Economic analysis of the impacts and management of subsoil constraints

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Aim of the analysis:

• Economic analysis of the effects of subsoil constraints on yields, cost structures and profits

• To analyse the cost-effectiveness of interventions for management of subsoil constraints
Four subsoil constraints:

1. Acidity
2. Compaction
3. Sodicity
4. Transient salinity

• Boron toxicity was considered but not included due to lack of data
The nine AgZones:
Methodology:

1. **Estimation of yield loss** due to each constraint, multiplied price and area affected

2. **Discounted cashflow analysis** for each management option
Area of moderate to high impact (‘000 ha)

<table>
<thead>
<tr>
<th></th>
<th>Acidity</th>
<th>Compaction</th>
<th>Sodicity</th>
<th>Transient salinity</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>11,430</td>
<td>12,320</td>
<td>5,850</td>
<td>400</td>
</tr>
</tbody>
</table>

Note: Total croppable area of the wheatbelt = 16.4 million ha
Estimated indicative average value of lost production ($/ha)

<table>
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<th>Transient salinity</th>
</tr>
</thead>
<tbody>
<tr>
<td>141</td>
<td>54</td>
<td>52</td>
<td>19</td>
</tr>
</tbody>
</table>
Estimated indicative total value of lost production ($million/year)

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<tr>
<td>1,574</td>
<td>883</td>
<td>577</td>
<td>92</td>
</tr>
</tbody>
</table>

Note: As most soils have multiple constraints, these numbers shouldn’t be summed
Managing acidity with lime

• Used Optlime
• Considered soil types that make up 70% of area affected
• For each region, considered
  1. Cost of cheapest lime source
  2. Freight distance
  3. Potential yield
  4. Optimal lime application for ameliorating subsoil acidity
• 68 runs
Example change in net revenue due to liming
Top-dressed and deep-banded in years 1 and 4
Results for managing acidity with lime

<table>
<thead>
<tr>
<th>Indicative equivalent annual profit ($/ha/year over 20 years)</th>
<th>Indicative benefit cost ratio (over 20 years)</th>
</tr>
</thead>
<tbody>
<tr>
<td>63</td>
<td>11:1</td>
</tr>
</tbody>
</table>
Managing compaction

1. Deep ripping and deep working (mechanical amelioration)

2. Deep ripping and deep working with gypsum (mechanical and non-mechanical amelioration)

3. Deep ripping and deep working with controlled traffic farming (mechanical amelioration with mitigation)
## Results for managing compaction

<table>
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<tr>
<th>Indicative equivalent annual profit ($/ha/year over 20 years)</th>
<th>Indicative benefit cost ratio (Over 20 years)</th>
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</thead>
<tbody>
<tr>
<td>DR/DW alone</td>
<td>DR/DW with gypsum</td>
</tr>
<tr>
<td>3</td>
<td>-16</td>
</tr>
</tbody>
</table>

DR = Deep ripping, DW = Deep working
Managing sodicity with gypsum

\[ y = -0.4784x^2 + 7.6746x + 101.73 \]

\[ n=160 \]
Cashflow

![Graph showing cashflow over time]

- Change in cumulative net revenue

- Cashflow ($/ha/year)

- Time (years)
## Results for managing sodicity

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<th>Indicative equivalent annual profit ($/ha/year over 20 years)</th>
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<tr>
<td>9</td>
<td>1.4 : 1</td>
</tr>
</tbody>
</table>
Take home messages

• Subsoil constraints have a significant impact on the WA grain industry

• This is especially true for subsoil acidity, but also for subsoil compaction and sodicity, and to a lesser extent, transient salinity

• Management strategies have potential to partly recover these losses
Limitations

- Assumes each subsoil constraint in isolation. Doesn’t account for multiple constraints
- Snap shot in time
- Includes agricultural costs only
- Costs in terms learning, investigation and understanding not included
- Assumes an average year
- Many data assumptions are indicative only
Future research

• Many of the GrainsWest projects aim to **improve the accuracy and reliability of assumptions** (especially estimated yield penalties and boosts)

• Include **multiple constraints**

• Consider boron toxicity
Sincere thanks to:

- **GRDC for funding the project:**
  - DAW00242 Subsoil constraints – understanding and management
- **DAFWA experts for providing advice:**
  - Dennis van Gool - mapping and area of susceptibility
  - Chris Gazey - subsoil acidity
  - James Hagan and Paul Blackwell - subsoil compaction
  - David Hall - subsoil sodicity
  - Ed Barrett-Lennard - transient salinity