Plantation and Farm Forestry in the Burnett Mary Region: Responding to Land Use Challenges
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Climate Change, Coasts and Catchments
Faculty of Science, Health and Education
University of the Sunshine Coast

Contact
Greg Laves
Telephone 07 5459 4679
glaves@usc.edu.au

Climate Change, Coasts and Catchments Team 2008-2009

Associate Professor Peter Waterman, Professor Richard Warwick, Dr. Peter Urich, Dr. Neil Tindale, Dr Shireen Fahey, Greg Laves, Ashton Berry, Gary Duffy, Graham Ashford, Diana Clarke, Theresa Ashford, Teresa Lewis, Sharlene Terry, Louise McDonell, Prue Pettett, Gemma Wright and Amanda Tunbridge

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1. Introduction

**Purpose**


This fourth Working Paper examines the potential impacts the forestry industry may have on the region’s social, economic, and environmental situation and makes recommendations regarding land use planning and environmental management practices for the expanding industry. Further, this paper also investigates the possible influences from global warming on species selection and the changing distribution patterns of farm forestry in the Burnett Mary Region.

The Burnett Mary region embodies some of the most productive land for timber production in the State in terms of soil and climate (BMRG, 2005a). The region currently encompasses the largest farm forestry industry in Queensland and contains 59% of the State’s timber plantations (Planning Plantations 2007). It also accounts for much of South East Queensland’s agroforestry and private native forest production. In contrast, there have been declines in rural population and significant restructuring in the agricultural sector as part of a national trend in response to changing markets, technologies and lifestyle choices (ABS 2003). These conditions have provided opportunities for the expansion of plantation forestry. As a result, concerns have been raised over the potential socio-economic and environmental impacts from the change in land use often associated with a thriving forestry industry. These issues are further complicated by continued urban population growth and increased climate variability and climate change.

Australia wide, growth in the national forest industry is projected to continue in the coming decades with a Commonwealth target of tripling plantation forests by 2020 (Plantation 2020). The Burnett Mary Region (see back cover) is also currently experiencing substantial growth in an already well established farm forestry industry. The 2005 BMRG Country To Coast – A Healthy Sustainable Future document indicates the potential for ‘expansion of Private Plantation and Farm Forestry extent in the region by 50% from 2004 levels by 2025, with an emphasis on native multi-species plantings providing environmental, economic and social returns’ (see RCT - LR4.2). To achieve this goal, expansion of farm forestry will need to compete for available land with traditional agricultural sectors.
2. Framing Farm Forestry

For the purposes of this Working Paper, Farm Forestry is used as an umbrella term that captures a number of concepts related to the planting and management of trees including Plantation Forestry, Agroforestry and Land Protection Plantations. It is important to note that the boundaries between these classifications of farm forestry are blurred and that any exact delineation would need to be determined on a case by case basis. The two characteristics recognised by Prosser (1995) that drive the distinctions between farm forestry sectors relate to the scale of the planting and the degree of emphasis on timber production. This relationship is illustrated in Figure 1.

A key purpose of this Working Paper is to address the need to understand the implications an expanding forestry industry may have for the built and natural environments in the Burnett Mary Region. While this paper will examine farm forestry at a range of scales, it needs to be recognised that in most cases, the scale of the plantation forestry industry and the land use change associated with it, is directly related to the scale of the potential impacts.

Figure 1: Defining Farm Forestry

Source: Prosser (1995)
3. Background: Queensland’s Changing Forestry Industry

Changing community attitudes and the realisation by stakeholders for the need to support a sustainable timber industry has seen a number of legislative, policy and economic decisions in the Queensland forestry sector over the last two decades. Responses to this need have seen the development of long term transitional policies leading to a shift from native forest harvesting to plantation based initiatives. This process began in 1988 with a ban on logging in wet tropic forests and was followed up in 1992 with a National Forest Policy Statement (Commonwealth of Australia 1992) which established a framework for conserving native forests by developing a competitive hardwood timber plantation and processing industry. By 1997 a system of identifying and conserving significant environmental forest assets was initiated through the Regional Forest Agreement (RFA) process. Forests suitable for timber hardwood harvesting were also identified and allocations for logging were determined, leading to the South East Queensland Forest Agreement (Environmental Protection Agency 2008) in 1999. The SEQFA is a long term strategy which aims to completely phase out logging in native Crown forests by 2025. Timber resources will instead be supplied from hardwood plantations, local agroforestry and private native forests.

Plantation Forestry

The distribution of plantations in Queensland is shown in Figure 2 and highlights the dominant role played by the Burnett Mary in the states forestry industry. Table 1 further illustrates the significant contribution the Burnett Mary’s plantation industry makes at the national, state and regional scales. Softwood plantations have an established history in the Burnett Mary Region and account for 83% of the regions plantation estate. This arm of the forestry industry is currently meeting market demand and consequentially, limited growth is taking place in this sector (see Figure 3). Hardwood plantations on the other hand are being established at a rapid rate in response to the world demand for hardwood products and decreasing supplies from native forests due to the RFA process.

Figure 2: MAP Distribution of Farm Forestry in QLD and Burnett Mary
The growing demand for hardwood timber has led to a national strategy which aims to triple the nation’s 1997 hardwood plantation forests by 2020 called *The Plantations 2020 Vision* (Plantations 2020). Additionally, Australia’s imminent emissions trading scheme will very likely provide further impetus for the growth in the nation’s forestry industry. To meet this demand, hardwood plantations are being established in farm land that traditionally supported agricultural crops and cattle grazing. The resulting rapid change in land use has raised concerns over the implications this may have on the socio-economic and environmental characteristics of the region. The results of studies examining these impacts in other parts of Australia are summarised elsewhere in this Working Paper.

**Figure 3: Distribution of Forestry Plantations by Wood**

While various aspects of farm forestry can be found throughout all areas of the Burnett Mary, the bulk of trees are grown in softwood plantations within the boundaries of the Gympie and Fraser Coast Regional Councils, particularly in the Cooloola, Maryborough and Tiaro areas (see *Figure 3*). Miriam Vale is the largest producer of hardwoods, which is mostly grown as a short rotation crop for the pulpwood market. Breakdowns of hardwood and softwood plantations as statistical areas in the Burnett Mary are shown in Table 2.
While softwood forests make up the bulk of plantation farm forestry, the growth sector for the industry is in addressing the increasing demand for hardwood products. **Figure 4** illustrates the rate at which new plantations are being established and highlights their potential as a driver of landuse change in the region. The area required for new plantings may decrease in the near future as short rotation crops established for pulp hardwood during the 1990’s are harvested. This land would then become available for replanting. However, any equilibrium achieved in this sector may not be representative in long rotation sectors such as saw log production and carbon offsets.

**Table 2: Plantation Forestry in the Burnett Mary Region 2007**

<table>
<thead>
<tr>
<th>Statistical Area</th>
<th>Area (ha)</th>
<th>Hardwood (ha)</th>
<th>Softwood (ha)</th>
<th>Total (ha)</th>
<th>Hardwood %</th>
<th>Softwood %</th>
<th>Plantations as % area</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biggenden</td>
<td>131 326</td>
<td>0</td>
<td>144</td>
<td>144</td>
<td>0</td>
<td>100</td>
<td>0.1</td>
</tr>
<tr>
<td>Bundaberg</td>
<td>9 528</td>
<td>403</td>
<td>0</td>
<td>403</td>
<td>100</td>
<td>0</td>
<td>4.2</td>
</tr>
<tr>
<td>Burnett</td>
<td>200 016</td>
<td>580</td>
<td>3474</td>
<td>4054</td>
<td>14</td>
<td>86</td>
<td>2.0</td>
</tr>
<tr>
<td>Cooroy</td>
<td>296 173</td>
<td>1552</td>
<td>33413</td>
<td>34965</td>
<td>4</td>
<td>96</td>
<td>11.8</td>
</tr>
<tr>
<td>Eidsvold</td>
<td>479 957</td>
<td>205</td>
<td>0</td>
<td>205</td>
<td>100</td>
<td>0</td>
<td>0.0</td>
</tr>
<tr>
<td>Gayndah</td>
<td>270 371</td>
<td>300</td>
<td>0</td>
<td>300</td>
<td>100</td>
<td>0</td>
<td>0.1</td>
</tr>
<tr>
<td>Hervey Bay</td>
<td>235 164</td>
<td>1</td>
<td>7903</td>
<td>7904</td>
<td>0</td>
<td>100</td>
<td>3.4</td>
</tr>
<tr>
<td>Isis</td>
<td>169 712</td>
<td>89</td>
<td>899</td>
<td>988</td>
<td>9</td>
<td>91</td>
<td>0.6</td>
</tr>
<tr>
<td>Kilkivan</td>
<td>325 825</td>
<td>628</td>
<td>6011</td>
<td>6639</td>
<td>9</td>
<td>91</td>
<td>2.0</td>
</tr>
<tr>
<td>Kingaroy</td>
<td>241 772</td>
<td>1603</td>
<td>30</td>
<td>1633</td>
<td>98</td>
<td>2</td>
<td>0.7</td>
</tr>
<tr>
<td>Kolan</td>
<td>264 482</td>
<td>728</td>
<td>2508</td>
<td>3236</td>
<td>22</td>
<td>78</td>
<td>1.2</td>
</tr>
<tr>
<td>Maryborough</td>
<td>123 168</td>
<td>0</td>
<td>13831</td>
<td>13831</td>
<td>0</td>
<td>100</td>
<td>11.2</td>
</tr>
<tr>
<td>Miriam Vale</td>
<td>376 993</td>
<td>13869</td>
<td>563</td>
<td>14432</td>
<td>96</td>
<td>4</td>
<td>3.8</td>
</tr>
<tr>
<td>Monto</td>
<td>431 267</td>
<td>35</td>
<td>1374</td>
<td>1409</td>
<td>2</td>
<td>98</td>
<td>0.3</td>
</tr>
<tr>
<td>Mundubbera</td>
<td>418 492</td>
<td>220</td>
<td>14</td>
<td>234</td>
<td>94</td>
<td>6</td>
<td>0.1</td>
</tr>
<tr>
<td>Murgon</td>
<td>66 352</td>
<td>154</td>
<td>0</td>
<td>154</td>
<td>100</td>
<td>0</td>
<td>0.2</td>
</tr>
<tr>
<td>Nanango</td>
<td>173 154</td>
<td>316</td>
<td>4830</td>
<td>5146</td>
<td>6</td>
<td>94</td>
<td>3.0</td>
</tr>
<tr>
<td>Perry</td>
<td>35 900</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0.0</td>
</tr>
<tr>
<td>Tiaro</td>
<td>218 282</td>
<td>489</td>
<td>36413</td>
<td>36902</td>
<td>1</td>
<td>99</td>
<td>16.9</td>
</tr>
<tr>
<td>Wondai</td>
<td>356 998</td>
<td>1369</td>
<td>4</td>
<td>1373</td>
<td>100</td>
<td>0</td>
<td>0.4</td>
</tr>
<tr>
<td>Woocoo</td>
<td>200 186</td>
<td>10</td>
<td>2846</td>
<td>2856</td>
<td>0</td>
<td>100</td>
<td>1.4</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>5 025 118</strong></td>
<td><strong>22,551</strong></td>
<td><strong>114,257</strong></td>
<td><strong>136,808</strong></td>
<td><strong>16.5</strong></td>
<td><strong>83.5</strong></td>
<td><strong>2.7</strong></td>
</tr>
</tbody>
</table>

*Source: Planning Plantations 2007*
Table 3: South East Queensland Softwood Plantations 2005 (Hectares)

<table>
<thead>
<tr>
<th>Southern Pines</th>
<th>Hoop Pine</th>
<th>Other Softwoods</th>
<th>Total Softwoods</th>
</tr>
</thead>
<tbody>
<tr>
<td>111,771</td>
<td>43,356</td>
<td>1,894</td>
<td>161,052</td>
</tr>
</tbody>
</table>

Table 4: South East Queensland Hardwood Plantations 2005 (Hectares)

<table>
<thead>
<tr>
<th>Blackbutt and flooded gum</th>
<th>Spotted gums</th>
<th>Dunn's white gum</th>
<th>Other eucalypts</th>
<th>Other hardwoods</th>
<th>Total hardwoods</th>
</tr>
</thead>
<tbody>
<tr>
<td>7,980</td>
<td>4,159</td>
<td>11,977</td>
<td>4,839</td>
<td>2,719</td>
<td>31,675</td>
</tr>
</tbody>
</table>

Source: Australia’s Plantations 2006 National Report

The predominant plantings of softwood species are shown in Table 3 and clearly illustrate the industries preference for Southern Pines, which comprise 70% of softwood plantations and 58% of all plantation production. For hardwoods, Table 4 illustrates that Dunn’s white gum and Blackbutt make up over half the hardwood estate and represent the bulk of new plantations being established in South East Queensland. However the potential for large scale production of Blackbutt in the Burnett Mary is still in the trial phase. Due to the long term nature of some forestry investments, careful consideration needs to be given to the selection of species being planted today. Tree species that are currently viable and profitable under current climate conditions may not necessarily remain so in the latter half of the 21st century. In particular, the potential impact on the distribution of Blackbutt, *E. pilularis*, from a dryer climate is examined in Section 9.

**Agroforestry**

While Queensland contains only 3% of the national agroforestry industry, it stands out as the state that is most rapidly developing this resource base. South East Queensland accounts for over 70% of the agroforestry carried out in the state and it has been estimated by the Rural Industries Research and Development Corporation (RIRDC) to include 3, 384 ha of hardwood and softwood species (URS Forestry, 2008). Of these, 2 178 ha (64%) were established in 123 joint venture projects between the Queensland Government and private landholders.

Government initiatives to provide assistance and security to the fledgling agroforestry industry have been successful. Funding commitments for the development of joint agroforestry ventures as illustrated in Figure 5. Other means of stimulation have attracted third party investment, mostly from managed investment schemes.
Private Native Forests

Private native forests (PNF) contribute significantly to the timber industry in South East Queensland. An appraisal undertaken as part of the comprehensive regional assessment (CRA 2003) identified 1.2 million hectares of PNF under periodic harvest, providing around half the total native hardwood product of the region (DPI&F 2004). As the management of PNF resources is a decision for individual landholders, future supply from this source is difficult to evaluate. However, accurate quantification of this resource is important and more up to date estimates need to be made.

4. Socio Economic Impacts

The rapid expansion of plantation forestry in some areas has raised concerns over the negative impacts the industry may impose on regional economies, population, infrastructure, land values and community services. Research conducted in the Great Southern region WA (Schirmer et al 2005a) and the South West Slopes NSW (Schirmer et al 2005b) which were experiencing rapid landuse change due to the establishment of large scale plantations, has shown that the forestry industry has the ability to influence these issues. Whether these influences are costly or beneficial, and to what degree of influence the industry may exert, have been found to vary depending on a number of factors. These include:
• The phase of development the industry is passing through. The phases include the establishment, transition and mature periods of crop development and harvest;

• The scale and rapidity of land use change as a percentage of the total area within a region;

• The level at which economic benefits or costs are assessed – local, regional, state or national; and

• The health and diversity of the local and regional economy.

While a study by Tonts, Campbell and Black (2001) supports the beneficial aspects of farm forestry at a broad regional level, they point out that these regional advantages favour larger centres and often mask the significant restructuring of economies at the local level, especially those towns with a narrow economic base. They also found that in some areas, plantation forestry was accelerating the broader process of economic and social restructuring in the Australian agriculture sector, making it difficult for some businesses and residents in small towns to adjust.

Table 5,6,7 and 8 summarise the key findings of Bureau of Rural Sciences report on the socio-economic impacts of plantation forestry (Schirmer et. al. 2005a and 2005b). These findings are broken down into sectors: land and property markets; population change; expenditure and value of output; and employment. As in all economic drivers, plantation forestry creates a complex set of socio-economic impacts. Case studies undertaken and noted in Tables 5-8 generally indicate positive economic spin offs.

Table 5: Summary of Key Findings: Land and Property Markets

<table>
<thead>
<tr>
<th>Phase</th>
<th>Comments from the Bureau of Rural Sciences report on The Socio-economic Impacts of Plantation Forestry</th>
</tr>
</thead>
<tbody>
<tr>
<td>Establishment</td>
<td>Demand for land from the plantation sector can lead to higher than average growth in the value of land suited to plantation establishment. Eg Great Southern region WA. While purchase of land has the most direct impact on land markets, leasing may affect markets by reducing the area of land made available for sale.</td>
</tr>
<tr>
<td>Transition and Mature</td>
<td>Any period of rapid expansion of the plantation estate is likely to lead to the changes in the rural land market described above. During these phases, growing employment in harvesting, haulage and processing of plantation timber may also influence residential housing markets in plantation regions. During establishment of processing facilities, the influx of labour needed for construction can place strain on rental markets. The higher volume of employment associated with expansion of the plantation industry can also result in increased demand for housing in towns with processing facilities.</td>
</tr>
</tbody>
</table>
Table 6: Summary of Key Findings: Population Change

<table>
<thead>
<tr>
<th>Phase</th>
<th>Comments from the Bureau of Rural Sciences report on The Socio-economic Impacts of Plantation Forestry</th>
</tr>
</thead>
</table>
| Establishment | Plantations are usually established on cleared agricultural land sold or leased by landowners. The decision to sell has the same implications regardless of who buys it.  
This results in:  
- a decline in the rural population (if no new residents live on the property),  
- social change (as new residents move into the region)  
Eg Great Southern region WA  
From 1996 to 2001, areas undergoing rapid plantation expansion experienced an increase in rural population or a slower rate of decline than areas no plantations. Establishment of intensive agricultural enterprises, primarily vineyards, increased rural population, increasing numbers of 'lifestyle' rural residents and the rental of houses on plantation properties. This suggests that where plantation expansion occurs as part of a mix of land use changes, it does not lead to rural population decline. |
| Transition | Plantation processing facilities increase employment opportunities.  
This can lead to an increase in the population of towns with the facilities.  
There is also a temporary influx of population during construction of the facilities. |
| Mature | the level of employment generated, particularly by the harvesting, transport and processing sectors, can lead to a noticeable positive impact on populations  
Eg South West Slopes NSW  
The towns of Tumut, Adelong and Tumbarumba with the presence of a strong plantation timber processing sector either experienced population growth or had stable population levels from 1996 to 2001, while populations of similarly sized towns in nearby areas often declined. |
| Related Issues | Socio-demographic Trends  
In both case studies The economic diversity of an area was the key factor associated with socio-demographic change in the population.  
Regions with a more diverse economic base tended to experience higher growth in working age population (25 to 64 year olds) and more stable household income.  
These diverse economies included most plantation areas.  
In contrast, regions highly dependent on broadacre agriculture tended to experience higher growth in retirement age population (65 and over) and greater fluctuations in household income.  
Provision of Services  
As a result of factors including declining rural population and cost efficiency measures, many rural areas have lost services such as banks, schools and health services.  
The study found that population changes were generally a good predictor of similar directional changes in service provision.  
It was also found that short-term residents had little involvement in key types of services such as community groups.  
Changes in the plantation sector were not generally associated with changes in the level of service provision. |

Table 7: Summary of Key Findings: Expenditure and Value of Output

<table>
<thead>
<tr>
<th>Phase</th>
<th>Comments from the Bureau of Rural Sciences report on The Socio-economic Impacts of Plantation Forestry</th>
</tr>
</thead>
</table>
| Establishment | Measured by the level of expenditure on establishing a plantation  
Eg Great Southern region WA  
Reached the end of the establishment phase in 2002  
Plantation sector expenditure totalled $35.8 million (including chipping mill)  
69% was spent within the region. |
| Transition | Expenditure increases as harvesting and processing take place  
Eg Great Southern region WA  
2003-2004, expenditure totalled $49.7 million  
An increase of 40% compared to the pre-harvesting 2001–02 period |
| Mature | Measured by the value of output (similar area is harvested and replanted annually)  
Eg South West Slopes NSW  
Value of output rose from $401.4 million in 1993–94 to $574.5 million in 2002–03 |
| Flow-on impacts | The proportion of flow-on impacts generated by direct expenditure from the plantation sector is relatively similar at all stages of plantation development.  
Eg Great Southern region WA and South West Slopes NSW 2001-02  
Great Southern  
A total of $1.76 output was generated for every dollar spent by the plantation industry  
South West Slopes  
between $1.63 and $1.83 of economic output was generated for every dollar spent |
Dependant Industries

The Burnett Mary Region contains some of the largest mills in Queensland and process 58% of the states timber (DPI 2004). These provide employment for approximately 30% of the states 3,120 persons employed in the sawmilling industry. The overall contribution of the sawmilling industry to employment and economic value for South East Queensland is summed up in Table 9.

Table 9: 2006 Socio Economic Contributions by Sawmilling Industry to South East Queensland

<table>
<thead>
<tr>
<th>Employment</th>
<th>Economic value</th>
</tr>
</thead>
<tbody>
<tr>
<td>3452</td>
<td>$571 million</td>
</tr>
</tbody>
</table>

Source: Australia’s Plantations 2006 National Report

As indicated in Table 9, the flow on impacts of plantation forestry are significant and generally equate to $1.76 to every dollar spent by the industry. Economic diversification which looks towards manufacturing and production of wood based product in addition to processing of raw timber will further stimulate the local economy.
5. Transport and Forestry

Roads
Road transport network plays a critical role in the movement of goods in and out of forestry plantations. In total 86.6% of domestic freight hauled for the industry is by road, with rail and coastal shipping accounting for 12% and 1.4% respectively. However, the forestry industry only accounts for about 0.05% of all registered vehicles on the road in Australia, and about 1.7% of all freight trucks (Plantations 2006).

Though minor on the national and state scale, at the local level the volume of heavy vehicles and the costs associated maintaining and upgrading road networks, has raised community concerns. With a trebling of hardwood plantation product anticipated by 2020, a similar growth in haulage would be expected in the regions where this takes place, including the Burnett Mary. In light of this, studies undertaken in 1999 and 2003 respectively, by Greenfield Resource Options (GRO) and the South East Queensland Comprehensive Regional Assessment have indicated that the Burnett Mary has a well developed road network capable of supporting an expanding forestry industry without major upgrades. However, both reports point out that the general growing trend by freight providers to employ ‘B-double’ trucks may require future upgrades to the Bruce Highway. Additional localised improvements may also be required as farm forestry develops in new areas. GRO (1999) recommends that collaboration between industry and relevant local, State and Commonwealth agencies be undertaken to identify and reduce potential impacts from haulage as part of the planning process.

Rail
The region is traversed by a north-south coastal rail system, with lateral lines servicing Maryborough, Murgon, Kingaroy, Mundubbera, Monto and the major forestry areas of Gympie and Imbil. Additionally, networks of sidings that once supported the agricultural industry may also be available, but many of these have become disused in recent decades and fallen into disrepair. None-the-less the rail network has the potential to provide an efficient alternate to road haulage for the transport of both plantation and processed products. Should demand be sufficient, there is the potential for disused lines to be upgraded or new lines built, as was the case for the Canterwood woodchip mill railway line near Maryborough (GRO 1999).

Port Facilities
The Port of Gladstone is a major Queensland port. Woodchips are currently exported from the No. 1 loading facility at Auckland Point Wharf, which is capable of loading ships up to 65 000 DWT at a rate of 600 – 800 tonnes/hour. However, the CRA/RFA steering committee (1999) points out that the ability of this facility to cope with a rapidly expanding woodchip export industry is limited by the lack of stockpiling capacity. This bottle neck could prove to be a significant impediment without the costly expansion of the current infrastructure (Spencer et al. 1999). A less expensive alternative may be through the conversion of coal loading facilities at nearby Barney Point to produce a dedicated woodchip loading facility (GRO 1999).
Logging Roads and the Environment

Haul roads and secondary logging roads can have significant environmental impacts dependent on the terrain, soil type, and natural cover and wildlife habitat. The prime issues are the increased erosion and sediment pollution that is created by building and using these roads. These recommendations by Constantini et al. 1999 were developed to be undertaken as part of normal forest plantation management to reduce environmental damage from erosion.

Best Practice Guidelines - Logging Roads

- Road systems located nearer than 40 metres from a watercourse require filter strips.
- Roads approaching watercourse crossings should be short, and those roads that approach watercourses through cuttings, should be drained into vegetative filter strips.
- For hillslope infiltration to be effective, it is essential that turnout drains discharge to areas which are stable, have high infiltration capacities, and maximise the spread of flow.
- Road systems should be constructed prior to any forest operations that may destabilise hillslopes, such as compaction during harvesting and cultivation during site preparation.
- Areas containing unstable hillslopes should be avoided, including hillslopes where potential for landslips may be exacerbated by increased soil moisture.
- Turnout drains should be designed so that, they discharge over a wide area of hillslope rather than discharge at a point.

Source: Constantini et. al 1999

6. Hydrological Impacts from Farm Forestry

The National Water Initiative NWI (2004) signed by all jurisdictions, recognised large scale plantation forestry as an activity of concern in regards to interception of water which ‘presents a risk to the future integrity of water access entitlements and the achievement of environmental objectives for water systems’ (NWI 2004). The degree of impact depends upon a variety of issues including the nature of the catchment, the scale of plantation forestry in the catchment and the management practices employed in the farming process. The planned expansion of the plantation industry in the Burnett Mary has drawn attention to the potentially undesirable effects that mass tree planting may have on the hydrological dynamics of catchments.

There is a delicate balance between water quality and quantity issues and farm forestry. Water quality issues resulting from chemical use in the forest industry are generally low, being recognised as having less pollution output than most other agricultural enterprises (see Section 8). Chemical regimes involving fertilisers and pesticides are mostly applied in the early stages of tree growth or as a response to an outbreak of blight or borers. The most significant impact to water quality is large scale clear felling which has been shown to impact on stream flow and water quality from sediment pollution (Bubb and Croton 2002, Costantini et al 1997).

A 2004 technical report produced for the Burnett Mary Regional group indicates that the ‘predominant forestry practice’ (BMRG 2004) of low intensity or selective harvesting practiced over most of both catchments (Burnett and Mary) is unlikely to cause significant disturbance to either terrestrial or aquatic ecology with basic
environmental protection guidelines in place. While this may be the current situation, this outcome may change in the future with the planned expansion of plantation forestry in the region, particularly if concentrated in catchments. Impacts from logging can be minimised however, if plantation managers work cooperatively to distribute harvesting activities. Issues relating to management best practice are discussed in the full report to follow.

Historically, deforestation to clear land for farming also removed the impediments to runoff that trees impose through evapotranspirational processes. As a result, clearing produced stream flows beyond what would occur naturally. While benefitting farmers on one hand, it also created costs in the form of stream and gully erosion and salinity due to rising water tables. Most significantly, as the current trend towards reforestation continues, forests are again reducing local stream flows and groundwater recharge. This in turn impacts on downstream farming and environmental needs.

The full effects of forests on hydrological processes depend upon a number of issues including:

- Biophysical characteristics of the catchment including landform and soil;
- Location, distribution and proportion of plantations within the catchment;
- Annual and seasonal distribution of rainfall; and
- Forestry management practices.

It has been found that streamflow in catchments dominated by forests, is lower than streams in an equivalent catchment supporting only grass or annual crops. This difference is mainly due to the manner and amount of water consumed by different species (transpiration) and the amount of rainfall captured by the surface of leaves which subsequently evaporates (interception) (Zang et al 2003). Pastoral grasses, cereal crops and forests all intercept water to varying degrees. Trees, however, tend to have broader leaves, maintain foliage all year and experience greater energy exchange with the atmosphere compared to plants that grow closer to the ground, resulting in substantial losses in runoff when compared to grass and most crops (Vertessy et al 2003).

Interception, combined with trees high water requirements (and the ability to service that demand), create significant losses through evapotranspiration compared to those produced by grasses and seasonal crops. As a result, catchments which have had traditional farmlands replanted with forests may experience reduced runoff, lower water table levels and diminished groundwater recharge. Streamflow patterns are also likely to be affected, with lower flood peaks and an increase in low or zero flow days.

**Best Practice Guidelines - Planting**

* Limiting new plantations to 20% in any given catchment;
* Dispersing new plantations across the landscape;
* Establishing new plantations in catchments with lower rainfall (<800 mm/year) where impacts on runoff and streamflow are smaller;
* Phasing planting to stagger the impacts of growth cycles; and
* Thinning plantations to maintain them at lower stocking densities

*Source: Parsons et al (2007)*
7. Biodiversity Impacts

Biodiversity refers to the variety of all living organisms, their genes and the ecosystems in which they exist. Australia is the home to over one million species of plants and animals making it one of the most diverse countries on the planet (DEWHA, 2008). Biodiversity is recognised as an essential and valuable commodity for the vital role it plays in providing ecosystem services to the community and the agriculture sector. Ecosystem services include providing clean air and water, building of fertile soils, nutrient cycling, reducing risks from erosion and salinity, insect control, and carbon sequestration.

The Burnett Mary region contributes significantly to biodiversity, taking in the northern most extreme of the South East Queensland bioregion and the southern most extreme of the Brigalow Belt South bioregion. The area contains a number of biodiversity hotspots that may potentially be impacted by farm forestry. These include the Cooloola coast, Conondale and Blackall ranges, Bunya Mountains, Baffle basin and many of the aquatic ecosystems that contain rare and endangered species (BMRG 2006).

Best Practice Guidelines - Biodiversity

In order to clearly understand the impacts of a growing farm forestry sector on biodiversity values in the Burnett Mary region more research will need to be done to quantify, identify and map regional biodiversity values so strategic conservation activities can occur and mitigation measures used to decrease ecosystem damage. This research must also be informed by the climate change projections contained in this suite of documents as habitat areas may shift and change. See Overview: Climate Variability and Climate Change – Scenarios and Projections.

8. Chemical Fertilisers and Pesticides

Pesticides are used in agriculture to control the unwanted impacts from biological pests such as insects and plants. Weeds and other unwanted plants compete directly with trees for moisture and nutrients, while insects and browsing animals can defoliate whole trees. Pest control is an essential management tool which produces higher survival rates and greater productive growth in those that survive.

The use of chemicals in forestry enhances production and profitability; however their use can have harmful impacts on the environment. Pesticide use in the plantation forestry sector for 2003 – 04 is estimated to have cost between $16.2 - $20.9 million dollars, which accounts for 0.7% of the $2.4 billion spent on commercial and domestic pesticides throughout Australia in that year (Jenkins and Tomkins 2006). The use of pesticides in the plantation industry is almost exclusively herbicidal (99%), with the other 1% being for used to control insect pests.
The industry promotes itself as a responsible user of chemical herbicides and pesticides, with low usage rates compared to other forms of agriculture, which have annual rotations and require several treatments a season. Forestry crop rotations vary from 10 to 30 years and herbicides are generally used only during the first two years after planting. Generally, herbicides are broadcast on cleared land prior to planting as part of the preparation process. After planting, strip spray treatments are applied which limits distribution of pesticides to 50% of the planted surface. Follow up treatments may be conducted over the next two years but may be less necessary for sites that were initially well treated. Insecticides are generally only used in response to insect outbreaks and are often aerial sprayed.

**Best Practice Guideline: Spray Drift**

Australia wide, aerial spraying is currently applied to over 10 million hectares of agriculture, with plantation forestry making up about 0.35% of the total area sprayed. It is mostly used for the broad distribution of initial herbicides on cleared land and for the rapid and efficient treatment of insect outbreaks in forest canopies.

Use of Helicopters and directionally spraying can dramatically reduce spray drift.

*Source: Jenkin, B. M. and Tomkins, B. 2006*

**9. Climatic Variability and Climate Change**

The Australian Department of Climate Change has identified a number of impacts on the forestry industry due to global warming and are shown in Table 10. Changes in climatic conditions will have implications for the distribution of farm forestry in general and for individual species in particular. Shifting rainfall patterns and temperature ranges may see a change in conditions that may be advantageous to some regions or species and detrimental to others. Changes in pest and pathogenic organisms as well as increases in the number and intensity bush fires, droughts and storms may result in increased damage to forests in terms of biodiversity and commercial productivity. Elevated CO2 on the other hand may provide some benefits through stimulating growth and improving water efficiency.

The Overview: Climate Variability and Climate Change: Scenarios and Projects report for this research suite discusses in depth the range of potential climatic outcomes that are projected for the Burnett Mary Region. Of particular interest to the farm forestry sector is mean annual precipitation.
### Table 10: Potential Forest Impacts due to Climate Change

#### Potential Forest Impacts

<table>
<thead>
<tr>
<th>Elevated carbon dioxide</th>
<th>Potential Forest Impacts</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• Increased forest productivity (subject to water and nutrient availability)</td>
</tr>
<tr>
<td></td>
<td>• Reduction in the nutritional quality of forest foliage</td>
</tr>
<tr>
<td></td>
<td>• Increased water use efficiency</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Altered rainfall patterns</th>
<th>Potential Forest Impacts</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• Changes in tree species distribution</td>
</tr>
<tr>
<td></td>
<td>• Decreased forest productivity in regions where rainfall decreases</td>
</tr>
<tr>
<td></td>
<td>• Increased storm frequency and intensity leading to increases in forest damage</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Increases in temperature</th>
<th>Potential Forest Impacts</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• Changes in tree species distribution</td>
</tr>
<tr>
<td></td>
<td>• Changes in forest biodiversity</td>
</tr>
<tr>
<td></td>
<td>• Increased forest productivity subject to moisture and nutrient availability</td>
</tr>
<tr>
<td></td>
<td>• Decreased forest productivity due to increased evaporation leading to reduced water availability</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Increases in frequency and intensity of bushfires</th>
<th>Potential Forest Impacts</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• Increased forest damage</td>
</tr>
<tr>
<td></td>
<td>• Decline in forest biodiversity</td>
</tr>
<tr>
<td></td>
<td>• Increased greenhouse gas emissions from forests</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Changes to pests and pathogens</th>
<th>Potential Forest Impacts</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• Increased forest damage</td>
</tr>
<tr>
<td></td>
<td>• Decline in forest biodiversity</td>
</tr>
<tr>
<td></td>
<td>• Reduction in forest productivity</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Increased drought</th>
<th>Potential Forest Impacts</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• Reduced forest productivity</td>
</tr>
</tbody>
</table>

Source: Australian Department of Climate Change. 2008

For this Working Paper, the impact of changes in rainfall was mapped for various species of commercial hardwood using a worst case scenario (Hadley GCM, A1F1 emission scenario and high sensitivity). A **worst case scenario** was chosen to identify areas which may have **minimal risk** of declining productivity in the face of an uncertain climatic future. Unlike the production of seasonal crops and grazing, which can be trans-located in response to changing conditions, plantation timber represents a long term, high cost investment which lacks the ability to react quickly to changing conditions. Consequentially, a thorough understanding of the impacts that future global warming may have on the plantations being established today is an essential component for any risk management strategies being developed. A sound knowledge of the implications and appropriate adaptive measures will also help establish the integrity of the emerging carbon based forestry industry.
Climate Change and Planning

The importance of incorporating climate change into long term forest strategies can be demonstrated by testing the conclusions reached by the 1998 report, Commercial Plantation Land Capability Analysis of South East Queensland, prepared as part of the CRA and RFA process. The products of this report included a series of maps assessing the capability and suitability of areas within the region for various commercial forestry species. One of the key parameters was mean annual rainfall, a variable which may change significantly under future climate change conditions. The outputs from the report were assessed under a dryer climate change scenario (Hadley GCM, A1F1 Emission Scenario, High Sensitivity) to determine the ongoing validity of the recommendations.

Using the climatic tolerances of forestry species provided in the report (see Table 11), spatial projections of climate change impacts on the potential distribution of *E. pilularis* (Blackbutt) were produced and are shown in Figures 6 and 7. Additional projections for other softwood and hardwood species of commercial interest were also produced and are shown in the full report. *E. pilularis* requires a mean annual rainfall of between 900mm and 1750mm, as indicated in Table 11.

Table 11: Preferred Climatic Conditions for Selected Forestry Species

<table>
<thead>
<tr>
<th>Species</th>
<th>Common Name</th>
<th>Mean Max Hottest Month</th>
<th>Mean Annual Rainfall (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>E. cloeziana</em></td>
<td>Gympie Messmate</td>
<td>29 - 34</td>
<td>550 - 2300</td>
</tr>
<tr>
<td><em>E. pilularis</em></td>
<td>Blackbutt</td>
<td>24 - 32</td>
<td>900 - 1750</td>
</tr>
<tr>
<td><em>C. citriodora</em></td>
<td>Spotted Gum</td>
<td>25 - 30</td>
<td>750 - 1750</td>
</tr>
<tr>
<td><em>E. dunnii</em></td>
<td>Dunn's White Gum</td>
<td>27 - 30</td>
<td>1000 - 1750</td>
</tr>
</tbody>
</table>

Source: Queensland CRA/RFA Steering Committee, 1998

The baseline map shown in Figure 6 indicates that the required amount of rainfall currently occurs in a wide coastal margin that runs consistently through the Burnett Mary from Miriam Vale to the Sunshine Coast. The modelling projections indicate that by 2030 this margin begins to thin, particularly in the north. The northern range may also experience contractions to the south in the inland areas of Miriam Vale. However, new areas are emerging suitable for trees in the southern coastal region which were previously designated too wet for the species. These processes continue through to 2070 with significant reductions north of Fraser Island. By 2100 the range is limited to a narrow band south of Fraser Island and a few fragmented pockets in the Miriam Vale region.

While short rotation plantations may readily adapt to these changes, long rotation stands producing quality sawlogs may be impacted by dryer conditions within their anticipated growth period. This suggests that plantation operators looking for long term security may see benefits in acquiring land in areas which are likely to maintain appropriate rainfall patterns throughout long rotational periods.
Figure 6: Planting Limitations for E. Pilularis by Mean Rainfall 1990-2100 (Hadley GCM, A1F1 Emission Scenario, High Sensitivity)

<table>
<thead>
<tr>
<th>Year</th>
<th>Key Rainfall</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline</td>
<td>Over 1750mm</td>
</tr>
<tr>
<td>2030</td>
<td></td>
</tr>
<tr>
<td>2070</td>
<td></td>
</tr>
<tr>
<td>2100</td>
<td></td>
</tr>
</tbody>
</table>

Key Rainfall: Black = Over 1750mm, Blue = 900 – 1750 mm, Yellow = Under 900mm
**Figure 7** demonstrates the impact of a dryer projection for the year 2100 on the areas classified during the 1998 CRA process as having the **capability** of growing *E. pilularis*. The modelled changes to rainfall patterns in the Burnett Mary Region show that some areas which are currently designated as having high and moderate capability, such as the western inland areas and those along the coast north of Hervey Bay, may no longer receive adequate rainfall to sustain the growth of *E. Pilularis*.

**Figure 7: Shifts in distribution of land capable of supporting *E. Pilularis* by mean rainfall for 2100**
Figure 8 further illustrates the impact of shifting rainfall patterns on areas identified in the same CRA process as having the highest profitability for the growth of Blackbutt. Under the dryer scenario for 2100, all of the areas highlighted in the report as having the highest suitability (NPV > 95% of land value), no longer receives sufficient rainfall. It should be noted that these representations are based on a rapid assessment process employing a single rainfall parameter and are used to demonstrate the necessity of incorporating climate change impacts into long term strategic plans. The production value of this or any other species is determined by a range of other considerations that are beyond the scope of this report.

**Figure 8: Shifts in Distribution of Profitability in Growing E. Pilularis by Mean Rainfall 1990-2100**

- Blackbutt land suitability in the Burnett Mary 1998
- Highest suitability (NPV > 95% of land value)
- Lower suitability (NPV 75% - 95% of land value)
- Rainfall over 900mm (Hadley 2100)
- Rainfall under 900mm (Hadley 2100)
10. Summing Up

A number of important themes are identified in this Working Paper. First is the fact that the regional landscape is multifaceted. It offers a number of different functions and as such is under varying degrees of utilisation and stress. This paper has focused on one specific land use as its effects on the broader natural and built environments. Also, it has also examined the implications of future climate regimes and revealed that climate change may have impacts on farm forestry areas in the Burnett Mary catchments region. These include changes in the distribution of plantations in general and for species in particular. Overall the research has indicated that many of the potential problems may be alleviated by proactive planning regarding the distribution of farm forestry within catchments and the development of sound management practices.

Towards Best Practice

A number of actions are needed to ensure that land use planning and environmental management meet best practices. These include:

- Limiting new plantations to 20% in any given catchment;
- Dispersing new plantations across the landscape;
- Establishing new plantations in catchments with lower rainfall (<800 mm/year) where impacts on runoff and streamflow are smaller;
- Phasing planting to stagger the impacts of growth cycles;
- Thinning plantations to maintain them at lower stocking densities;
- Establishing buffers between forestry allotments as a safeguard against bush fires;
- Establishing or upgrading logging roads to minimise to minimise erosion and sediment pollution, especially those within 40 metres of a water course or on unstable hill slopes;
- Adopting where possible pesticide regimes that minimise spray drift through use of environmental delivery technologies including aerial spraying by helicopter;
- Undertaking research to quantify, identify and map regional biodiversity so as to clearly understand the impacts of a growing farm forestry sector on biodiversity values in the Burnett Mary region;
- Undertaking research to clearly identify the implications of global warming on the distribution of current and emerging farm forestry estates; and
- Undertaking research to determine the implications of global warming on current farm forestry species and to identify appropriate species for future climates.
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