



Overview and progress report on outcomes for Project 2016-1010 “Organic and inorganic waste management at abattoirs”

AMPC Environmental Network Meeting
Oakey Beef Exports, Oakey, Queensland
16th March 2016

Project Overview

- Portfolio of three solid waste management projects relating to:
 1. Paunch management and handling
 2. Characterisation of paunch waste to inform design criteria for paunch drying/dewatering technologies
 3. Inorganic waste reduction, reuse and recycling



Project Team

National Centre for Engineering in Agriculture, University of Southern Queensland (Project 1 and 2)

- A/Prof Bernadette McCabe
- Dr Dio Antille
- Ms Jennifer Spence

All Energy PTY LTD (Project 3)

- Dr Gareth Forde

Project 1 : Paunch Management and Handling

Background – Mike Spence, Churchill Abattoir

- Paunch management has been an issue since EPA introduced in 1995
- In Qld:
 - a) Paunch is a limited regulated waste
 - b) Unless on an individual licence as a condition, cannot be used on site
 - c) As a regulated waste it has to be waste tracked and sent to a specific regulated waste business.
 - d) Disposal costs in SEQ are about \$20/cubic metre including transport



- Paunch is a prime agricultural resource
- Application to the land has no scientific or factual basis
- Regulations vary from State to State
- Project aims to identify risks and benefits to paunch application to land
- Objective is to minimize costs and maximize beneficial re-use

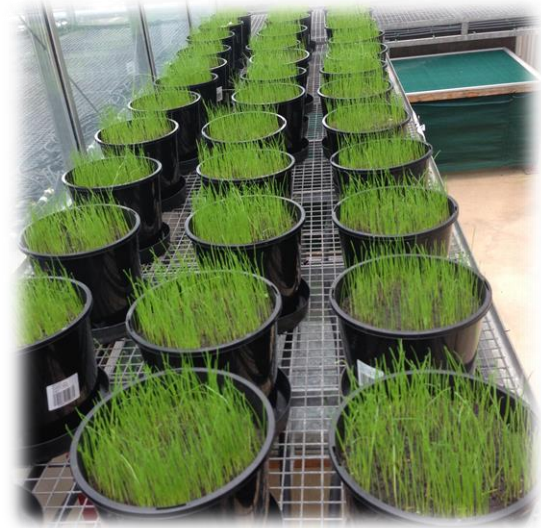


Project Objectives

- (i) Validate the criteria for paunch stabilization;
- (ii) Determine the application rates for on farm use;
and
- (iii) Develop a Beneficial Use Agreement (BUA)/End of Waste (EofW) for handling PW.



Project 1: Update on fertiliser value of paunch



Experimental

- **Germination test**
 - To determine the risk of weed infestation following soil application of paunch.
- **Incubation experiment**
 - To determine the nitrogen and phosphorus release characteristics from soil amended with paunch.
- **Glasshouse experiment**
 - To determine the yield response of ryegrass to application of paunch,
 - To quantify nitrogen uptake and nitrogen use efficiency of paunch.

Set-up

• Germination test

- Five types of paunch with different degree of stabilisation (from fresh to 16 weeks) plus a control (zero-paunch),
- Pure sand and maintained at field capacity throughout the experiment,
- Paunch applied at a 1-to-4 ratio (paunch-to-sand, by weight), and treatments replicated 5 times,
- Plant count conducted daily over a period of two weeks.

Results

- No germinations recorded over the two-week period: no effect of paunch type at the rates used in the study,
- There appears to be no risk of weed infestation following soil application.



Fig. 1: Overview of the germination trial using paunch (note the control is not shown).

Set-up

• Incubation experiment

- Semi-composted paunch (4-6 weeks), urea and single superphosphate plus a control (zero-amendment),
- Black Vertisol maintained at $25 \pm 1^\circ\text{C}$, and between field capacity (FC) and 75% of FC throughout the experiment,
- Inorganic fertiliser and paunch applied at a field equivalent rate of 300 kg ha^{-1} of N, and inorganic P adjusted to match P input with the organic amendment,
- All treatments including controls replicated 5 times,
- Sampling for soil mineral N (NH_4^+ , NO_3^-) and Colwell-P at 0, 3, 7, 15, 30, 45 and 60 days, respectively.

Results

- Ongoing experiment – five sampling events were conducted,
- Patterns of N and P release from paunch can be related to field conditions using cumulative degree-days.



Fig. 2: Overview of the incubation experiment.

Set-up

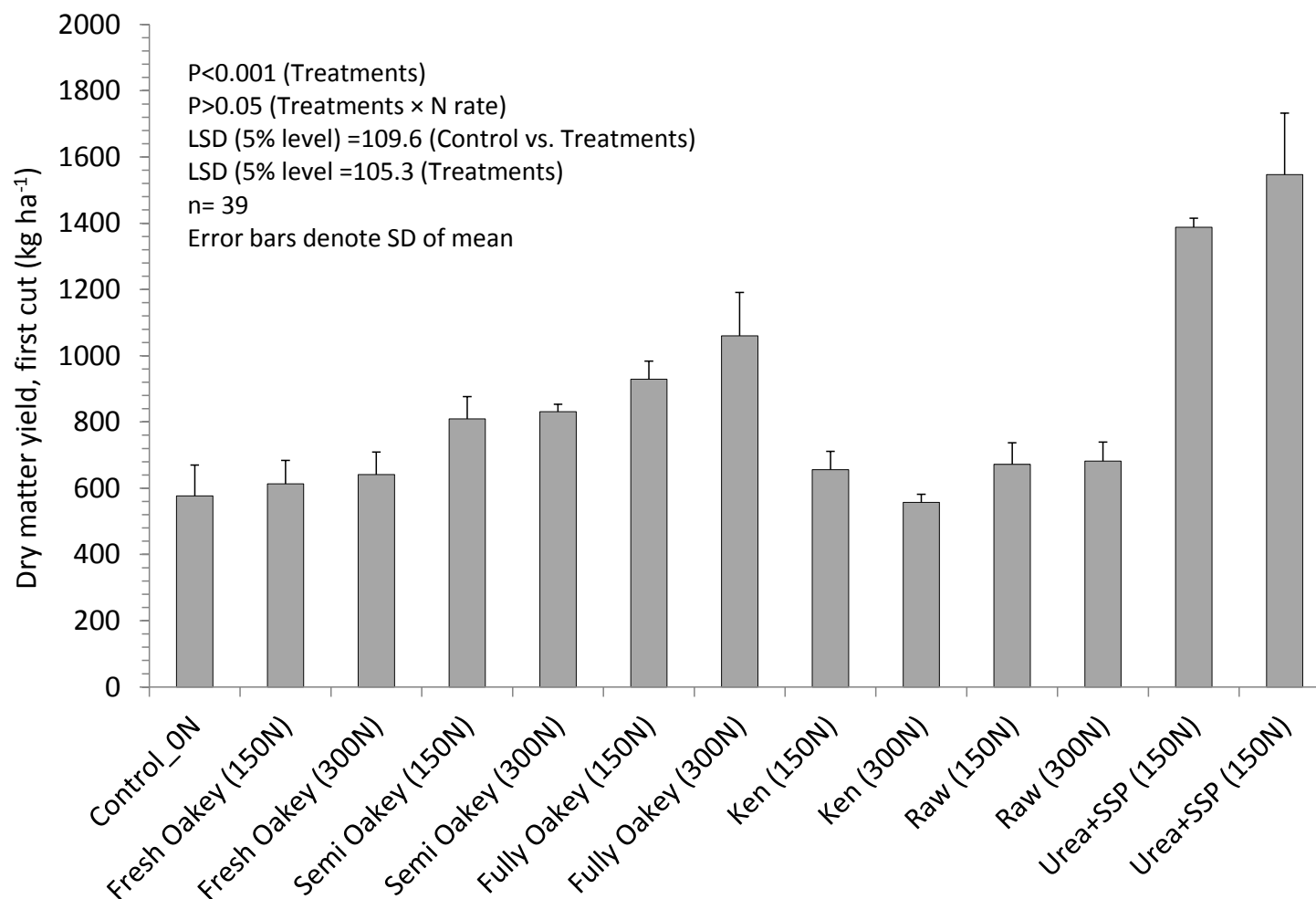
• Glasshouse experiment (Pots)

- Five types of paunch (from fresh to fully composted), urea + single superphosphate, and a control (zero-amendment),
- Black Vertisol maintained at $25 \pm 5^\circ\text{C}$, and near-field capacity throughout the experiment,
- Inorganic fertiliser and paunch applied at a field equivalent rates of 150 and 300 kg ha⁻¹ of N. Inorganic P applied on urea-treated pots only and adjusted to match P input with the organic amendment,
- All treatments including controls replicated 3 times,
- Cuts for biomass and N uptake conducted every 21 days from emergence and for a total of 3 cuts,
- Sampling for soil fertility properties before and after completion of the experiment.



Fig. 2: Overview of the pots experiment in the glasshouse (top), and close-up of a pot a week after germination (bottom).

Preliminary results: glasshouse experiment

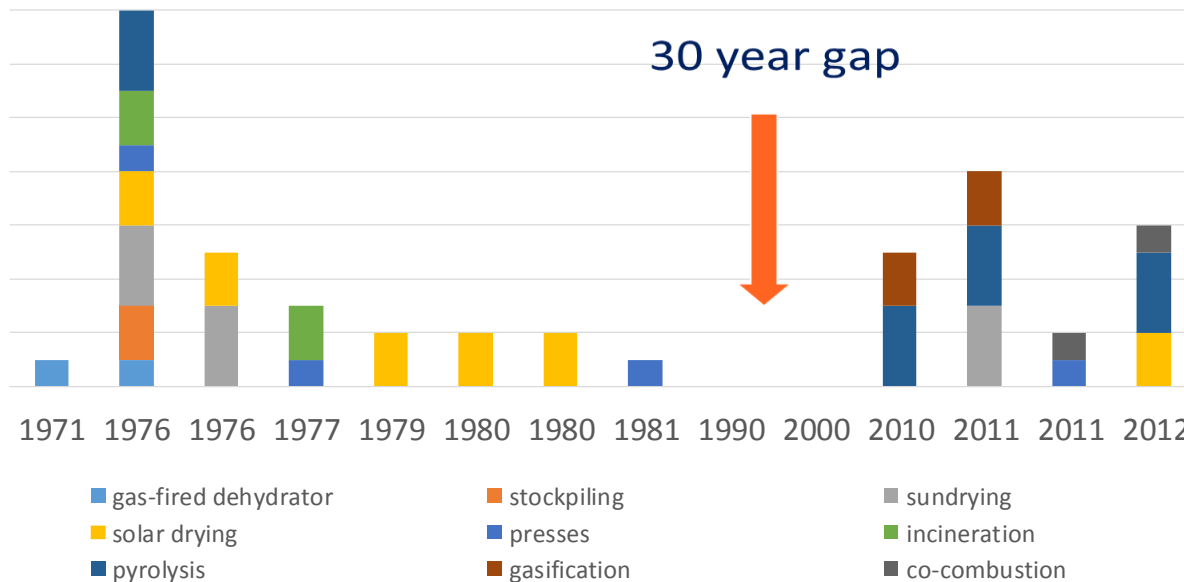


Project 2: Characterisation of paunch waste to inform criteria for drying/dewatering technology



Literature Review

- During the 1970's & early 80's a number of studies were done on treatment methods and benefits of paunch as a biomass



- Biggest problem has always been the high initial moisture content of paunch.
- Dewatering of surface moisture is not enough to lower initial moisture content to gain maximum benefit from paunch for use as a biomass.
- **Some form of drying will be required.**

Why Characterise Paunch for Drying?

- Drying characteristics allow informed decisions to be made regarding drying technology assessment and selection.
- Drying rates – what temperature and humidity are optimum?
- Equilibrium moisture content – what are the limits to drying and how will storage affect it?
- Energy content – What is the expected energy output for the specified moisture content?

Project Objectives

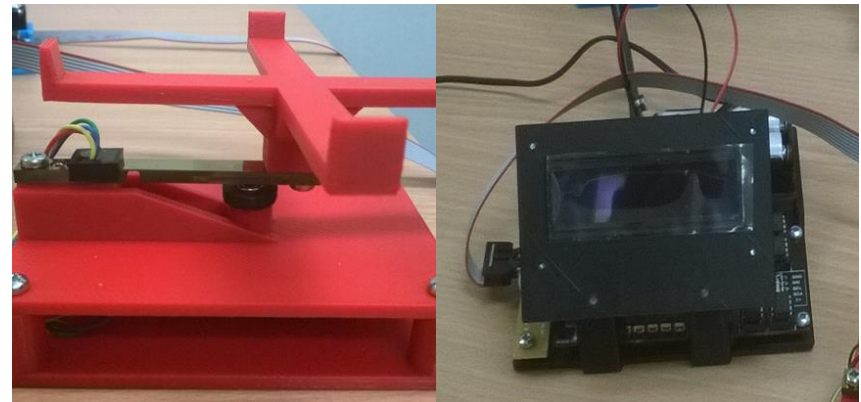
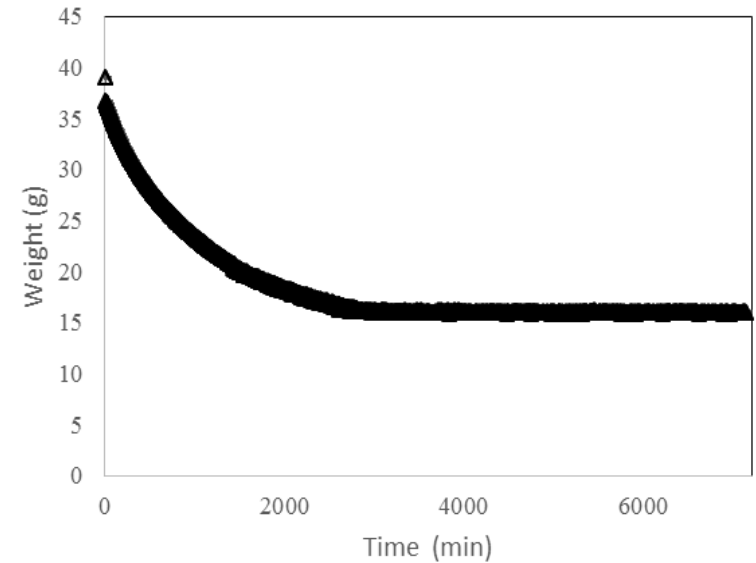
- (i) Develop a methodology to determine the drying properties and characteristics of paunch;
- (ii) Determine the optimum paunch drying times and conditions; and
- (iii) Determine whether dried paunch is a viable biofuel.

Methodology

- Drying rates obtained in a simulated thin layer dryer
- Equilibrium moisture content obtained for samples held at constant temperature and humidity for 72hrs
- An oxygen bomb calorimeter used to obtain energy content

Drying rates & EMC

The data obtained for the simulated thin layer dryer shows the load cell maintained accuracy and demonstrates an expected plateau around 15g when equilibrium was reached



Energy content

Paunch type	Average HHV (MJ/kg)
Grass	17.31 ± 0.53
Grain	20.19 ± 0.76

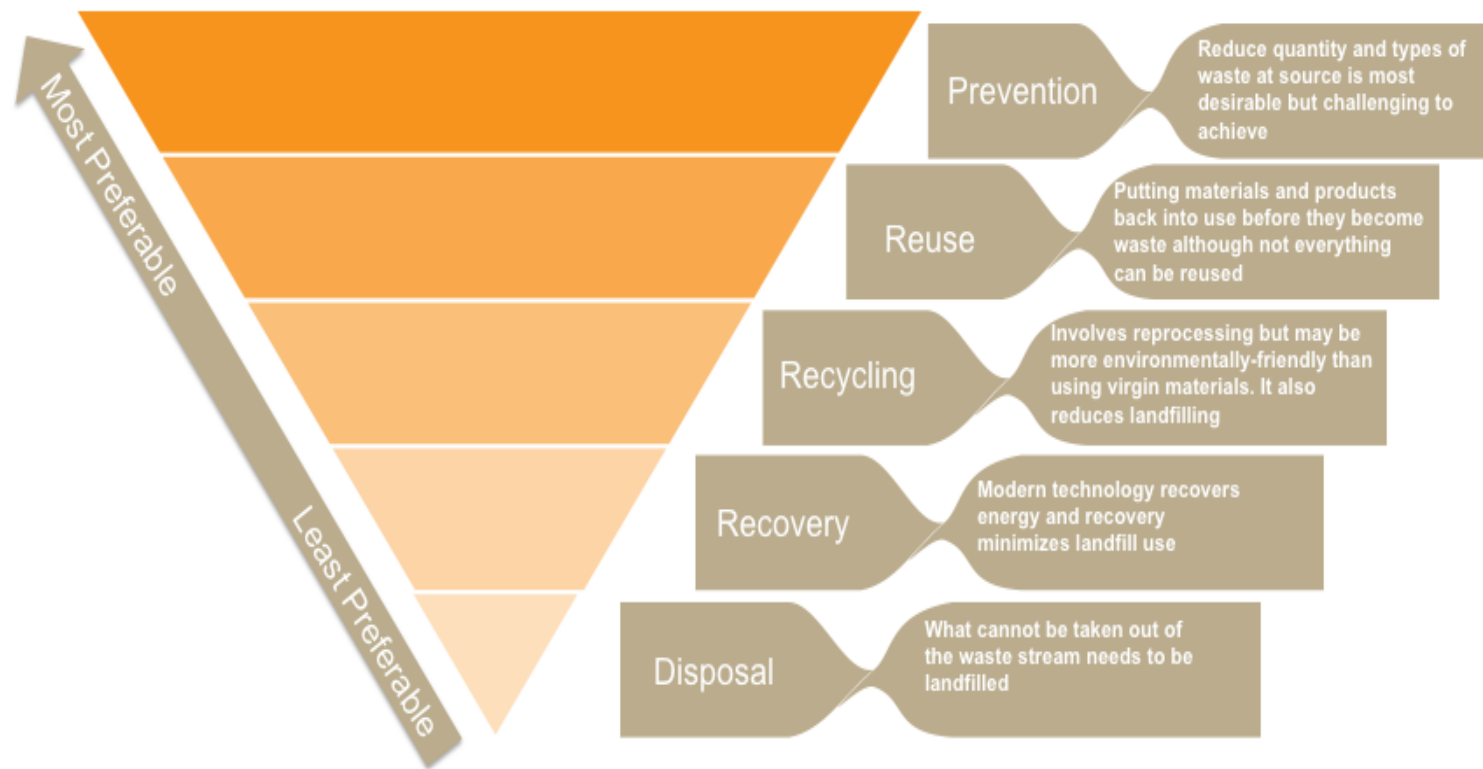


Why is this important?

- Coal substitute
- Energy benefits
- Economics
- Reduction in GHG

Paunch waste appears to be a viable site-specific bioenergy stream for the RMP industry to adopt.

Project 3 : Inorganic waste reduction, reuse and recycling



Waste hierarchy and its applicability to meat processors environmental programs



Project Objectives

- (i) Benchmark Fast Moving Consumer Good (FMGC) and Australian Red Meat Processing practices
- (ii) Develop a cost-benefit and return on investment model; and
- (iii) Develop a tabulated and graphical display between technologies to enable a clear comparison.

Work to date

- (i) Benchmarking of FMCG and Australian Meat Processing
- (ii) Review of current practices for inorganic waste reduction, reuse and recycling
- (iii) Generated a short list of opportunities for Australian processors for reduction / reuse / recycling of inorganic waste

Short list of potential areas for detailed CBA

1. Procurement of plastics and supplier requirements: A simple yet highly effective option is to be selective on the plastics that enter and are used in the facility. According to “Plastic Hierarchies”, bio/biodegradable plastics, HDPE and LDPE are most preferred with PVC being prohibited
2. Efficiency: via the use of methods such as lean manufacturing and Six Sigma, the amount of wastage and hence the amount of inorganic waste generated can be reduced whilst creating more product with less
3. Waste to energy: for example, combustion in cement kilns. One of the few options available for landfill avoidance of contaminated materials

4. Recycling: Explore options, discuss with suppliers (e.g. pallets and crates) as part of a waste management plan. Segregation e.g. lights, batteries and oil can be recycled at no cost.
5. Carton gluing rather than strapping
6. Recyclable liner-less cartons
7. Materials handling optimization: size of containers (e.g. receiving bulk materials in larger containers, computerized tracking)
8. Smarter packaging: less waste, robust, recyclable, better stacking
9. Automation or robots, in particular for packaging (e.g. carton assembly)

Process Change	Maintenance	Equipment/Plant Upgrade
\$ up to \$1,000	\$\$ \$1,000-\$10,000	\$\$\$ \$10,000-\$50,000
		\$\$\$\$ \$50,000+

	Option	Cost	Saving	Payback Period	Waste Hierarchy
Equipment	Install upgrades automated packaging equipment	\$\$\$\$	Waste material and packaging quantity	2-5 years	Prevention
Process	Collection of bailed contaminated waste to EfW	\$	Landfill Costs	<1 year	Recovery
Process and Equipment	Delivery of Bailed contaminated waste to EfW (with minor pre treatment)	\$\$	Landfill Costs	1-2 years	Recovery
Equipment	Investment in reusable crates and pallets	\$\$\$	Re purchasing of disposal packaging and transport containers	2 years	Reuse

Example of CBA template for waste treatment / Disposal Options

Processors...your participation in a detailed CBA for inorganic waste would be appreciated!

1. Procurement of plastics: A simple yet highly effective option is to be selective with plastics that enter and are used in the facility. According to "Plastic Hierarchies", bio/biodegradable plastics, HDPE and LDPE are most preferred with PVC being prohibited.
2. Materials handling optimization: size of containers (e.g. receiving bulk materials in larger containers, computerized tracking)
3. Automation: in particular for packaging (e.g. roboticized carton assembly)

Alternatively, please suggest a project which you have in mind.. Thanks



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