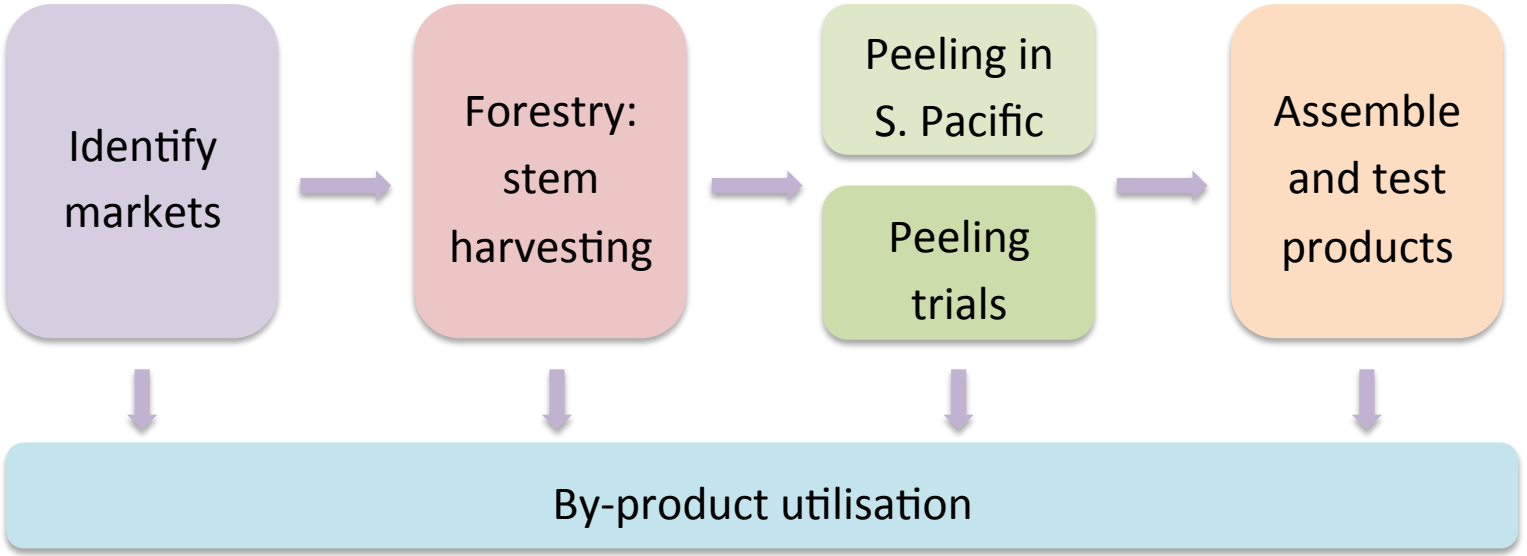
Objective 6

Determine the costs and benefits of using the residual cortex and soft, central cores for bio-char and other agricultural products

Project Objectives



Objective 6 – By-product utilisation

By-product utilisation

Objective 6 - Determine the costs and benefits of using the residual cortex and soft, central cores for bio-char and other agricultural products

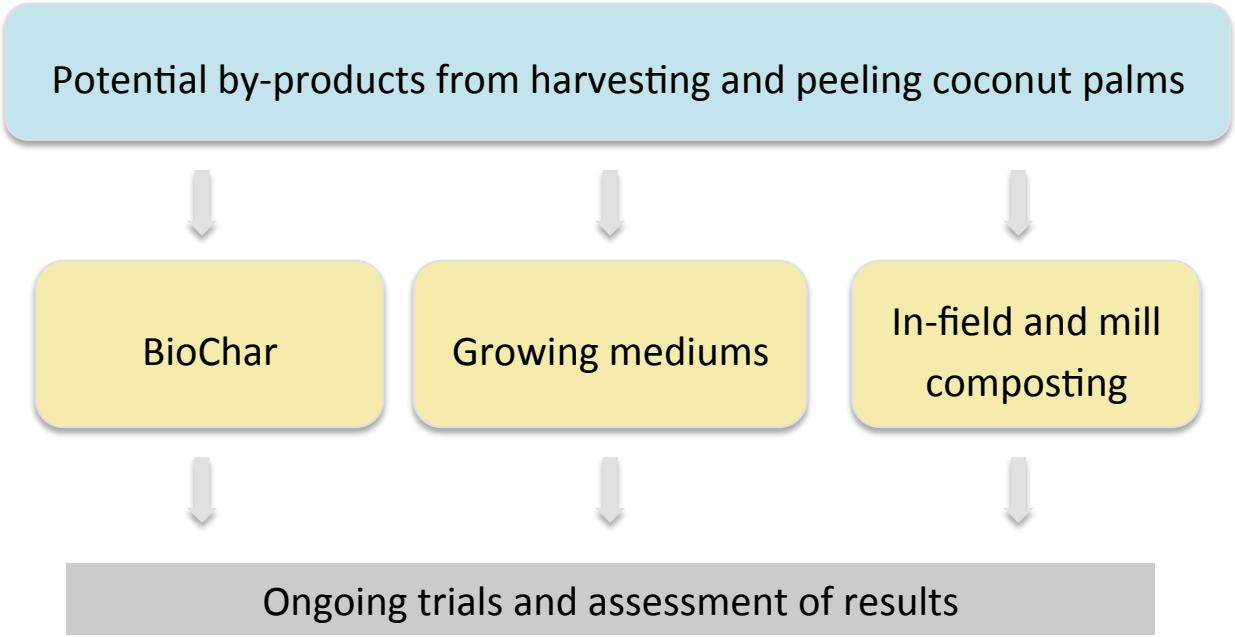
6.1 – Collaboration with agricultural projects

- Pot trials
- Composting

6.2 – Biochar

Objective 6 – By-product utilisation

Objective 6 – By-product utilisation



6. 1 By-product utilisation

Previous ACIAR published work by Gary Hopewell and Rachel Poulter at Agri-Science Queensland, in 2010, showed that coconut wood has suitable physical properties for a growing medium.

Physical analysis of fine ground cocowood medium compared with coir media

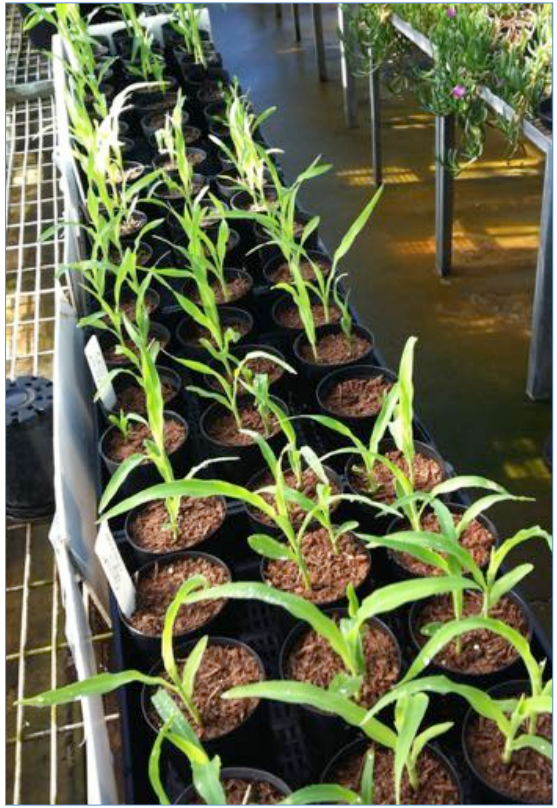
Parameter	**Cocowood (fine-ground)**	**Coir 1***	**Coir 2***	**Recommended range** (Bodman and Sharman, 1993)
Air filled porosity	34.18%	16%	35%	5-20%
Water holding capacity	44.41%	35%	64%	>40%
Water retention efficiency	61.33%	46%	63%	No data
Wettability	55 seconds	<5 seconds	15 seconds	No data
Bulk density	0.09 (g/vol)	0.07	0.08	<1.2
pH	6.22	5.84	6.4	4.7-7
Electrical conductivity	1727μS/cm	629	2254 μS/cm	<700- 1800

*source: Poulter *et al*., 2009

6.1 By-product utilisation

In 2014, coconut woodchip were used as a plant growing medium and as a substrate for mushroom production.

6.1 By-product utilisation



Plant growth trials were established to compare germination and growth rates of sweet corn in a coconut chip substrate with other growing media

6.1 By-product utilisation

Growing mix	% Germination rate at 14 days	Plant height (cm) at 14 days
Coconut wood chip	83	5.2
Coconut wood chip + Nutrients	87	6.3
Potting mix	85	9.5
Potting mix + Nutrients	83	10.7

Evaluation of Coconut chips as a growing medium for sweet corn

6.1 By-product utilisation

Nutrient		Growing Medium: Coconut Wood Nil Fertiliser	Growing Medium: Coconut Wood with Fertiliser	Premium Potting Mix
Kjeldahl Nitrogen	%	1.11	4.50	1.10
Phosphorus	%	0.30	0.77	0.22
Potassium	%	2.67	5.38	1.57
Calcium	%	0.45	0.85	0.29
Magnesium	%	0.31	0.49	0.20
Sulphur	%	0.15	0.41	0.17
Manganese	mg/kg	55	130	39
Zinc	mg/kg	47	80	29
Copper	mg/kg	8.6	14	9.8
Iron	mg/kg	53	28	38
Boron	mg/kg	6	54	7

A comparison of leaf dry matter from plants grown in coconut woodchip and a standard potting mix

6.1 By-product utilisation

A comparison of ground coconut woodchip to the Australian Potting Mix Standard AS3743 -2003

Nutrient		Units	*Ground coconut woodchip*	*Potting Mix*	*Status*
Air-filled Porosity		%	25	*≥13*	*Pass*
Total Water Holding Capacity		%	**42**	*≥50*	*Fail*
Wettability		min	1m 20s	*≤2*	*Pass*
pH (1:1.5)		pH units	6.1	*5.3 - 6.5*	*Pass*
Electrical Conductivity (1:1.5)		dS/m	**5.4**	*≤2.2*	*Fail*
Chloride	Cl	mg/L	162	*≤200*	*Pass*
Ammonium	N	mg/L	2.75	*≤100*	*Pass*
NH4 + NO3	N	mg/L	**2.96**	*≥50*	*Fail*
Nitrogen Drawdown Index		NDI	To come	*≥0.7*	*Pass*
Toxicity		mm	To come	*≥70*	*Pass*
Phosphorus	P	mg/L	14	*8 to 40*	*Pass*
Potassium	K	mg/L	55	*≥30*	*Pass*
Sulfur	S	mg/L	**8**	*≥40*	*Fail*
Calcium	Ca	mg/L	**28**	*≥80*	*Fail*
Magnesium	Mg	mg/L	25	*≥15*	*Pass*
Ca:Mg Ratio		Ratio	**1.1**	*1.5 to 10*	*Pass*
K:Mg Ratio		Ratio	2.2	*1 to 7*	*Pass*
Sodium	Na	mg/L	**511**	*≤130*	*Fail*
Iron	Fe	mg/L	**1.0**	*≥25*	*Fail*
Copper	Cu	mg/L	**0.1**	*0.4 to 15*	*Fail*
Zinc	Zn	mg/L	1.0	*0.3 to 10*	*Pass*
Manganese	Mn	mg/L	1.0	*1 to 15*	*Pass*
Boron	B	mg/L	0.07	*0.02 to 0.65*	*Pass*

6.1 By-product utilisation

Potential composting of coconut palm log harvesting residues.

Residual material from the recent harvesting of coconut palms at Graham Haynes Estate near Savusavu.

6.1 By-product utilisation

CSAW is presently trial composting coconut woodchip on a garden-scale to examine end-product properties.

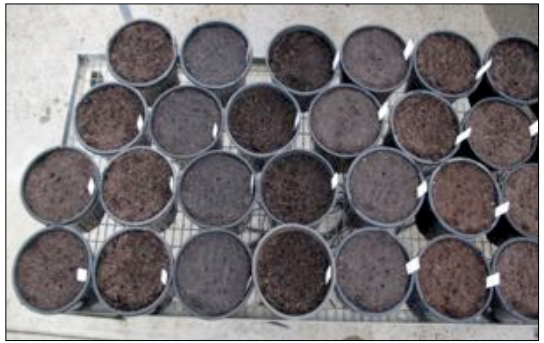
6.1 By-product utilisation

Composting coconut palm log harvest residues would be particularly useful for most site rehabilitation options

6.1 By-product utilisation

- Several unsuccessful attempts were made to arranged trials in Labasa and Savusavu.
- Now attempting to organise trials in Samoa and Suva.
- The key is availability of a chipper.

6.2 - Biochar

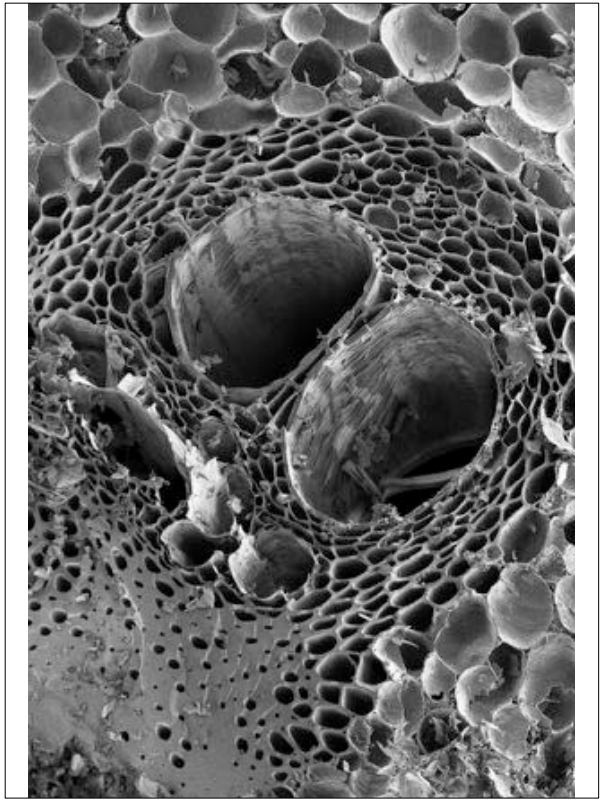


- Any biomass can be processed into biochar but the final product depends largely on feedstock chosen.
- Product properties produced depends on the temperature and time taken for pyrolysis.
- The main property is carbon in a stable form, which can remain in soil for a long period.
- Results from application vary greatly depending on the type of soil.
  - In general the worse soil quality, the more noticeable results are observed.

Objective 6 – By-product utilisation

- Benefits from biochar are not universal
  - Soil types respond differently
- Applying biochar to soil in the Pacific may have beneficial effects
  - Increased crop productivity through higher nutrient use efficiency
  - A retention of nutrients - limits nutrient leaching
  - An increase in water-holding capacity
  - A decrease in soil acidity

6.2 - Biochar



- Coconut woodchip were pyrolised into three different biochars.
- These were analysed to determine chemical and physical properties.
- The biochars were used in a field trial in Taveuni.
- Pot trials scheduled at UTas.

Biochar from coconut wood pyrolysis

6.2 – Biochar field trial

In Taveuni, all biochars were crushed in a modified grinder

Primed treatments were mixed with fishmeal; soft rock phosphate fortified with additional K; molasses; a small amount of compost; water.

Treatments spread and mixed with tractor mounted rotivator.

6.2 – Biochar field trial

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Results

No statistically significant differences in mean corm weight between biochar treatments .

No consistent effects of initial feedstock, pyrolysis temperature, rate of biochar and priming.

Objective 6 – By-product utilisation

By-product utilisation

In Summary

- Biochar will have a liming effect, increase K and P soil availability with a possible increase in cation exchange

  (Mg^{++}, Na^{+}, Ca^{++}, Al^{+++}, K^{+}).
- At sawdust particle size coconut wood is showing potential as a plant growing medium.
- Coconut woodchip can be used as a mushroom growing substrate.
- Composting coconut wood could provide a plant nutrient rich medium for crop production.

Objective 6 – By-product utilisation

By-product utilisation

Key completion dates –

Activity	Planned	Actual
Mulching trials complete	April 2014	Ongoing
Assessment of biochar completed	November 2013	April 2014
Biochar produced and used in trials	July 2014	August 2014
Fijiian biochar production trial and reported	November 2014	April 2015

Objective 6 – By-product utilisation

Questions?

Ask Greg or email:
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Australian Government
Australian Centre for International Agricultural Research

Queensland Government

SPC Secretariat of the Pacific Community

UTAS

centre for sustainable architecture with wood
CSAW