Coconut wood characteristics

Coconut wood:

Potential log supply and characteristics.

Contents

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- Senility profile and estate renewal: Nut and log supply impacts.
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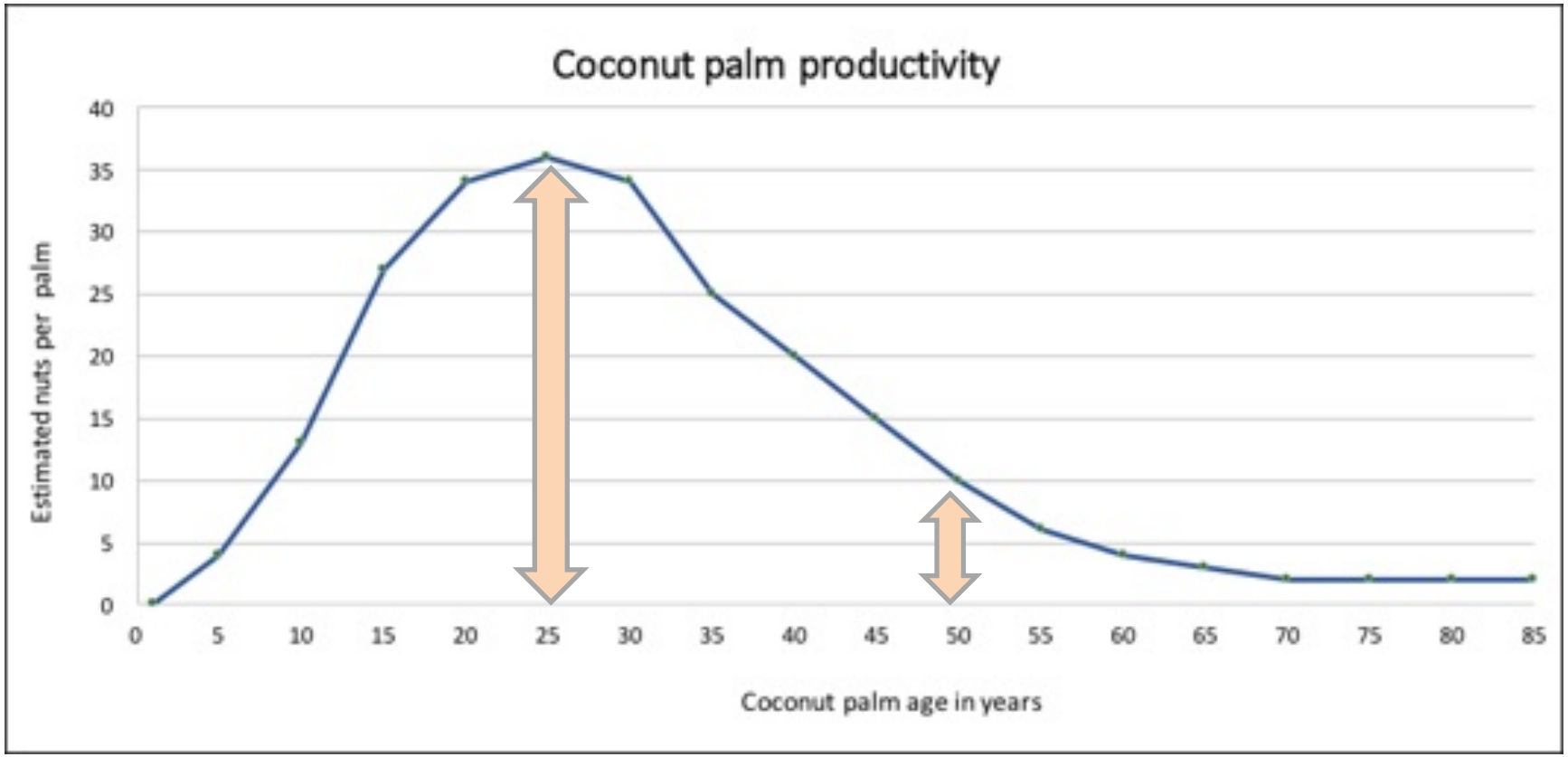
- CocoWood characteristics: Impacts on processing and products.

Coconut in community

- Coconut plantations are a valuable economic and social resource for South Pacific communities.
- However, many palms in South Pacific coconut plantations are old and have lost their vitality and productivity.

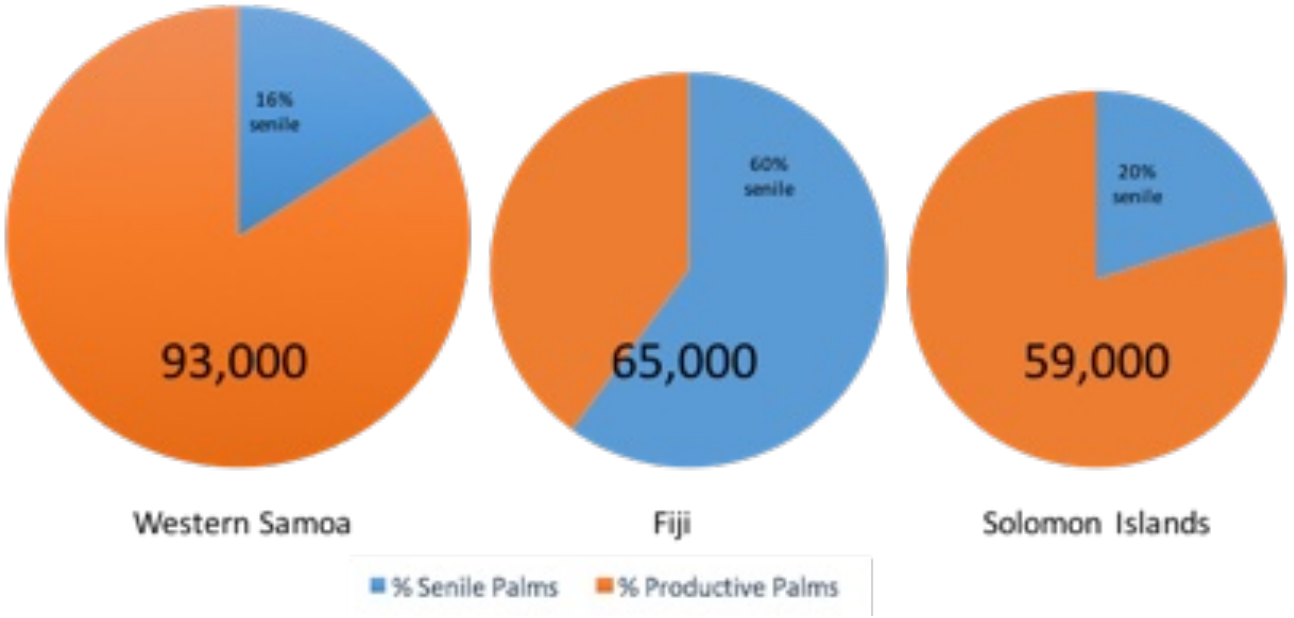
Impacts of coconut senility



Trend of coconut nut productivity yields with palm age *Source: Forstreuter, SPC 2013*

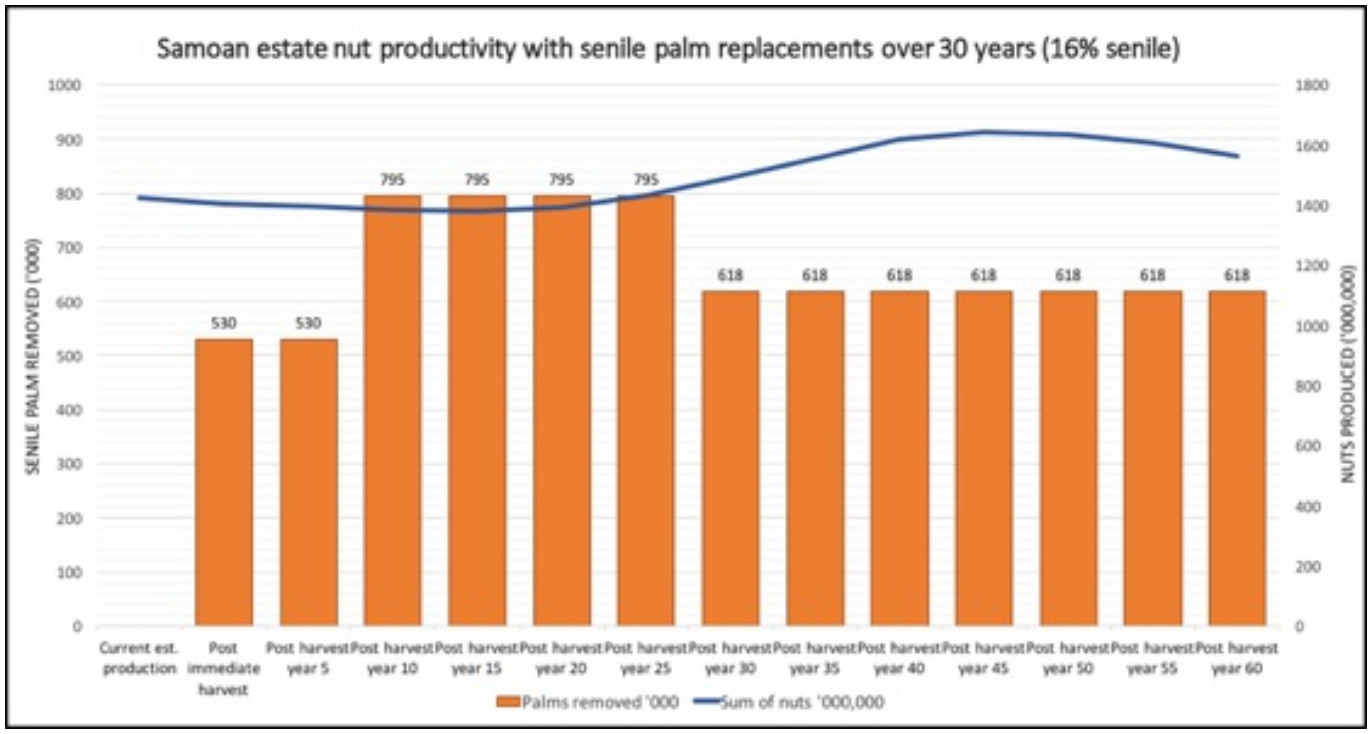
Extent of the senile estate

The profile of aging or senile palms in the estate creates an increasing drag on community income and development.



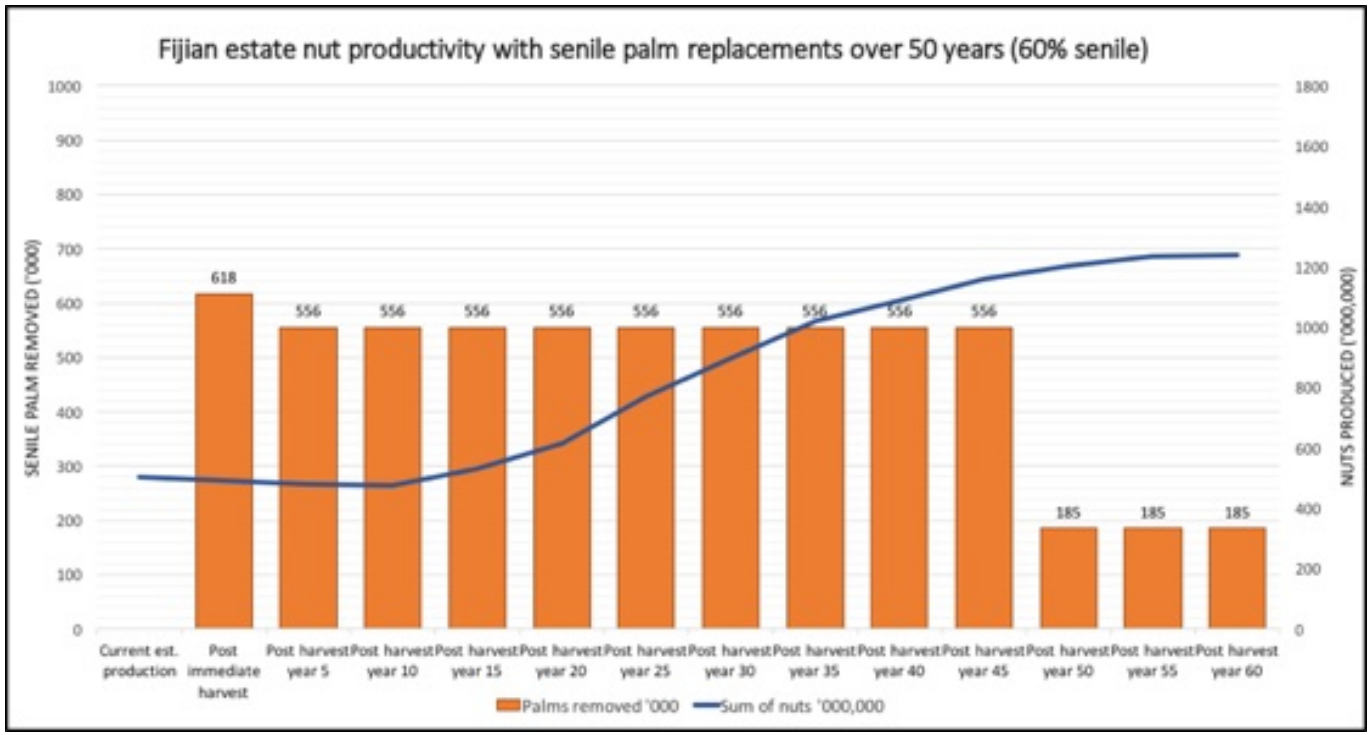
	Samoa	Fiji	Solomon Is
Total area of coconut plantations (ha)	93,000	65,000	59,000
Percentage area of senile palms (%)	16	60	20
Total area of senile palms (ha)	14,880	39,000	11,800

Impacts of coconut renewal - Samoa



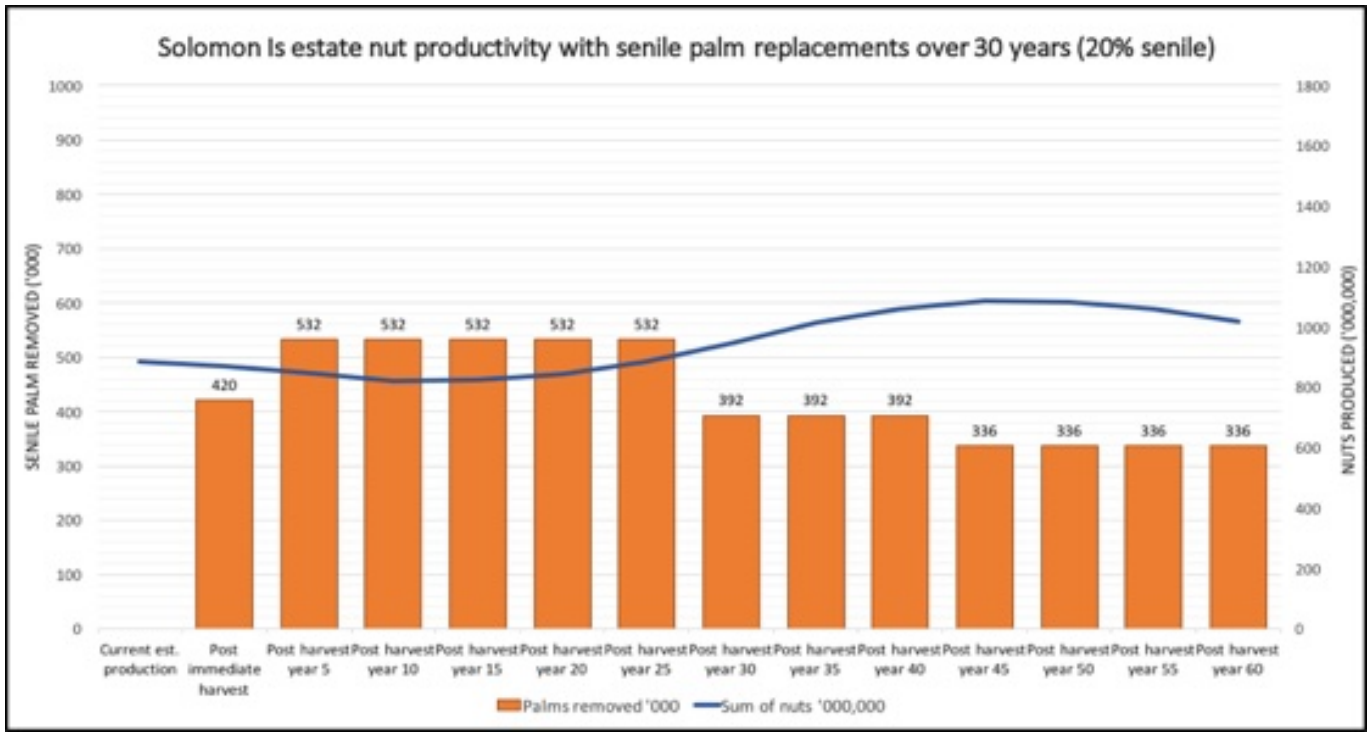
- Based on constant estate area with renewal over 30 years with harvest event at 5 yearly intervals.
- Nut production increases ~ 115% at year 45.
- Significant log supply generated.

Impacts of coconut renewal - Fiji



- Based on constant estate area with renewal over 50 years with harvest event at 5 yearly intervals.
- Nut production increases ~ 230% at year 45.
- Significant log supply generated.

Impact of coconut renewal – Solomon Is



- Based on constant estate area with renewal over 30 years with harvest event at 5 yearly intervals.
- Nut production increases ~ 120% at year 45.
- Significant log supply generated.

Coconut renewal generates a resource

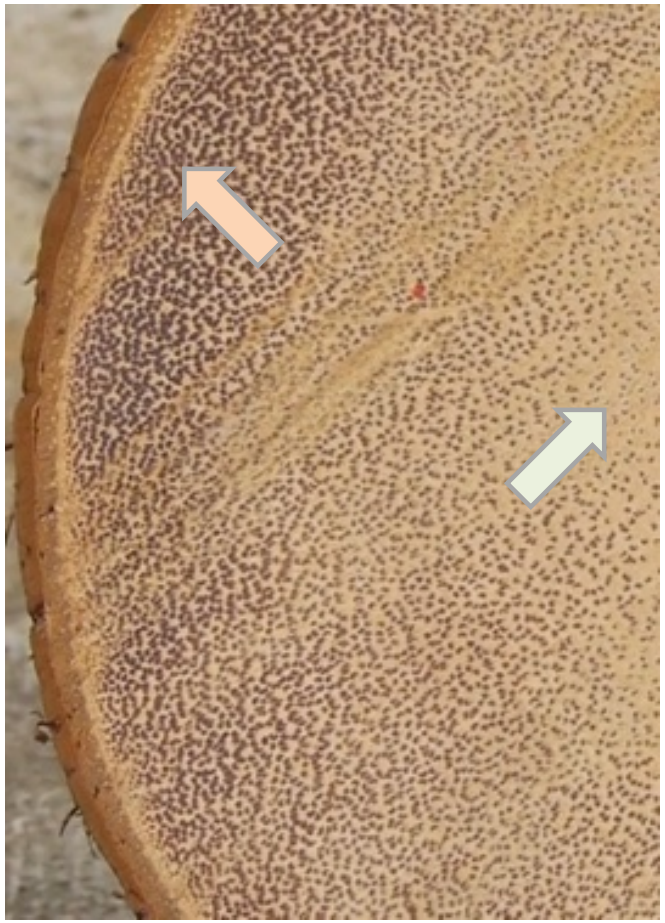
Harvest of senile palms during estate renewal generates:

- Saw and peeler logs for wood products.
- Residue products:
  - At the estate: a bole, upper stem and fronds.
  - At the process mill

Character of coconut wood

- The coconut palm is a monocot (grass).
  - It is not a true wood.
- The stem's vascular structure is different to traditional timber.
- Logs are small at ~ < 350 mm diameter with:
  - A high density zone towards the periphery and the base.
  - A low density inner zone.

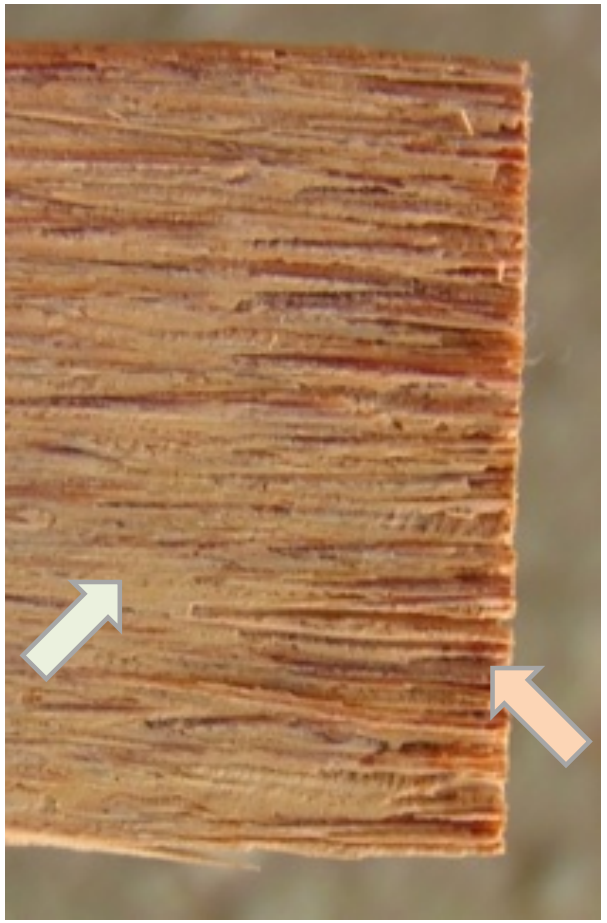
Coconut wood cell structure



The wood consists of high density vascular bundles in a matrix of spongy, low-density, parenchyma tissue.

There is low radial and tangential connection between bundles.

Bundles are clustered at the outside of the stem.



Coconut wood cell structure

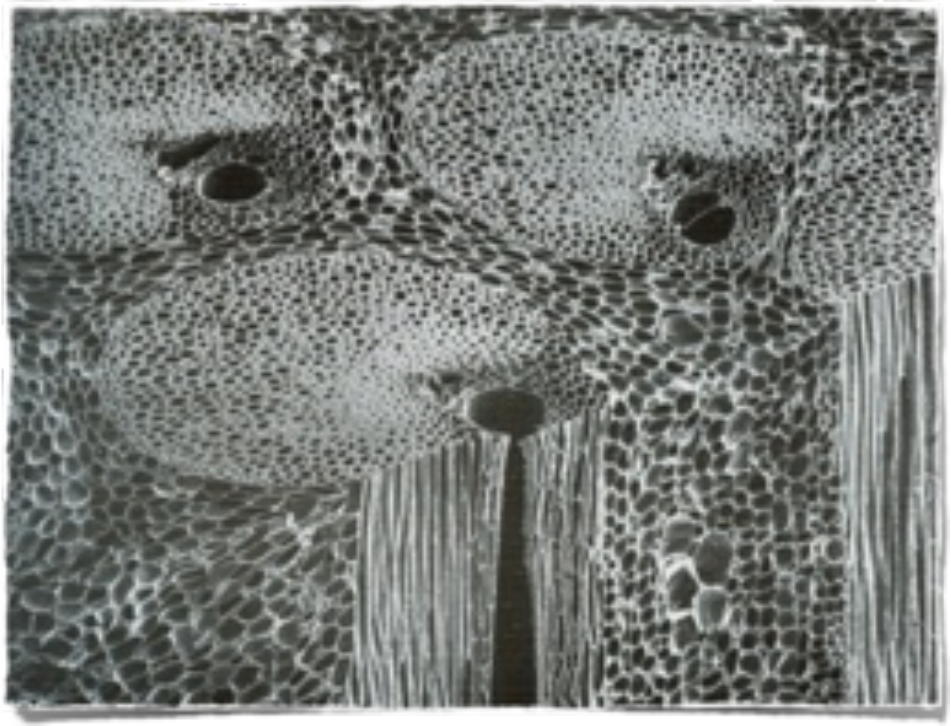


Image from QDAF CocoWood project

Density variation in coconut wood

Density decreases with bundle frequency

- From the outside of the stem to the middle.
- Up the stem from the base.

Density range:

- > 800 kg m^3
- < 300 kg m^3

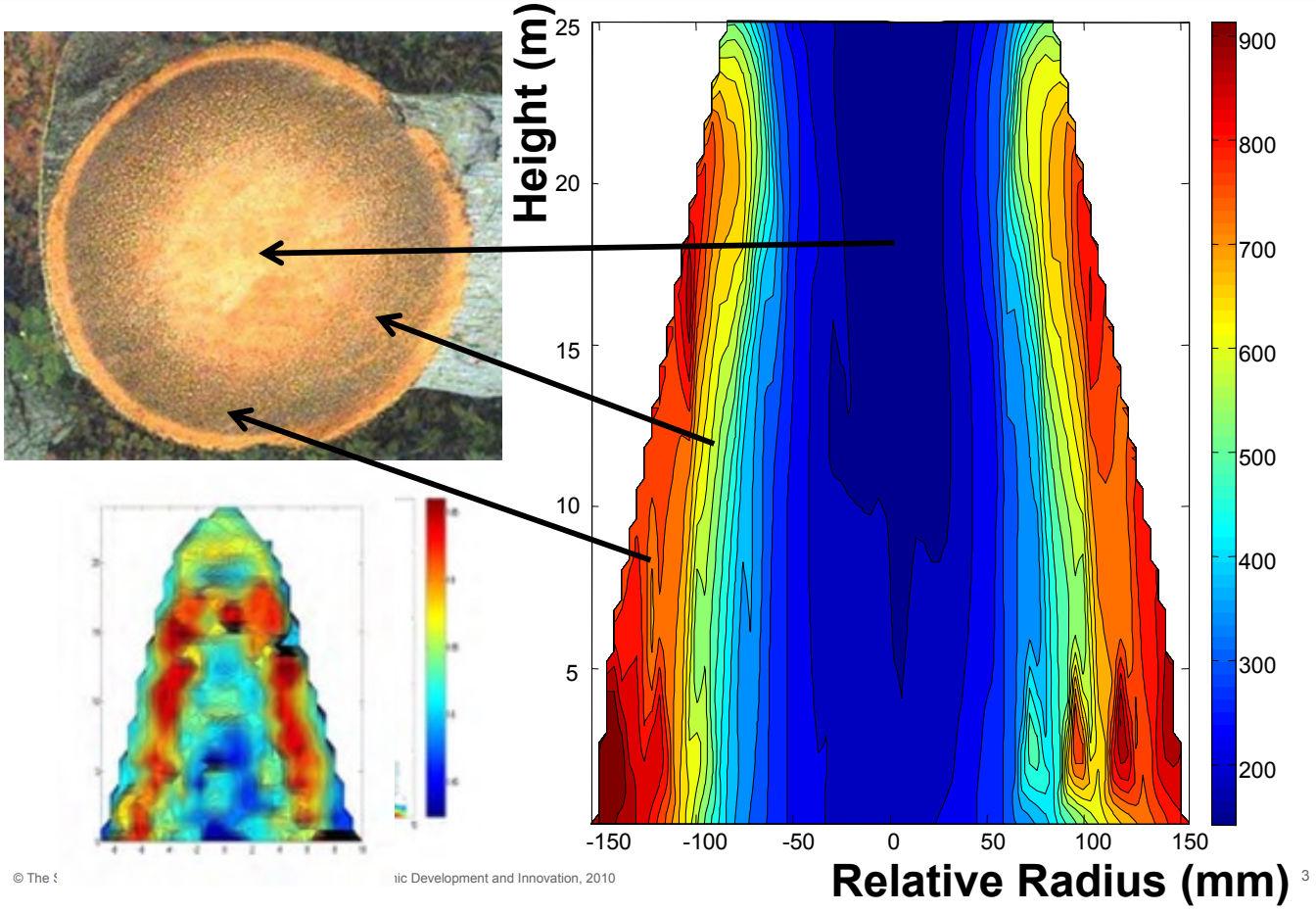


Image from QDAF CocoWood project

Coconut applications

- Coconut stems can be used in the round, sawn into board, or peeled into veneer.
- The stem's vascular structure and small log diameters complicate conversion.
  - Board recovery of dense material is limited to the outside zone.
  - High density vascular material can be difficult to cut cleanly in veneering.
  - Other characteristics are also different to true wood.

Cocowood properties

Table 1. Physical, mechanical and chemical properties of the coconut palm (*Cocos nucifera*)

Physical Properties (units)	**Range = low-high density fibre**
Density – basic (kg/m^3)	100-1020 [a]
Density – air dry (kg/m^3)	200-1170 [a]
Density for flooring products (Janka hardness >7) (kg/m^3)	>700 [a]
Specific gravity	0.26-0.59 [d]
Shrinkage: tangential, green to dry (%)	3.0-6.0 [b,c,d]
Shrinkage: radial, green to dry (%)	2.7-7.4 [b,c,d]
Unit shrinkage: tangential	0.05-0.42 I high density: 0.32-0.38 [a]
Unit shrinkage: radial	0.05-0.34 I high density: 0.24-0.3 [a]
Workability	Firm to hard; use sharp tools
Mechanical Properties (units)	
Modulus of elasticity: dry (GPa)	2-25 [a] I high density: 11.4 [c]
Modulus of rupture: dry (GPa)	28-205 [a] I high density: 104 [c]
Maximum crushing strength: dry (MPa)	19-57 [c] I high density: 40 [a]
Janka hardness: dry (kN)	0.7-23.9 [a]
Chemical Properties (units)	
Inorganic pure ash (%)	0.75 (0.25-2.4) [a]
Silica (%)	0.07 (0.01-0.2) [a]
Lignin (%)	25.1 [d]
Holocellulose (%)	66.7 [d]
Pentosans (%)	22.9 [d]
Starch (%)	4.3-4.6 [e] (> 6 m/old; starch reduces with age)
pH	6.2 [e]
Durability, susceptibility to pests and staining	
Natural durability above-ground (averaged over all densities)	Class 4; life expectancy 0-7 years [f]
Natural durability below-ground (averaged over all densities)	Class 4; life expectancy 0-5 years [f]
Susceptibility to *Lyctus*	Not susceptible [b,f]
Termite resistance (averaged over all densities)	Not resistant [a]
Staining	Susceptible to staining [b]

Coconut wood properties are available from QDAF CocoWood project on: cocowood.net

Summary

- Many South Pacific coconut palms are old with low productivity.
- Coconut estate renewal can generate increased nut production and stems to process.
- Coconut wood is not true wood. Its vascular structure creates considerable variability.
- Density varies from the outside of the stem to the core, and up the stem from the base. Density range: > 800 kg m^3 & < 300 kg m^3
- Coconut stems can be used in the round, sawn into board, or peeled into veneer.

Questions