Land Accounts

Workshop on Forest Accounting
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The environment and national accounts

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Content

1. Emerging capability to create markets for environmental goods and services (EG&S)
   - Mechanism design
   - Implications for the environment

2. Implications for national accounts
   - SNA and SEEA
     - Flow accounts
     - Stock accounts

3. Information for national accounts
   - Catchment Management Framework (CMF)

4. Example accounts
1. Emerging capability

Mechanism design to create markets

**Mechanism design** (see Roth 2002)
- Design new institutions that mimic the efficiency properties of markets
  - Game theory (**Von Neumann, Morgenstern, Nash, Vickrey**)
  - Theory of incentives (Laffont)
  - Information economics (**Akelof, Stiglitz, Spence**)
  - Experimental economics (**Smith, Kahneman** and Plott)
  - Mechanism design (**Myerson, Maskin, Hurwicz**)  

Applications of the mechanism design approach
- Mobile phone spectrum
  - Adverse selection
1. Emerging capability

Design and create markets

Markets
• Commodities
• Capital
• Inputs

Create new markets
• Mobile phone
• Legislation and regulation
• Airport landing slots
• Government programs
• Aquaculture sites
• Water
• Environment
1. Emerging capability

Victoria’s ESAS (ecoMarkets) program

Information from:
- Transactions (flow)
- Biophysical models (stock)

The public

NGOs

Consumers

Auction

Non-point-source

Tradeable permit

Emission Trading Scheme

Landholder

Markets

Offset markets

NVeX

Information from Transactions

& Surveys

Satellite Accounts - Environment

National Accounts
1. Emerging capability

In the real world

Site visit - visual assessment of habitat

Model - salinity, water quality, carbon, stream flow

Contract - payment to grow EG&S:
- construct fence
- exclude stock
- control weeds and pests
- plant more native species
- sell the carbon in CPRS market

What extra would I need to be paid to change land use?

What will other landholders ask for and do I have a good site?

Discover prices

Facilitate transactions in EG&S

Submit bid

Efficient allocation of land between commodities, carbon, EG&S
3. Implications for national accounts

Contribution to GDP (SNA)

Value added (contribution to GDP) equate to area ABC

Bid curve represents costs
3. Implications for national accounts

Contribution to GDP (SNA)

- **Production of EG&S**
  - Creates value (Revenue > Costs)
  - Adds to GDP

- **Environment production included in GDP estimates**
  - Revenue available from farm records
  - Costs included in farm records (materials etc.)

- **Markets for EG&S give a small increase in aggregate GDP**
  - Participation constraint

- **Attribution of GDP**
  - Able to attribute a component of GDP to environmental production
  - Able to estimate gross investment in environmental production
3. Implementation for environmental accounts - SEEA

Environmental asset accounts – satellite accounts

- Economic activity represented in SNA
  - Land Account (include land cover)
    - Terrestrial Ecosystems Account (EA3.1)
    - Aquatic Ecosystems Account (EA3.2)
      - Aquatic habitat account (EA3.2.1)
      - Surface water account (EA 3.2.2)
      - Groundwater Account (EA 3.2.3)
    - EnSym
  - Atmospheric Ecosystem Account – Bio-sequestration (EA3.3)

- Spatially referenced biophysical models
3. Implications for national accounts

Asset accounts – general format

- **Opening stock level – 1750... or now**
  - Increases in stock
    - Due to economic activity
    - Due to regular natural processes
  
  - Decreases in stock
    - Due to economic activity
    - Due to regular natural processes
    - Due to natural disasters (net increase)

- **Changes due to economic reclassification**

- **Closing stock levels (current)**

- **Changes in environmental quality**
  - Due to natural processes
  - Due to economic activity
Australian Land Use and Management (ALUM) Classification

- **Class 1 – Conservation and Natural Environments**
  Land is used primarily for conservation purposes, based on the maintenance of essentially natural ecosystems already present.

- **Class 2 – Production from Relatively Natural Environments**
  Land is used mainly for primary production, based on limited change to the native vegetation.

- **Class 3 – Production from Dryland Agriculture and Plantations**
  Land is used mainly for primary production, based on dryland farming systems.

- **Class 4 – Production from Irrigated Agriculture and Plantations**
  Land is used mainly for primary production, based on irrigated farming.

- **Class 5 – Intensive Uses**
  Land is subject to substantial modification, generally in association with closer residential settlement, commercial or industrial uses.

- **Class 6 – Water**
  Although primarily land cover types, water features are regarded as essential to the classification system.
Victorian Application of ALUM

- Class 1
  - 1.1.0 Nature conservation
    - 1.1.1 Strict Nature Conservation
  - 1.2.0 Managed recourse protection
    - 1.2.1 Biodiversity
    - Ecological Vegetation Classes
    - EVC (1 – 999)

- Additional classifications have been added to:
  - represent the value (preferences) within a class
  - estimate the ecological services provided
    - e.g. Rare and threatened, biodiversity conservation status, RAMSAR, National Significance (CFOC)
Catchment Management Framework

ALUM Classifications

Victorian EVC Classifications
CMF – Accounts Interface

ACCOUNTS CLASSIFICATION SUMMARY TABLE

<table>
<thead>
<tr>
<th>Input</th>
<th>Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Sown grasses</td>
<td>Agriculture</td>
</tr>
<tr>
<td>2. Grazing modified pastures</td>
<td>Agriculture</td>
</tr>
<tr>
<td>3. Irrigated vegetables &amp; herbs</td>
<td>Agriculture</td>
</tr>
<tr>
<td>4. Irrigated seasonal horticulture</td>
<td>Agriculture</td>
</tr>
<tr>
<td>5. Cereals</td>
<td>Agriculture</td>
</tr>
<tr>
<td>6. Cropping</td>
<td>Agriculture</td>
</tr>
<tr>
<td>7. Irrigated vine fruits</td>
<td>Agriculture</td>
</tr>
<tr>
<td>8. Poultry</td>
<td>Agriculture</td>
</tr>
<tr>
<td>9. Irrigated modified pastures</td>
<td>Agriculture</td>
</tr>
<tr>
<td>10. Oleaginous fruits</td>
<td>Agriculture</td>
</tr>
<tr>
<td>11. Vegetables &amp; herbs</td>
<td>Agriculture</td>
</tr>
<tr>
<td>12. Oil seeds &amp; oleaginous fruit</td>
<td>Agriculture</td>
</tr>
<tr>
<td>13. Irrigated vegetables &amp; herbs</td>
<td>Agriculture</td>
</tr>
<tr>
<td>14. Intensive horticulture</td>
<td>Agriculture</td>
</tr>
<tr>
<td>15. Shadehouses</td>
<td>Agriculture</td>
</tr>
<tr>
<td>16. Hay &amp; silage</td>
<td>Agriculture</td>
</tr>
<tr>
<td>17. Legumes</td>
<td>Agriculture</td>
</tr>
<tr>
<td>18. Intensive animal production</td>
<td>Agriculture</td>
</tr>
<tr>
<td>19. Aquaculture</td>
<td>Agriculture</td>
</tr>
<tr>
<td>20. Irrigated cropping</td>
<td>Agriculture</td>
</tr>
<tr>
<td>21. Irrigated flowers &amp; bulbs</td>
<td>Agriculture</td>
</tr>
</tbody>
</table>
Summary Land Account (ha)

<table>
<thead>
<tr>
<th>Pre-1750</th>
<th>Agriculture</th>
<th>Natural</th>
<th>Forestry</th>
<th>Urban Industrial</th>
<th>Water</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1,328,241</td>
<td>219,367</td>
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<td>101,221</td>
<td>5,345</td>
<td>1,328,241</td>
</tr>
<tr>
<td>2008</td>
<td>835,149</td>
<td>-83</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Corangamite – total area = 1.3m ha**
- 17% of the land remains “natural”
- Predominant change is towards agriculture, making up 75%
  - Still contains some “natural” features
- Forestry – 15%
## Current Biophysical Environmental Services

<table>
<thead>
<tr>
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<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Carbon Stored</strong></td>
<td>183,794</td>
<td>6,060,573</td>
<td>1,153,741</td>
<td>2,974</td>
<td>24,593</td>
<td>7,425,675</td>
</tr>
<tr>
<td><strong>Carbon Sequestration</strong></td>
<td>1,157</td>
<td>692</td>
<td>339</td>
<td>22</td>
<td>3</td>
<td>2,212</td>
</tr>
<tr>
<td><strong>Drainage</strong></td>
<td>132</td>
<td>63</td>
<td>33</td>
<td>19</td>
<td>1</td>
<td>248</td>
</tr>
<tr>
<td><strong>Dry Matter</strong></td>
<td>266,532</td>
<td>13,162,256</td>
<td>2,489,527</td>
<td>5,457</td>
<td>53,417</td>
<td>15,977,189</td>
</tr>
<tr>
<td><strong>Pan Evaporation</strong></td>
<td>925</td>
<td>237</td>
<td>174</td>
<td>112</td>
<td>6</td>
<td>1,454</td>
</tr>
<tr>
<td><strong>Transpiration</strong></td>
<td>255</td>
<td>90</td>
<td>127</td>
<td>9</td>
<td>2</td>
<td>483</td>
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<tr>
<td><strong>Surf. Runoff</strong></td>
<td>6</td>
<td>1</td>
<td>2</td>
<td>4</td>
<td>0</td>
<td>14</td>
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<tr>
<td><strong>Erosion (t/h)</strong></td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>Rainfall (mm)</strong></td>
<td>580</td>
<td>182</td>
<td>174</td>
<td>71</td>
<td>4</td>
<td>1,011</td>
</tr>
<tr>
<td><strong>Subsurface Lat.</strong></td>
<td>40</td>
<td>25</td>
<td>14</td>
<td>6</td>
<td>0</td>
<td>86</td>
</tr>
<tr>
<td><strong>Recharge</strong></td>
<td>92</td>
<td>38</td>
<td>19</td>
<td>13</td>
<td>1</td>
<td>162</td>
</tr>
<tr>
<td><strong>Evaporation</strong></td>
<td>187</td>
<td>27</td>
<td>11</td>
<td>38</td>
<td>1</td>
<td>264</td>
</tr>
</tbody>
</table>
### Carbon Stored (t/m) - Biosequestered

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<tbody>
<tr>
<td><strong>Pre-1750</strong></td>
<td>-</td>
<td>69,079,663</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>69,079,663</td>
</tr>
<tr>
<td><strong>2008</strong></td>
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<tr>
<td><strong>% Change</strong></td>
<td></td>
<td>-91</td>
<td></td>
<td></td>
<td></td>
<td>-89</td>
</tr>
</tbody>
</table>

- 89% of the carbon that was stored in the landscape has been released since European settlement
  - to the atmosphere
  - stored in buildings etc
- The largest store is still in the natural systems (81%)
Runoff (ML/yr)

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<tr>
<td>Pre-1750</td>
<td></td>
<td>5,209,596</td>
<td></td>
<td></td>
<td></td>
<td>5,209,596</td>
</tr>
<tr>
<td>2008</td>
<td>6,413,089</td>
<td>1,280,301</td>
<td>1,805,200</td>
<td>4,028,518</td>
<td>37,836</td>
<td>13,564,944</td>
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<tr>
<td>% Change</td>
<td></td>
<td>-75</td>
<td></td>
<td></td>
<td></td>
<td>160</td>
</tr>
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</table>

- 160% increase in runoff to streams
  - A significant movement away from natural flow regimes
- Re-establishing the landscape in key areas can contribute to returning flows to “natural” regimes (EcoTender in Victoria)
- Flood and asset risks can also benefit from strategic land use change
Recharge (ML/y)

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<tr>
<td>Pre-1750</td>
<td></td>
<td>173,061,320</td>
<td></td>
<td></td>
<td></td>
<td>173,061,320</td>
</tr>
<tr>
<td>2008</td>
<td>91,550,860</td>
<td>37,554,013</td>
<td>19,333,963</td>
<td>12,754,149</td>
<td>906,292</td>
<td>162,099,277</td>
</tr>
<tr>
<td>% Change</td>
<td></td>
<td>-78</td>
<td></td>
<td></td>
<td></td>
<td>-6</td>
</tr>
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</table>

- 6% decrease in recharge (to groundwater)
  - A small overall change
  - A substantial change in the area it is occurring
  - Saline land increases as a result of increasing recharge in specific areas!
  - Agriculture is located in high (relatively) rainfall areas and thus increasing net recharge to groundwater – more saline land area
## Habitat Hectare
*(Terrestrial biodiversity metric)*

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<td>134,173</td>
<td>116,922</td>
<td>96,451</td>
<td>26,144</td>
<td>2,265</td>
<td>375,954</td>
</tr>
<tr>
<td><strong>% Change</strong></td>
<td></td>
<td>-91</td>
<td></td>
<td></td>
<td></td>
<td>-72</td>
</tr>
</tbody>
</table>

- 72% decrease habitat hectare
  - Significant loss in habitat services for flora and fauna
- **NOTE**: agriculture and forestry still provide some services
  - Victorian EcoTender pays landholders to manage natural systems on their land and thus increase habitats services for flora and fauna
## Summary Land Account (ha)
(Annual reporting of transactions)

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<td>-330</td>
<td>330</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Additions to stock levels</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Deductions from stock levels</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Others changes to stock levels</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
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<td>5,345</td>
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</tr>
<tr>
<td>% Change</td>
<td>-0.04</td>
<td>0.15</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
</tbody>
</table>

- $1.2m EcoTender in Corangamite
- 330 ha of land is now defined as “natural”
- Remains in private ownership and under private management
- *EcoTender transactions between the Victorian government and landholders add value to the agricultural sector by producing EG&S*
Habitat Hectare – biodiversity
(Annual reporting of transactions)

<table>
<thead>
<tr>
<th>Area (ha)</th>
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<td>2,265</td>
<td>375,954</td>
</tr>
<tr>
<td>Changes due to transactions</td>
<td>4,950</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
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<tr>
<td>Additions to stock levels</td>
<td>-</td>
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<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Others changes to stock levels</td>
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<td>-</td>
<td>-</td>
<td>-</td>
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<td>96,451</td>
<td>26,144</td>
<td>2,265</td>
<td>380,904</td>
</tr>
<tr>
<td>% Change</td>
<td>3.69</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>1.32</td>
</tr>
</tbody>
</table>

- 1.3% increase in habitat services for flora and fauna
  - *All these services are being sourced from “agricultural” land*
Status of Victorian Accounts project
(Next twelve months)

- Ten catchment management areas covering all of Victoria
- Can geographically report for any zones / areas
  - local council, sub catchments, river basins etc
- Can geo-reference all transactions involving the environment
  - Can spatially present locations of all transactions
- Develop alignment between ALUM classification system and Victorian land use mapping
  - Process for inclusion of Ecological Vegetation Classes
- Provide the Environmental Accounts Reporting System (EARS) to NRM investors for reporting to the commonwealth and state government
National application

- Catchment Management Framework (CMF)
  - Is applicable nationally
  - Landuse data sets
  - Base data sets – status
    - Soil mapping, DEM
    - Native vegetation classifications

- Potential to report nationally consistent set of environmental accounts and geo-referenced transactions
5. Some conclusions

Summary points

1. Can now create markets where missing
   - Mechanism design
   - Significant investment in quantitative tools that connect science with points in space

2. Markets for EG&S will eventually be attractive to government
   - Superior economic efficiency properties (+30%)
   - Design to mimic markets

3. Increasing use of markets for EG&S
   - Water markets
   - Emission Trading
   - Procurement auctions (Victoria)
   - Offset markets (eBX)

4. Transactions in EG&S reveal price and define value attributes

5. Implications for national accounts:
   - Environmental production recognised in Flow accounts (transactions occur) in SNA
   - Environmental stocks included in Asset accounts (models developed) using SEEA
Thank you