area of cropping as part of mixed farming enterprises. Production of wine grapes and thoroughbred horse breeding is also significant in rainfall areas of above 700 mm and in irrigated parts of the valley floor.[79]

About 13,000 ha of mainly agricultural land in the upper catchment of the Hunter River is directly affected by dryland salinity, largely in local groundwater flow systems. About 65% of the region is influenced by local groundwater flow systems, with intermediate groundwater flow systems dominant in the higher rainfall eastern valley.

Some localised salinity is associated with urban, mining and industrial activities. Median in-stream salinity levels range from 200 µS/cm in the Hunter River (north) to 1400 µS/cm in the Goulburn River (west) with extreme salinities in some river tributaries, such as Saddler Creek (6600 µS/cm).[80] The key management focus has been to reduce high salt loads (about 80,000 t/yr from mainly diffuse sources) in the Hunter River, which supplies water for irrigation, towns, power generation and coal mining.[79]

FIGURE 11: Hunter NSW showing 450-750 mm rainfall zone, groundwater flow systems and existing plantation resource



Integrated forestry prospects for managing land and water salinity

Only about 200 ha of forestry plantations have been established in Hunter NSW, largely on mine and power station buffer land. One quarter of this area is research trials. In neighbouring landscapes of much higher rainfall (>1150 mm), about 3500–4000 ha of eucalypt plantations have been established within state forests by Forests NSW.[81] Most of these plantations will produce sawlogs in the long-term with thinnings used for pulp, small sawlogs and poles.

Tree planting is an effective groundwater recharge control option in the large tracts of Hunter NSW. The best prospects are for improved *C. maculata* for sawlogs, except in areas prone to excessive frost.[82] Other species such as *E. badgensis*, *E. longirostrata* and *E. moluccana*, hybrid eucalypts *E. camaldulensis x grandis*, *E. camaldulensis x globulus* and selections are being trialled. These species are productive, perform well in relatively harsh sites and are suitable for timber, pulp and co-firing end uses. There is some concern about genetic pollution of local *E. camaldulensis* stands, for which risk management strategies are being developed.

Early indications are that growth rates can be improved with genetically improved planting stock for short-rotation pulp logs or sawlogs. A clonal propagation system for hardwoods is being developed. Species selection has been examined, seed orchards of appropriate species have been established and best management practices are being developed. These resources will form support for expansion of tree planting in the region. Integrated forestry is generally perceived positively by the agricultural, mining and power sectors; but adoption is conservative due to low and unpredictable rainfall impacting on growth.[83]

Existing road and rail infrastructure and a nearby port facility could support further plantation development, but the rail system is predominantly used to transport coal. There are opportunities to establish plantations on mining sites and the significant buffer areas surrounding these operations. Mining leaseholders are currently required to rehabilitate mine sites to their prior land quality. This includes rehabilitation for biodiversity enhancement. Mining companies seeking to expand their activities are required to set aside 'green offsets' to compensate for the increased impact on the environment. These green offsets are currently fenced areas of land with little further management. Allowing plantation forestry as a valid offset for the mining sector and other industries, together with further development of a carbon-trading scheme, would assist in driving a viable plantation industry in the region. Small trials have also been undertaken to investigate the prospects of using saline mine water to irrigate plantations during the establishment phase to divert salt from entering streams. The region has an existing salinity credit trading scheme to regulate release of saline mine water to the Hunter River. Plantations have potential to play a role in this scheme.

PHOTO: Catriona Nicholls, Kondinin Group

Plantation forestry can be an option for buffer zones around mine sites

In summary

Prospects for integrated forestry to address salinity exist for the mining and power sectors, but are less promising for the agricultural sector due to high land prices and low profitability compared with alternative options, such as viticulture. The existing resource is small but expanding. Rehabilitation of mining land and surrounding buffer zones as productive plantations offers potential to develop a larger resource base. Given the extent of the buffer lands surrounding the mining and power industries, there is potential to match sites with recharge control priorities, but the extent of this match is unknown.

Influences

The prospects for integrated forestry in lower rainfall zones will be influenced to some extent by global forces, many of which are outside of the direct control of landholders, industries and Australian governments. This section briefly discusses the major influences.

Markets

International markets will be a principal driver of future demand for Australian wood and timber products. Trends in global markets drive production and competition and with it the flows and shortages of particular products. However, businesses need sound projections of future product demand and supply, especially in the case of too much product pushing market prices down. It is estimated the sale of illegal logs currently restrains prices by around 7–16%, but a reduction in illegal logging would positively impact on sales of Australian sourced logs.[84] Local markets may be less affected by these global trends, especially for niche products such as native cabinet timbers. Greater risks are faced by product grown principally for export markets, such as woodchips, or product such as ethanol or eucalyptus oil that can be readily substituted by imports.

Emerging markets for environmental services could play a major role in the expansion of integrated forestry in the lower rainfall zone, injecting substantial financial resources.

At the global level, carbon sequestration and biodiversity enhancement stand out as the most likely markets to emerge. Limited carbon credits trading is occurring in New South Wales (e.g. see page 15). Markets for salinity credits within Australia operate for discrete salt interception schemes, such as in the Murray-Darling Basin. However, credit markets for land-use change are some way off.

The development of any of these markets must be underpinned by efficient and effective trading mechanisms. On the other hand, markets for water trading, which are in place in some countries and emerging in Australia under the National Water Initiative, could be a disincentive for integrated forestry in some regions because of potential provisions for creating a market that would charge major new water interceptors, including plantation forestry, for the water used.

influences

PHOTO: ©ITC Limited

PHOTO: ©ITC Limited

Climate

Climate variability and change is a global phenomenon that presents new risks and challenges to the development of integrated forestry in lower rainfall environments. Survival and growth of trees could be affected, potentially diminishing investment prospects in the more marginal environments.

Selection, improvement and management of trees to cope with a broad range of environments is crucial, especially the ability of species to survive under conditions with prolonged dry periods. Issues such as tree spacing and configuration are important to consider when designing systems to cope with increased climate variability and change. It will be difficult to determine the specific impacts climate variability and change could have for any particular site, the uncertainty being greatest for long-rotation crops.

Policy

Australian governments operate within a global policy context, which shapes our policy processes and responses. This is a fluid process and governments can adjust slowly or rapidly to reflect changing community expectations. There are numerous policies that affect the prospects for integrated forestry in lower rainfall environments and they are not confined to the area of natural resource management. Examples include free trade agreements, the International Convention on Biodiversity, the Kyoto Protocol, the National Water Initiative, and the Asia Pacific Partnership on Clean Development and Climate which could present opportunities for international trading of carbon credits. Some policies apply uniformly across Australia, while others differ between states, sometimes creating a competitive advantage. Specific policies could also increase or decrease access to particular markets. While changing policy settings can present new opportunities that attract investment, too much uncertainty could be a significant deterrent, especially to longer-term investment prospects. No jurisdiction currently has a plantation policy that seeks to attract investment and address impediments across the full spectrum of plantation activities.[85]

Opportunities

A tension exists between taking on-ground action and undertaking further research and development. There is a role for both and the right balance needs to be struck. While on-ground action can give a sense of progress, this may be unfounded in terms of salinity and other impacts.[86] Research has shown how tree planting for dryland salinity management is a critical need, yet can result in unintended outcomes. There is time to proceed cautiously as salt mobilisation cannot be turned around quickly or easily. Impacts of changing climatic conditions on salinity progression also need to be considered. Effective decision-making informed by further research is called for.[87]

Integrated forestry needs to be developed within the context of a clear vision for the regional landscape and economy, guided by the setting of targets to protect local assets. A piecemeal or purely market-driven approach to industry development will not achieve the multiple objectives of the many stakeholder interests. This will necessitate both rapid and detailed modelling and evaluation approaches before tree planting at any significant scale, including predicting water-use of planned tree stands in eastern Australia. How reforestation might impact on stream salinity in discrete subcatchments requires some on-going investigation. Greater consideration should also be given to visual amenity to mitigate conflicts arising from extensive landscape change. Technical advice should carefully guide the transfer of research results from one subcatchment to another and from one scale to another.

Adequate and reliable data are necessary to inform and validate all modelling and assessments. Modelled outputs compared against real data will reduce risks. While there is a sound general understanding of the salinity problem, data are often lacking at the local and regional scale to inform responses. Minimum data collection requirements need to be identified and the data subsequently collected for the significant salt-source catchments. Reliance on past studies must also consider changes to management such as lower stocking, heavy thinning, and rotation lengths, along with climate variability and change scenarios.

A clearer idea is required of the timeframe to achieving salinity benefits (and detriments) from integrated forestry development, their nature and the scale at which they accrue. These factors will be important in determining the viability of any enterprise and any basis for public investment. Markets for environmental services warrant particular attention,[88] especially in overcoming financial impediments to adoption by landholders.[89]

Salinity is often only one of several NRM issues being dealt with and there are often opportunities to incorporate this with water, sediment, and other resource management issues.

Impediments to investment in integrated forestry by institutions (including superannuation funds) and in relatively small blocks of trees by managed investment companies need to be more clearly assessed and articulated, especially with respect to returns and risks. Investors need information on the area to be planted, the timeframe for planting, the environmental services sought and the price to be paid.

The case for investment by landholders needs to be better established, including products, growth rates, markets, tax incentives, co-investment options (annuities, leases, cooperatives), infrastructure and the like. Further work is required on how forestry fits into the farming systems context and on the relative economics of forestry and other agricultural enterprises.

Landholders need to be informed by further investigations about what species and provenances work well and where, particularly in the case of the low (<600 mm) rainfall zone. This needs to be supported by the information, equipment and re-skilling necessary to manage a farm forest for specific outcomes (including profitability, salinity, water-use, and carbon sequestration).

The development of genetically improved planting material needs to be accelerated, together with frameworks for risk assessment on genetic pollution. Best bet options with sound prospects and faster growing trees need further assessment, as well as the further development of infrastructure, including portable and farm-based machinery.

Future priorities

This Prospects Statement has shown that integrated forestry has a role to play in managing dryland salinity in targeted areas of the 450–750 mm rainfall zone of southern Australia.

Research indicates that tree planting needs to be carefully targeted to protect other community values, especially water yields in small upland catchments. Our knowledge of the big picture issues is advanced, but further investigations are needed to understand risks and more confidently recommend response options at the regional, subcatchment and property scales. This report has emphasised the importance of information (for example, the total area to plant in catchments, outcomes to be achieved, payment structure for environmental services) at the right scale in achieving desired outcomes.

We know where the major salt-source catchments are and assets to be protected, so we know where to focus our efforts. We also have adequate knowledge to justify putting in place measures to protect high water-yielding catchments from inappropriate tree planting.[86] The advancement of integrated forestry needs to be guided by a clearer vision for landscape change at the regional scale. Priority sites for tree planting for salinity outcomes need to be identified within the broader forest resource base of the region and water industry needs.

For the 600–750 mm rainfall zone, integrated forestry prospects are relatively better for two of the six regions examined — south-west Victoria and south-east SA, and south-west WA. Prospects for Murray western slopes Murrumbidgee NSW and northern Victoria are somewhat lower as the predicted reduction in stream flow outweighs salinity benefits from integrated forestry development in many areas. However, these regions already have significant forestry activity, especially in higher rainfall zones. The remaining regions — northern NSW, central-west NSW, Hunter NSW — lack significant forest industries and infrastructure, so forestry has a lower economic value and competes against more profitable agricultural options.

Capturing significant salinity and non-salinity benefits will depend upon substantial, well-targeted incentive payments to underpin integrated forestry development.

For the 450–600 mm rainfall zone, prospects are relatively low across all regions, but with greater capacity to address land and water salinity in the eastern states. These lower rainfall environments offer the greatest opportunity to capture on- and off-site salinity and non-salinity benefits, while having the least impact on water yield. The progressive development of forest industries in the neighbouring 600–750 mm rainfall zone should improve prospects in this environment with time.

Achieving landscape scale change to address salinity in the eastern states will necessitate a mix of large-scale and niche industries, accommodating the need to target tree planting precisely in salt-source catchments to protect water yield and quality. In WA, integrated forestry will take the form of larger-scale plantings, dictating large centralised processing facilities but in conjunction with other options, including engineering, to manage salinity. Currently, managed investment schemes and subsidised planting activities are driving large-scale tree planting. Better salinity impacts could be realised through more targeted tree planting locations.

Species list

The following table lists the common names for all species mentioned in this publication:

Species Name	Common Name
Acacia decurrens	Green wattle
A. implexa	Hickory wattle
A. mearnsii	Black wattle
A. stenophylla	River cooba
Allocasuarina spp.	She-oaks
Callitris spp.	Cypress pines
Casuarina cunninghamiana	River she-oak
Corymbia maculata	Spotted gum
C. maculata/variegata	Spotted gum hybrid
Eucalyptus albens	White box
E. argophloia	Queensland white gum
E. badgensis	Big badja gum
E. blakelyi	Blakely's red gum
E. camaldulensis	River red gum
E. camaldulensis x globulus	River red gum x blue gum hybrid
E. camaldulensis x grandis	River red gum x flooded gum hybrid
E. cladocalyx	Sugar gum
E. conica	Fuzzy gum
E. fastigata	Brown barrel
E. globulus	Tasmanian blue gum
E. grandis	Flooded gum
E. longirostrata	Grey gum
E. melliodora	Yellow box
E. microcarpa	Inland grey box
E. moluccana	Grey box
E. muelleriana	Yellow stringybark
E. nitens	Shining gum
E. nobilis	Australian manna gum
E. occidentalis	Swamp yate
E. populnea	Bimble box
E. saligna	Sydney blue gum
E. sideroxylon	Red ironbark
E. tricarpa	Red ironbark
E. viminalis	Manna gum
Grevillea robusta	Silky oak
Melaleuca uncinata	Broombush
Pinus brutia	Brutian pine
P. pinaster	Maritime pine
P. radiata	Radiata pine

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