Integrated bioenergy tree crops in south-western Western Australia enhance water quality and environmental outcomes

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Issues

- The environment of south-west WA
- Dryland salinity:
  - Hydrological processes & scale
- Developing biomass production systems
  - Deliver economic biomass
  - Improve water quality
Regional climate variation in southern WA

Rainfall

Evaporation

South West WA - Annual Rainfall

South West WA - Annual Evaporation
WA Soils:
deeply weathered, leached, infertile, salt stored at depth, low relief
Reduced water use leads to dryland salinity

Audit.ea.gov.au/ANRA/land/docs/national/Salinity_Salt_AUS.html
Salinity impacts

Extent of salinization

- Currently 1 m ha
- 3.0 – 4.5 M ha predicted
- > 400 species at risk
Reasons/Drivers for bioenergy programs

- **South West WA**
  - Biodiversity hotspot
  - 16 M ha in the wheatbelt (600-300 mm)

- **Mitigate the hydrologic imbalance**
  - Protect biodiversity
  - Maintain agriculture

- **Mitigate climate change**
  - Bioenergy

- **Additional rural income**
  - Farms, industry
Integrating trees to capture water & maintain production

Conceptual water balance by Ellis et al. (1999, 2001) modified by Bartie et al 2011
Project status (1)
Knowledge

  - Growing & managing mallees
  - Harvest & delivery systems/supply chain logistics
  - Economic modeling of tree crops in whole farm systems

- Operational practices for large-scale biomass supply can be specified.
Project status (2)
Implementation

- Large scale commercial development hasn’t eventuated:
  - Current commercial conditions (international/national)
  - Weakening of policy support
  - Planting stalled since 2007 (13,000 ha)

- Small regional industries - combined heat & power
  - Mallee biomass identified as a prospective feedstock

- WA work on pyrolysis for biofuels (Curtin Uni.)
  - Testing pre-commercial prototypes
Positive impacts on water quality

- Scale & high cost of salinity
  - Prioritize valuable and protectable assets,

- Multiple treatments required
  - Single actions - won’t prevent salinization
  - Combined – salinity can be mitigated

- Improved aquatic and wetland systems
  - Natural Diversity Recovery Catchments, Toolibin Lake (RAMSAR wetland), protected by:
    - Planting integrated trees
      - reduces groundwater recharge
    - Diverting saline inflows (early season)
    - Pumping to suppress groundwater

Positive impacts on water quality
Positive impacts for water availability

- **Low rainfall areas (<600 mm)**
  - Reduced salinity increases farm water availability

- **Higher rainfall areas (>600 mm)**
  - Water supply catchments have marginal salinity (TSS >500 ug g\(^{-1}\)) from clearing
  - Revegetation reduces overall water flows, but increases the supply of potable water
Key enabling factors

- **Broad recognition of dryland salinity:**
  Rural communities, policy, NRM & water professionals

- **Governments prioritized natural resource management:**
  - 1980-2010 favorable policies & funding
  - Expertise in government agencies

- **Climate change:**
  - Trees provide opportunities for renewable energy

- **Economic analysis demonstrating that:**
  - Farm businesses alone can’t fund salinity mitigation
  - Trees provide viable mitigation at the necessary scale
Achieved outcomes

- Understand the role of trees in salinity control
  - Multiple perennial systems and engineering required to rebalance hydrology
- Developed effective mallee production systems.
  - Systems produce biomass & improve water quality
  - Design criteria for integrating mallee into agriculture,
- All components of the supply chain investigated
  - Combined chipper/harvester
    - an operational prototype is under construction
- Understand prospective biomass processing options and likely early commercial developers
Main challenges

- **Policy challenges**
  - Maintaining positive policies (salinity, renewable energy and carbon)
  - Multiple policy layers (State and Commonwealth)

- **Technical challenges**
  - Reducing the cost of biomass: (species, productivity, systems)
  - Quantifying competition with crops
  - Developing a biomass supply chain

- **Financial challenges**
  - Variable environment funding (policy changes)
  - Uncertainty for farmers and environmental programs
  - Competition: solar and wind
  - Decline in oil prices
Potential for scaling-up & replicability

- **Salinity requires large scale response**
  - Existing mallees ~13,000 ha
  - Potential Woody biomass - WA wheat belt: ~1.5 - 2 M ha; ~10 M tonnes dry biomass/year
  - Use of cropping residues?
    - several million tonnes of biomass

- **Adoption across Australia’s cropping regions**
  - Multiply the potential resource 3-5 fold

- **Reduce salinity in WA water supply catchments**
  - Land clearing increased salinity (same process)
  - Integrated systems may be applicable ~100,000 ha, 100 – 200 GI water with lower salinity
Summary

- Dryland salinity is extensive across southern Australia
- Understand hydrological processes
- Large scale and cost of mitigation mean multiple actions required
- High water use systems are an important component of salinity mitigation
- Effective biomass production systems developed
- Current political and economic uncertainties have restricted expansion
Eucalypts for bioenergy
Goldfields ‘Woodlines’ 1900 -1965

- Primary energy source 1900 -1945
- 3 M ha of woodlands harvested
- ~30M tonnes of wood
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