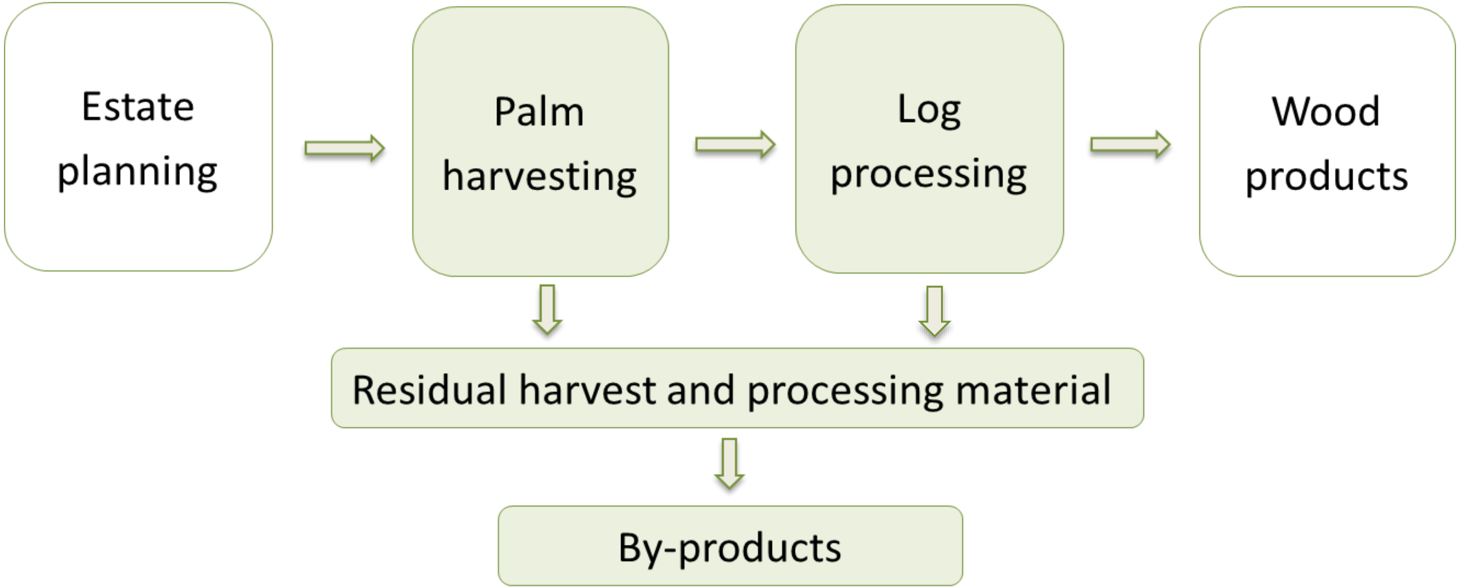
Australian Government
Australian Centre for International Agricultural Research
Queensland Government
Pacific Community
Communauté du Pacifique
UNIVERSITY of TASMANIA

Objective 6

CSAW

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

Objective 6 – By-products



Objective 6 – By-products

Coconut palm harvesting residues

Palm selection for peeling trials

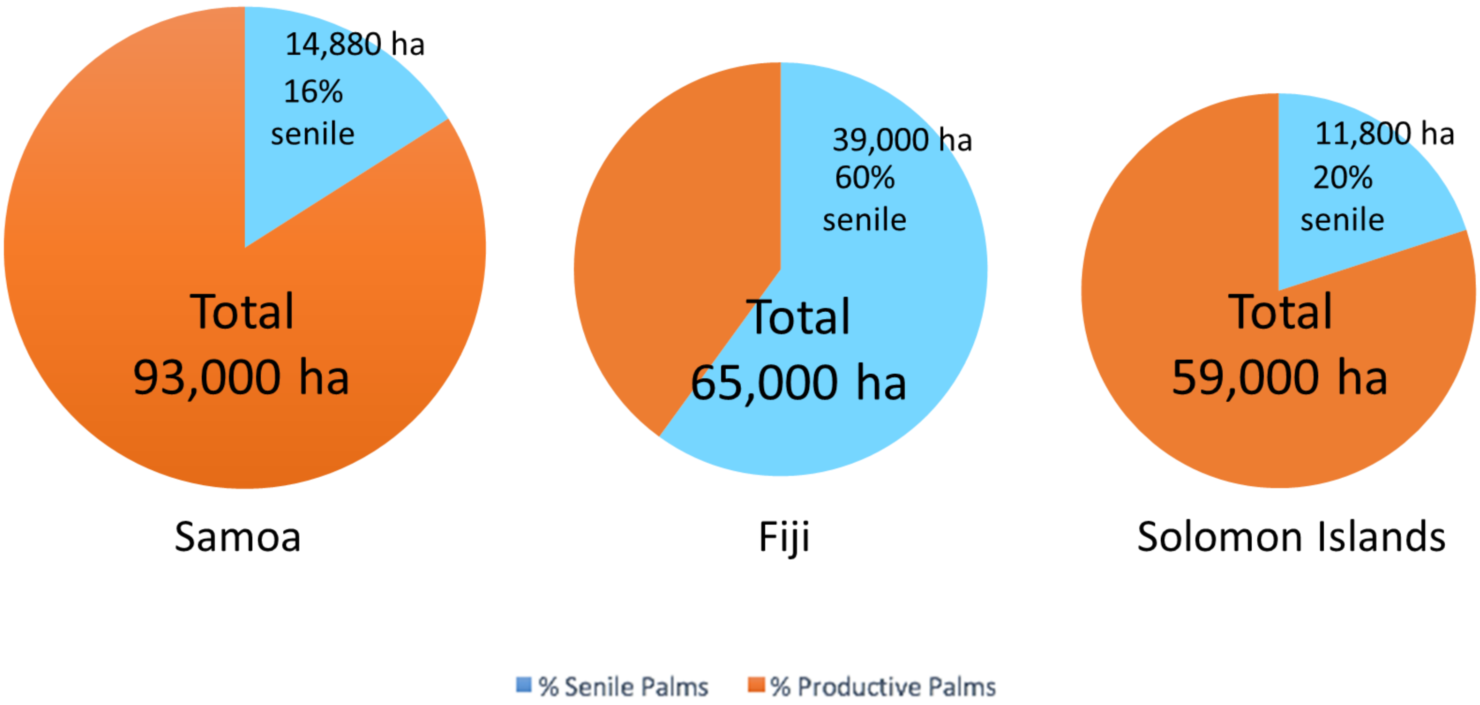
(Savusavu, Vanua Levu. Fiji. 2015)

Objective 6 – By-products

Coconut log processing residues

(Labasa, Vanua Levu. Fiji. 2014)

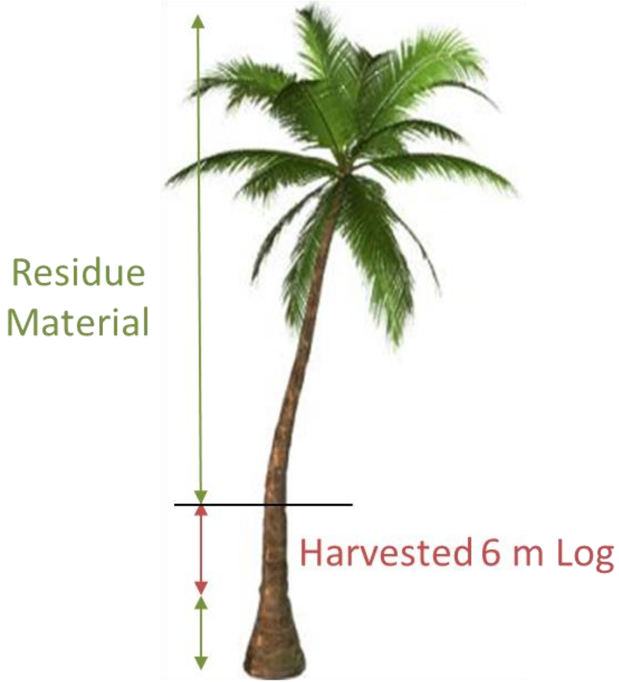
Objective 6 – By-products



Objective 6 – By-products

Estimated volume of harvesting residues – 20 hectare plantation, 60 year rotation

Postharvest Rotation Years	Fiji Vol.m3	Solomon Islands Vol.m3	Samoa Vol.m3
Immediate harvest	390	291	235
Year 5	351	369	235
Year 10	351	369	352
Year 15	351	369	352
Year 20	351	369	352
Year 25	351	369	352
Year 30	351	272	274
Year 35	351	272	274
Year 40	351	272	274
Year 45	351	233	274
Year 50	117	233	274
Year 55	117	233	274
Year 60	117	233	274



Objective 6 – By-products

Potential coconut palm by-products

- Fuelwood
- Growing mediums
- Biochars
- Compost

Objective 6 By-products – Fuelwood

Table 3. A comparison of the energy content of various fuel types used across the South Pacific Islands (derived from Mario, R. 2000)

Fuelwood

Fuel	Gigajoules per Tonne
Automotive Gasoline or Diesel	46
Liquid Petroleum Gas	49.4
Coconut Oil	38.4
Charcoal	30.0
Wood waste @ 40 % moisture content	10.8
Wood waste @ 12 % moisture content	17.1
Coconut palm wood	11.5
Coconut shell and husk	14.0
Sugar bagasse	9.7

Objective 6 By-products – Fuelwood

Tropik wood Industries limited

Objective 6 By-products – Fuelwood

A jet-box continuous veneer dryer processing 50,000 cubic metres of veneer a year requires a 16 MW biomass heat-plant that would consume an estimated. 25,000 tonnes of biomass wood residue.

Objective 6 By-products – Growing mediums

Growing mediums

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	1727mS/cm	629	2254 mS/cm	<700- 1800

*source: Poulter *et al*., 2009

Objective 6 By-products – Growing mediums

Test Required: Australian Standard Applicable:			**Sample 1** 240393-Coconut Wood Chips CA-PACK-007 Premium AS3743/2003	***Requirment*** AS3743/2003	***Status***
Nutrient		Units	**E3286/1**	***Potting Mix***	
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*
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*
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*

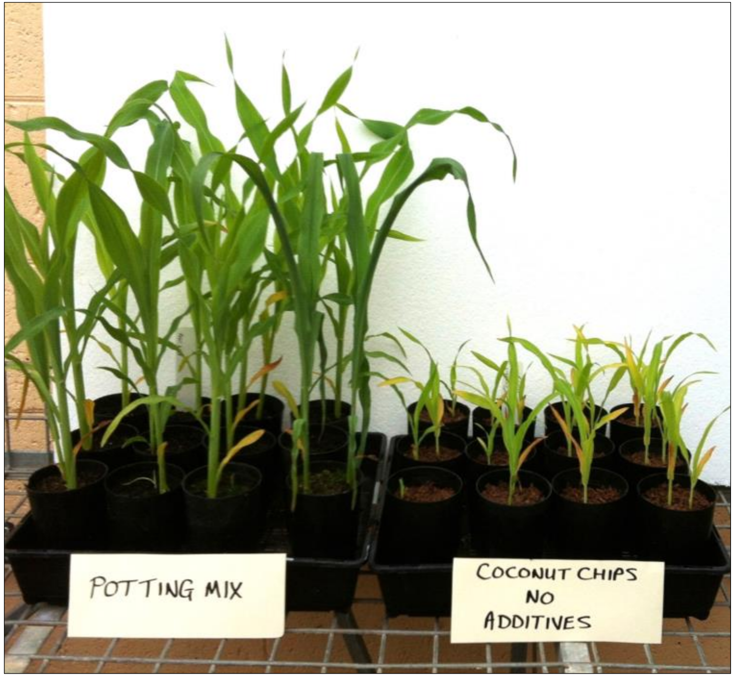
Objective 6 By-products – Growing mediums

Good mycellium growth through the substrate

Mushroom production, but very poor yields

By-products – Growing mediums

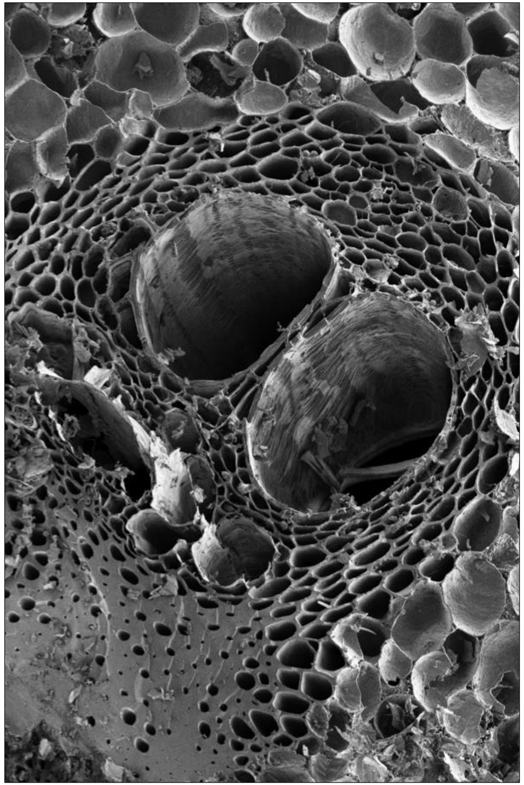
Plant growth trials were established to compare germination and growth rates of sweet corn



Objective 6 By-products – Biochars

Biochars

Biochars from the pyrolysis of coconut wood



Objective 6 By-products – Biochars

Benefits from biochar are not universal

- Soil types respond differently

Applying biochar to soils in the Pacific Islands 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

Objective 6 By-products – Biochars



Objective 6 By-products – Biochars

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-products – Growing mediums

Compost

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

Objective 6 By-products – Compost

Compost

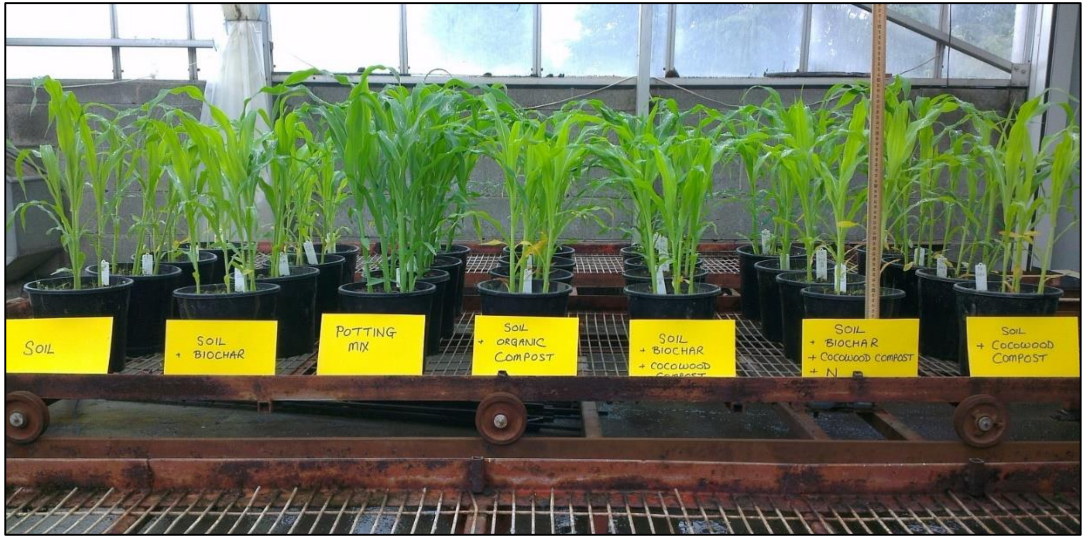
CSAW has trial composted coconut woodchip on a garden-scale to examine end-product properties.

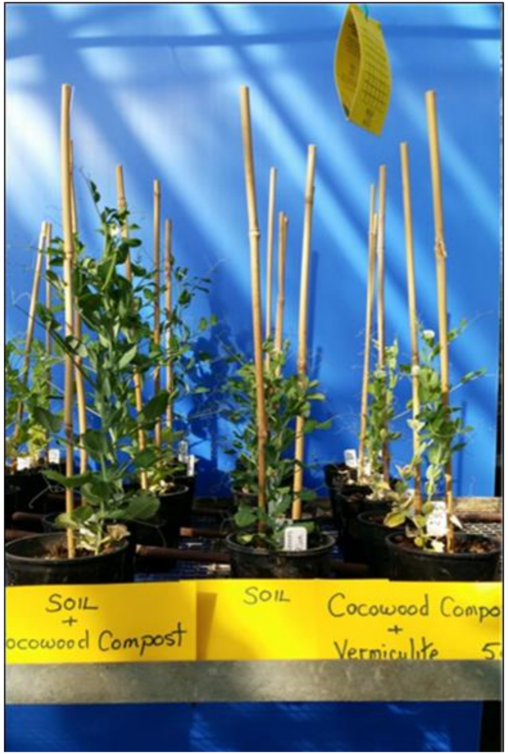
12 weeks

Objective 6 By-products – Compost

Aust. Std. AS3743:2003	Nutrient	Units	Value	Acceptable Range
Moisture Content		%	74	*>40*
Air-filled Porosity		%	..	*?13*
Total Water Holding Capacity		%	..	*?40*
Wettability		min	..	*?5*
pH (1:1.5)		pH units	7.3	*5.3 to 6.5*
Electrical Conductivity (1:1.5)		dS/m	1.62 5.4	*?2.2*
Chloride	Cl	mg/L	98	*?200*
Ammonium	N	mg/L	28.12	*?100*
NH4 + NO3	N	mg/L	3.8	*..*
Nitrogen Drawdown Index		NDI	..	*?0.2*
Toxicity		mm	..	*?70*
Phosphorus	P	mg/L	424	*..*
Potassium	K	mg/L	824	*?30*
Sulfur	S	mg/L	86	*..*
Calcium	Ca	mg/L	568	*?50*
Magnesium	Mg	mg/L	214	*?15*
Ca:Mg Ratio		Ratio	2.7	*1.5 to 10*
K:Mg Ratio		Ratio	3.9	*1 to 7*
Sodium	Na	mg/L	195 511	*?130*
Iron	Fe	mg/L	10.3	*?25*
Copper	Cu	mg/L	1.96	*0.4 to 15*
Zinc	Zn	mg/L	22.8	*0.3 to 10*
Manganese	Mn	mg/L	14	*1 to 15*
Boron	B	mg/L	1.14	*0.02 to 0.65*

By-products – Compost





A second series of plant growth trials were established to again compare germination and growth rates of sweet corn and peas

By-products – Compost

Sweet corn and Pea growth trial results –
mean dry weights

Treatment	Sweet Corn 9 weeks	Peas 6 weeks
Soil	12.53 g	1.87 g
Soil and CWC	16.77 g	4.93 g
Soil, CWC and biochar	22.13 g	-

Objective 6 By-products – In summary

	Fiji Vol.m3	Solomon Islands Vol.m3	Samoa Vol.m3
Average residue from 20 ha every 5-years	300	299	292
Total estate residue every 5-years	585,038	176,326	217,253
Total estate residue every year	117,008	35,265	43,451

By-products – Questions