Silvo-pastoralism

Integrating beef and timber production to enhance private native forests

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PFSQ
Key Points

- A viable forest industry requires
  - suitable commercial species
  - a market for products
  - a competitive processing sector

- Private native forests in Queensland are concentrated in the south-east corner of the state and dominated by dry sclerophyll ‘remnant’ and ‘regrowth’ forests.

- PNF resources is generally extensive, of moderate to low relative productivity and generally in poor to moderate condition.

- The majority of the resource exists on freehold land where extensive grazing is the primary land use.

- There is considerable potential to improve the condition, productive capacity and value of the resource through enhanced silvicultural practices.

- Silvicultural treatment is economically viable when PNF combines with grazing.

- Extension activities need develop an ethos of silvo-pastoralism.
64 million ha of grazed woodland in Qld

- Qld 173 million ha
- 91 Mha woody vegetation
- 50 Mha Remnant grassland, wetlands, mangroves
- 30 Mha Non-remnant/cleared
- 64 Mha Grazed woodlands

For most beef producers in Qld, managing their land and businesses means managing the mix of cattle, grass and trees.
• What is the natural density of woody plants?
Where is the Qld private forest resource?

Most in South Eastern Qld

How much contains commercial species?
• Exotic pine plantations produce the bulk of timber processed in Queensland.

• Native hardwood provides high quality timber.

• About half of this is sourced from private native forests.

• The Mackay region has traditionally been a minor source of timber and timber processing.
PNF supply about 220,000 m³ per year
(50 % to 60% of hardwood supply)

Source: DPI Forestry Yearbooks 1975–76 to 2002–03.
• Mackay region is a minor player in a minor industry (forestry).

• The size of this industry has contracted in the last decade due to Government policy (RFA) and economic reasons (GFC).

• There may be opportunities for other non-wood related forestry activities (vegetation offsets and carbon sequestration).
So.....

• There is a sizable and valuable resource …

• With a lot of potential for increase (value and area) ….

• But it wont happen by itself; it needs to be managed ….

• The majority of the resource is on land where grazing is the primary land use; Land holders see themselves as graziers.

• For most this will mean working within their existing grazing enterprise
Silvo-pastoralism

- Cows, grass and trees – what are the interactions?
  - Looking at the grass bit
  - Looking at the tree (wood) bit
  - Working with them both
- Relative economics
- Enterprise focus
• Beef production is highly variable.
• Prices fluctuate – weekly, yearly and over the long term.
• Seasonal conditions vary.
• Grass growth differs between seasons and years.
• Tree density also changes over time – it just happens slower than the eye can see.
• Tends to be forgotten about; the cows are the focus.
Looking at the ‘grass’ bit

• Beef production is underpinned by carrying capacity of land.

• Carrying capacity is a function of :-
  - land type
  - climate (particularly rainfall)
  - land condition (tree density is a subset)

• How can we objectively assess the impact of changing tree density on carrying capacity?
GRASP modelled pasture growth

Pasture growth kg/ha

Year
Developed Brigalow Scrub

Grows on average 5,000 kg/ha

Safe UR 30%

1,500 kg/ha available forage

AE needs 3,650 kg / yr

Carrying Capacity 2.4 ha : AE

Spotted gum ridges

Grows on average 1,100 kg/ha

Safe UR 20%

220 kg/ha Available forage

AE needs 3,650 kg / yr

Carrying Capacity 16.6 ha : AE
Managing the Tree Grass balance

- Ecological benefits of trees in the landscape
- Some production benefits
- Options for management have been reduced in recent years

Source: EDGE network Grazing Land Management
…. Once tree density increases …

- Net competitive effect (mostly for moisture) takes over
- Reduced grass production
- Reduced carrying capacity

![Graph showing pasture yield (kg/ha) vs. basal area (m²/ha) for different plantations. Source: EDGE network Grazing Land Management]
Trees and grass need to be in balance – be aware of risks and opportunities

• When it comes to trees, there are some benefits

• But, you can have too much of a good thing; there comes a point when tree density will reduce carrying capacity.

• How do we account for the inherent value of the tree itself??
Looking at the ‘tree’ bit

Is forestry so different to cattle production?

Do you sell off your breeding stock that you have built up over many decades to be left with the runts and still expect a productive herd?

Do you stock at 20 hd/ha and expect that productivity and health will be maintained?

Do you neglect to cull poor quality animals, neglect their husbandry and just leave a herd to natural selection?

Do you invite the meat works buyer on to your property and say “There you go mate take what you want and just pay us a fair price”

For a forest to earn its keep, it must be managed!
Basics of sustainable native forest management

– Leave the forest in a condition that has the ability to regenerate and improve in quality and health over time.

– Competition between trees is the major influence on future forest health, quality and value. “trees need space”.

– Tree stocking levels is dependent upon tree species, their diameter and the quality of the site.

– Ecosystem health and biodiversity are enhanced by maintaining forest health, structural diversity and stand protection.
The productive (and ecological) health of a forest determined by: -

- Crown health
- Form
- Spacing
- Species mix
- Age class mix
Crown health is the major indicator
Crown health is the major indicator
Tree form

Watch for:

- bole shape
- bole length
- fire scars
- dead branches
- mechanical damage
What products?

What values?

What to harvest first?
## Major Forest Products

<table>
<thead>
<tr>
<th>Product</th>
<th>Measurement Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Compulsory Sawlog</td>
<td>m³</td>
</tr>
<tr>
<td>• Salvage grade Sawlog</td>
<td>m³</td>
</tr>
<tr>
<td>• Sleeper blocks</td>
<td>m³</td>
</tr>
<tr>
<td>• Veneer Billets</td>
<td>m³</td>
</tr>
<tr>
<td>• Railway Girders</td>
<td>lm/m³</td>
</tr>
<tr>
<td>• Main Roads Girders</td>
<td>lm/m³</td>
</tr>
<tr>
<td>• Electricity Poles</td>
<td>lm</td>
</tr>
<tr>
<td>• Building poles</td>
<td>lm</td>
</tr>
<tr>
<td>• House stumps</td>
<td>lm</td>
</tr>
<tr>
<td>• Construction Piles</td>
<td>lm</td>
</tr>
<tr>
<td>• Landscape rounds (small diameter)</td>
<td>lm</td>
</tr>
<tr>
<td>• Split posts</td>
<td>each</td>
</tr>
<tr>
<td>• Rails</td>
<td>each</td>
</tr>
<tr>
<td>• Stays</td>
<td>each</td>
</tr>
<tr>
<td>• Strainers</td>
<td>each</td>
</tr>
<tr>
<td>• Line posts</td>
<td>each</td>
</tr>
<tr>
<td>• Yard posts</td>
<td>each</td>
</tr>
<tr>
<td>• Firewood</td>
<td>tonne</td>
</tr>
</tbody>
</table>
Electricity Poles

Must conform to the Australian Standard

Length from 8m – 23m commonly

Four classes: 5kn, 8kn, 12kn & 20kn

Must have a minimum d-line and small end diameter
Girders

Min 4.5 x 45cm sedub
(small end diameter under bark)
41cm - 56 cm free of sap
Durability 1 & 2

As a guide
Generally minimum 52cm dbh
Straight enough to cut min 45cm diameter straight octagonal
Compulsory Grade Sawlog

2.4m x 30cm sedub, 0.3m increments

Cut to D.P.I specifications

• Limbs affecting less than 50% of the circumference of the log at any point,

• Pipe etc ≤ 50% of large end diameter, 25% of small end diameter

• Degree of bend, this varies with centre girth, (as a guide, - 40 cm - 2.5°, 40 – 49 cm - 5°, 50 cm+ - 10°), Gum vein, ring shakes, etc
Slice Veneer Billets

2.7 & 3.0 increments x 40cm sedub

Straight, no ring shakes, only small clean pipe and very little defect such as stubs, bumps or insect damage
Salvage Grade Sawlog

2.4 x 25-27cm sedub
0.3m increments
Mostly cut to D.P.I specifications
<table>
<thead>
<tr>
<th>Item</th>
<th>Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Landscape rounds (lm)</td>
<td></td>
</tr>
<tr>
<td>Split posts (each)</td>
<td></td>
</tr>
<tr>
<td>Rails (each)</td>
<td></td>
</tr>
<tr>
<td>Stays (each)</td>
<td></td>
</tr>
<tr>
<td>Strainers (each)</td>
<td></td>
</tr>
<tr>
<td>Line posts (each)</td>
<td></td>
</tr>
<tr>
<td>Yard posts (each)</td>
<td></td>
</tr>
<tr>
<td>Firewood (tonne)</td>
<td></td>
</tr>
</tbody>
</table>

**Strainer Posts**

2.4m x 20-30cm sedub

Only durability class 1 timbers

Must be barked, only small pipe and straight

**Split Posts**

2.1m x 150mm arc

Only durability class 1 timbers

Must be barked, narrow sap band and straight
Silvicultural thinning to improve PNF

Only keep high quality trees

- Good crown, not suppressed
- Long log
- No defect
- Removal of suppressed trees

Allow adequate room to grow

- Larger trees (30 cm +) 10 – 15 m apart
- Smaller trees (10 – 20) 5 – 7m
- Range of size classes
Response to thinning - Longer term State Forest studies (Lewis et al 2010)

Experiment 258HWD (Tiaro)
- 1964 and measured up to 1997
- ‘thinned’ treatment 50–111 sph
- ‘routine management’ 235–297 sph

Experiment 165DBY (Dalby)
- 1976 and was last measured in 1997.
- 8 × 8 m (156 stems/ha)
- 10 × 10 m (100 stems/ha)
- 12 × 12 m (69 stems/ha)
- 14 × 14 m (51 stems/ha)
- Control with no treatment.
Well managed private forests, especially regrowth that is ‘captured’ early has potential to grow better than this.

<table>
<thead>
<tr>
<th>Tree stocking (trees / ha)</th>
<th>Predicted diameter growth (± SE) (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>50</td>
<td>0.54 ± 0.07</td>
</tr>
<tr>
<td>100</td>
<td>0.41 ± 0.06</td>
</tr>
<tr>
<td>150</td>
<td>0.33 ± 0.06</td>
</tr>
<tr>
<td>200</td>
<td>0.28 ± 0.07</td>
</tr>
<tr>
<td>250</td>
<td>0.23 ± 0.07</td>
</tr>
<tr>
<td>300</td>
<td>0.20 ± 0.07</td>
</tr>
<tr>
<td>350</td>
<td>0.17 ± 0.07</td>
</tr>
</tbody>
</table>
Potential Volume PAI of the Spotted gum resource (from Lewis et al 2010)
Show me the money

• Trees grow faster when I thin them out.

• The volume and quality of the wood I harvest improves with thinning.

• But ....
  - it costs me money to do it.
  - I’ll still grow trees if I don’t.
  - I wait a long time to cash it in.

• What impact will it have on the cattle side of the business?
Case study of a typical overstocked native forest

- 650 stems/ha

- Large proportion of non-commercial stems and unmerchantable stems.

- Compare the impact of managing for enhance timber production with typical “business as usual” high grading and clearing for grazing only.

- Include management for grazing and timber.
Stand Table - 650 sph

<table>
<thead>
<tr>
<th>DBH Range</th>
<th>SPH</th>
</tr>
</thead>
<tbody>
<tr>
<td>dbh 0-10</td>
<td>370</td>
</tr>
<tr>
<td>dbh 10-20</td>
<td>180</td>
</tr>
<tr>
<td>dbh 20-40</td>
<td>73</td>
</tr>
<tr>
<td>dbh 40-60</td>
<td>22</td>
</tr>
<tr>
<td>dbh &gt;60</td>
<td>5</td>
</tr>
</tbody>
</table>

Species Mix

- silver-leaved ironbark: 4%
- peppermint: 5%
- NCS: 11%
- narrow-leaved ironbark: 18%
- spotted gum: 23%
- acacia: 25%
- bluegum: 5%
- gum-topped box: 4%
- moreton bay ash: 5%
Business as usual (High Grading)

- Only removing quality stems (about 10 sph)
- Leaving defective or suppressed trees (600 sph)
- Damage to some retained trees (from both harvest operation and post harvest fire – 40 sph)
- Harvest interval of > 30 years
Good management

• Only removing stems that have reached optimum value; regardless of size (about 25 sph)

• Post harvest treatment within 5 years of harvest to remove poor quality stems (475 sph)

• Only retaining quality stems at adequate stocking (150 sph)

• Harvest interval of < 25 years
Clear for grazing only

- Pull, rake and burn
- Native pastures
- Re-clear 30 years later
Impact of management on Stand Density (stems/ha)

- Stems/ha - well managed
- Stems/ha - high graded
- Stems/ha - grazing only
- Trees in the managed forest average 0.54 cm/yr DBH increase
- Trees in the high graded forest average 0.1 cm/yr DBH increase
- Slight increase in mean product length (4.2m to 7.2m)
- The managed forest produces about 0.5 m³/ha/yr
- The high graded forest only produces about 0.15 m³/ha/yr
- Value of timber from the managed stand remains at $75/m³ following the initial harvest and treatment.
- Value of timber from the high graded forest drops from $60/m³ to $55/m³ after year 40.

Impact of management on Harvest Revenue ($/ha)

- timber sales - Well Managed
- timber sales - High Graded

<table>
<thead>
<tr>
<th>Year</th>
<th>Well Managed</th>
<th>High Graded</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>$433.39</td>
<td>$146.64</td>
</tr>
<tr>
<td>11</td>
<td>$256.98</td>
<td></td>
</tr>
<tr>
<td>21</td>
<td></td>
<td></td>
</tr>
<tr>
<td>31</td>
<td>$578.51</td>
<td>$256.98</td>
</tr>
<tr>
<td>41</td>
<td>$822.23</td>
<td></td>
</tr>
<tr>
<td>51</td>
<td>$200.00</td>
<td></td>
</tr>
<tr>
<td>61</td>
<td>$223.14</td>
<td></td>
</tr>
<tr>
<td>71</td>
<td>$738.33</td>
<td></td>
</tr>
<tr>
<td>81</td>
<td>$857.92</td>
<td></td>
</tr>
<tr>
<td>91</td>
<td>$1,131.23</td>
<td></td>
</tr>
<tr>
<td>101</td>
<td>$1,057.43</td>
<td></td>
</tr>
</tbody>
</table>

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Thinning for timber production will reduce TBA …. 

…. improves stand production; will also increase grass production
Linking timber production with grazing through changes in BA

Pasture Growth for Spotted Gum country near Gayndah

\[ y = 5.9252x^2 - 260.1x + 3442.2 \]
Unthinned 450 sph, BA = 15.6 m$^2$/ha

Grows on average **1000 kg/ha**

Safe UR 20%

**200 kg/ha** available forage

AE needs 3,650 kg / yr

Carrying Capacity 18.3 ha : AE

thinned 50 sph, BA = 2.6 m$^2$/ha

Grows on average **2,200 kg/ha**

Safe UR 20%

**440 kg/ha** Available forage

AE needs 3,650 kg / yr

Carrying Capacity 8.3 ha : AE
Impact of management on Cattle Carrying Capacity (AE/ha)

Cattle CC - Well Managed
Cattle CC - High Graded
Cattle CC - grazing only
Annual liveweight gain = 120 kg/head
Liveweight value = $1.75 /kg
Annual variable costs = $25/head

Impact of management on Grazing GM
Impact of management on Cash Flow
Impact of management on Discounted Cash Flow

- PV grazing only (@6%)
- PV combined - well managed (@ 6%)
- PV combined - high graded (@ 6%)
NPV against discount rate - Timber/Grazing only
NPV against discount rate - Combined

- NPV Wman
- NPV HG
- NPV Graz
Limitations and assumptions

- Not considering land value and capital invested in land or livestock.
- Not accounting for land condition (assuming all good grazing land condition).
- Not accounting for difficulties in managing livestock (in particular adjusting livestock numbers to match C.C.) and impacts on herd structure (require more complex herd modelling).
- Only very minor adjustment in average harvest value ($/m^3) and not considering other wood products.
- Not accounting for the change in the relative value of grazing and timber.
Value of Beef

- Ox (c/kg)
- Ox (c/kg) adjusted

Equations:
- $y = 5.9499x + 164.08$
- $y = -1.8285x + 164.08$
Value of wood products

\[ y = 3.0928x + 30.38 \]

\[ y = 0.1627x + 30.38 \]
What about other uses for trees?

• The carbon fairy
• Vegetation offsets
• Biofuels
• Ecosystem services
• Whatever the use you need to consider the risks and economics.
• What term is the caveat?
• What impact on the grazing enterprise?
• Considered retaining regrowth in strips on two land types and growing Eucalypt plantations (for poles or pulp) on one land type

• Looked at the economic impact of options compared with re-clearing for grazing only on a 1000 ha paddock.

• Considered income from Carbon sequestration (+/- methane emissions from livestock).
CQ Silvo-pastoralism Analysis  
(Donaghy et al 2009)

<table>
<thead>
<tr>
<th>Land Type</th>
<th>NPV of retaining regrowth strips</th>
<th>NPV of retaining regrowth strips and selling sequestered carbon ($10/t CO$_2$-e)</th>
<th>NPV of retaining regrowth strips and selling sequestered carbon net of methane emissions ($10/t CO$_2$-e)</th>
<th>NPV of changing to agroforestry model (electrical poles)</th>
<th>NPV of changing to an agroforestry model (pulp) ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brigalow land type</td>
<td>-$14,732</td>
<td>$84,107</td>
<td>$48,820</td>
<td>$209,087</td>
<td>$99,155</td>
</tr>
<tr>
<td>Eucalypt land type</td>
<td>-$1,701</td>
<td>$136,989</td>
<td>$112,876</td>
<td>n/a</td>
<td>n/a</td>
</tr>
</tbody>
</table>

What would be the impact for PNF?
Conclusions

- PNF resource is generally extensive, of moderate to low relative productivity and generally in poor to moderate condition.
- The majority of the resource exists on freehold land where extensive grazing is the primary land use and owned by landholders who see themselves primarily as graziers not foresters.
- There is considerable potential to improve the condition, productive capacity and value of the resource through enhanced silvicultural practices.
- Silvicultural treatment is economically viable when PNF combines with grazing.
- Extension activities need develop an ethos of silvo-pastoralism.
- There is a need to develop robust Bio-economic models applicable to a range of forest types, climate zones and production systems.
Thank you

any questions?