THE BENEFITS OF BIOMASS HARVEST AND CROP ROTATION IN THE AUSTRALIAN AGRICULTURAL LANDSCAPE

Task 43

A. Which are the most suitable areas for production and/or extraction of various biomass feedstocks?

B. How can biomass feedstock production systems be located, designed and managed to increase resource use efficiency, avoid/mitigate negative and promote positive environmental, economic, and social effects?

C. How can outcomes be optimized to meet the goals of individual stakeholders and society as a whole, including environmental, economic, and social goals?

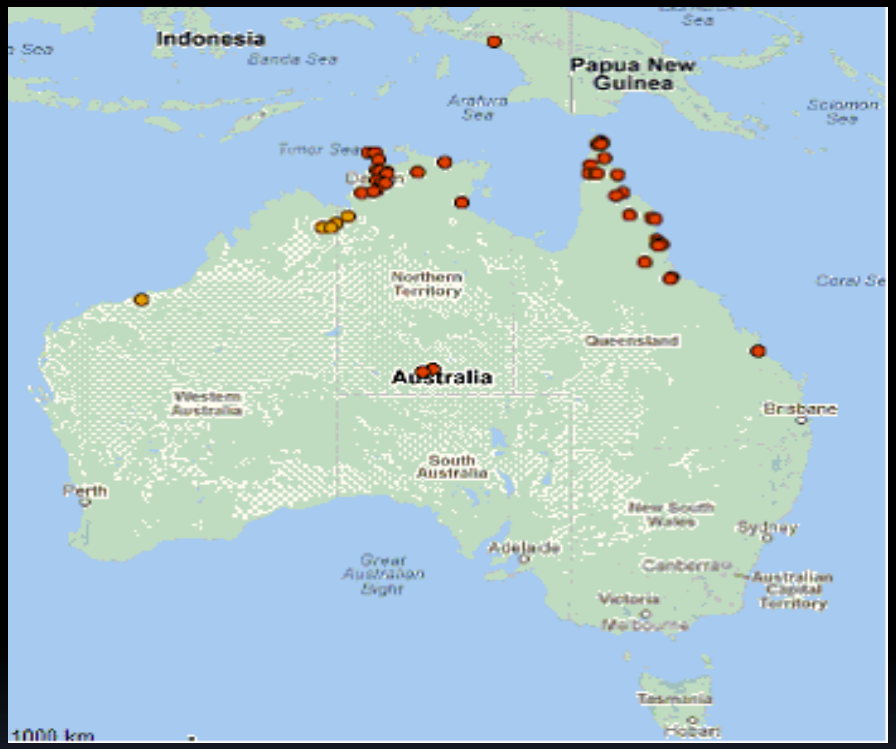
D. How can analysis and assessment inform participatory processes engaging landowners, policy makers, and other stakeholders in further developing and re-defining goals and plans for landscape management and designs?

Stubble locations & volume

20 year average crop stubble availability of 21 Mt, burning every year

This paper offers 10Mt with the balance required for organic carbon

Weed location & volume



Gamba in the Northern Territory & Far North Queensland

2000 – 7,000 Ha now 2016 – 1,200,000 Ha, burning every year

4.8 Mt available every year. Up to 4m stand needs to be harvested to remove shallow roots and restore country

Crop weed problem

Herbicide resistant weeds in Australia 2011

Annual Ryegrass	Liverseed grass
Awnless Barnyard Grass	Northern barley grass
Barnyard Grass	Paradoxa grass
Barley Grass	Serrated Tussock
Brome Grass	Silver grass
Giant Parramatta grass	Wild Oat
Goosegrass	Windmill grass
Large crab grass	Winter grass

Crop Disease problem

Crop Type and Disease	Potential yield reduction	Disease spores carried over by…
Barley		
Yellow Dwarf Virus	2 – 20%	Annual and Perennial pasture grasses and wild grasses, volunteer cereals
Canola		
Blackleg	0 – 50%	Crop residue
Faba Bean		
Chocolate Spot	30 – 50%	Crop residue, infected seed, self sown volunteer plants and sclerotia in the soil
Ascochyta Blight	10 – 30%	Crop residue, infected seed and self sown volunteer plants
Rust	0 – 30%	Crop residue and self sown volunteer plants
Field Pea		
Ascochyta Blight	0 – 45%	Crop residue, infected seed, soil borne
Lentil		
Botrytis Grey Mould	0 – 30%	Crop residue, sclerotia in the soil, host plants
Wheat		
Yellow Dwarf Virus	2 – 20%	Annual and Perennial pasture grasses and wild grasses, volunteer cereals

Disease

Heat Eradication Chart

Bacteria

Bacteria	Lethal Temperature	Time Duration	Reference
Acinetobacter baumannii	63°C/145°F	15 minutes	Dumalisile, et al., 2005
Bacillus anthracis	140°C/284°F	3 hours	Hampil, 1932; Koch, 1881
Escherichia coli	60°C/140°F	105 minutes	Abbott 2011
Klebsiella pneumoniae	60°C/140°F	105 minutes	Abbott 2011
Legionella pneumophila	60°C/140°F	30 minutes	Stout, et al., 1986
Listeria monocytogenes	63°C/145°F	30+ minutes	Rowan and Anderson 1998
Methicillin Resistant *Staphylococcus aureus* (MRSA)	65°C/149°F	45 minutes	Abbott, 2011
Mycobacterium tuberculosis	63°C/145°F	30 minutes	Connor, 2007
Pasteurella spp.	55°C/131°F	15 minutes	Health Canada, 2007
Pseudomonas aeruginosa	60°C/140°F	75 min	Abbott 2011
Salmonella sp.	60°C/140°F	60 min	Feachem 1983
Shigella sp.	55°C/131°F	1 Hour	Feachem 1983
Staphylococcus aureus	63°C/145°F	20 minutes	Dumalisile, et al., 2005
Streptococcus pyogenes	55°C/131°F	10 minutes	Jones & Martin, 2003; Day & Shaw, 2000

Excess stubble

- Above 3 tonne ha, seeding equipment and furrows are affected:
  - Hair pinning occurs – stubble wraps around tynes or discs limiting ability to create a furrow, the seed lays on top of the stubble and dies
  - Plugging occurs – stubble is dragged into the furrow, the seed fails to contact with soil sufficiently and dies

- Note : We shouldn't pelletise or export stubble with Mediterranean snails, Slugs or Diseases – Blackleg and Blights due to Bio security guidelines

The environmental imperative

	2 year rotation Maize - Soybean	3 year rotation Maize – Soybean – Oats/Red Clover	4 year rotation Maize – Soybean – Oats/Lucerne – Lucerne
Harvested Crop Mass	7.9 Mg (T) Ha	8.5 Mg (T) Ha	8.6 Mg (T) Ha
Profitability 2006 to 2011	$953+/- 36 ha	$965+/- 34 ha	$913+/- 26 ha
Weed biomass	3 +/- 0.7 kg / Mg Ha	76 +/- 1.2 kg / Mg Ha	90 +/- 1 kg / Mg Ha
Freshwater Toxicity	10,000 CTUe	100 CTUe	100 CTUe
Herbicide	1.9 +/- 0.6 kg ai Ha	0.26 +/- 0.05 kg ai Ha	0.20 +/- 0.03 kg ai Ha
Synthetic N inputs	80 +/- 3 Kg Ha	16 +/- 3 Kg Ha	11 +/- 2 Kg Ha
Fossil energy	8.6 GJ ha	4.5 GJ ha	4.2 GJ ha
Labour	1.8 hrs ha	3 hrs ha	3.5 hrs ha

Increasing cropping system diversity balances productivity, profitability and environmental health

AS Davis, JD Hill, CA Chase, AM Johanns, M Liebman - PloS one, 2012

The social imperative

- Employment - Increases by 94% in Agriculture
- Ensure Food Security – control Disease and Weeds

- The community does not want Agriculture to burn stubble & weed or create CO_2 but accepts a transition :
  - 1st generation – Bio fertiliser, Biomass pellets (bedding & absorbents) and Bioenergy (biogas & biomass combustion)
  - 2nd generation – As above minus Biomass combustion plus Biofuels (liquids)
  - 3rd generation – As above minus Biogas and Biofuels plus Bio hydrogen
  - 4th generation – As above plus Bio plastics

The economic imperative

- In 2016, research began on how agriculture could get stubble and weed to a pellet plant at a cost that enables entry into the global biomass pellet market

- That research substantiated AUD$65 per tonne for every tonne of biomass delivered to a pellet plant within a 30km radius for 90,000 tonne total p.a.

- Crop farmers benefit with combined income and savings equal to 39% of their annual harvest cost
- Pastoralists and NRM's benefit with restored country

Engaging landowners, policy makers, and stakeholders?

- Pellet exporters, Bio energy, Bio fuel, Bio bedding & absorbents plants - AUD $20 per tonne feedstock cost with a proven method to be tipping at your pits at AUD $65 tonne total cost.

- Natural Resource Managers – We will take away problem biomass at no cost to you and your budget can shift away from spraying, hazard reduction and fire fighting to clearing weed roots and restoring natural grasses, trees & shrubs.

Engaging landowners, policy makers, and stakeholders?

- Pastoralists – Savings from current weed management expense
- Crop farmers – combined income and savings equal to 39% of their annual harvest cost. Substantial capital savings on equipment. Stubble burn effort no longer required.
- Bio fertiliser – low cost feedstock: post biogas, bioenergy, bio fuel & bio hydrogen

Engaging landowners, policy makers, and stakeholders?

- Government – Jobs in Agriculture, Pre processing, Logistics, Manufacturing, Railways, Bio energy, Bio gas, Bio fuel, Bio hydrogen, Bio fertiliser and Bio plastics to help reduce job loss impacts from Tech and AI.

- Government – 50% increase in volumes on rail and 'Inland Rail' with part subsidy (like Grain)

- Education – Recognised Industry backed Certification for all of the above.

It always seems impossible until its done.

- Nelson Mandela

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