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Potential for profitable coconut production in northern Queensland

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Abstract

Although there is no tradition of coconut (*Cocos nucifera*) production in tropical Australia, there are subcoastal environments where it could be highly productive. On good quality, well-watered sugarcane lands the coconut is potentially quite productive and also could add some environmental amenity to the land. A lucrative market for home-grown fresh fruit could be developed. Technology for processing to high-value virgin oil on an appropriate scale has been refined already for small-island situations, and virgin oil technology might find an Australian niche in some situations. The presence of an Australian-based coconut industry, even on the most modest scale, might help in persuading Australians that coconut is a valuable health-promoting food. Turning the attention of Australian food researchers to coconut would provide an opportunity to redeem coconut oil from its bad reputation, which was constructed solely by competing oil marketers.

Introduction

The coconut (*Cocos nucifera*) palm, which is prominent in the food and trade economies of all peoples located in humid tropical coastlands and islands throughout the world, has a curiously low profile in Australia. Except for the Melanesian peoples of the Torres Strait Islands close to Papua New Guinea, there were no significant numbers of palms growing, and no coconut tradition, among the indigenous inhabitants of tropical northern Australia. While coconut seeds undoubtedly washed ashore in great numbers on the north-east coast of Australia, in particular, those that were not opened by the voracious native white-tailed rat were consumed as fortunate gifts from the sea by the human hunter-gatherers of the region. Any young palms that did become established on less-frequented strands provided a delicious meal of 'cabbage' when eventually discovered. With very few exceptions the coconut palm was absent from tropical Australia before European settlement began in the early 19th century.

During the early settlement period mariners operating in the vicinity of the tropical Australian coast were encouraged to plant coconut palms as a potential source of emergency food in case of shipwreck. Later, missionaries on Cape York planted coconuts for food, to help support settlements of Aboriginal people. Early in the 20th century the Australian Government encouraged some northern Queensland investment in coconut plantings in response to a very high price for coconut oil. These did not succeed as labour for processing was poorly skilled and too expensive, whereas contemporary plantations throughout the South Pacific were highly profitable (Foale 2003).

The dominance of coconut oil in the world market for edible and industrial vegetable oil has long gone, but virgin coconut oil (VCO) derived from cold pressing or biological separation is perhaps fetching a high enough price for local production from the coconut to find a niche in the Australian economy. The perceived need for diversification of products to supplement income from traditional sugarcane lands (ABC TV *Landline*, 3 April 2005) offers a possible opening for coconut to become a component of the production systems of suitable environments in tropical Australia.

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The coconut palm as a crop

The coconut palm is best known in tropical Australia as an ornamental plant that contributes to the atmosphere of tourist resorts and urban streetscapes. There is considerable farming experience that could be drawn upon for the management of coconut as a productive crop, yielding fresh fruit of mid, late and full maturity for various direct-to-consumer markets, but especially for the mature fruit to be processed for oil production.

The Tall form of coconut is best suited to oil production, having more oil in the kernel and larger fruit than the Dwarf form, which produces high-quality drinking nuts. A Tall palm would probably 'deliver' its first mature fruit at 5–6 years of age and reach maximum productivity at 15–20 years, by which time the trunk would be 6–8 m tall. The Dwarf variety bears fruit 1–2 years earlier but gains height at less than half the rate of the Tall. Where temperature fluctuation between seasons is moderate, both Dwarf and Tall forms of the coconut produce fruit regularly, usually achieving 12 or more bunches/year.

The potential productivity of a coconut monoculture depends on the environment, but under ideal conditions, comprising a non-seasonal mean temperature around 28 ^{o}C and rainfall around 3,000 mm per year, Tall palms could produce more than 3 t/ha/year of oil and 1 ha of Dwarf palms could produce 25,000 fruit/year. It may be possible to use a simulation tool to calculate the likely yield performance for several different locations in northern Australia, where seasonal water deficit and lower-than-ideal temperature would constrain productivity.

Possible field arrangements for a coconut crop

A Dwarf coconut plantation to produce drink products might well be suited to a monoculture arrangement on land close to an urban market or a concentration of tourist venues. The Tall varieties, on the other hand, could be planted as a companion crop on sugarcane farms, to provide another source of income that could be earned at regular short intervals.

Where the land is to be shared between sugarcane and coconut, strips of palms comprising two or three rows could be planted across the paddock, oriented to provide some protection against the most likely direction of cane-damaging wind. The proportion of land that is to be occupied by the coconut palms would need to be worked out in advance against the predicted value of the two products and the anticipated benefit to the business of having a diverse product base. Coconut rows that occupy one-tenth of the land might be a good starting point. In this case triple rows of palms that occupy a band 24 m wide would be separated by a strip of sugarcane 216 m wide. Closer spacing of the strips might be wise where the risk of wind damage is greater.

Coconut fruit could be harvested simply by mechanical raking and collection from the ground, every 2 months, from a particular section. This time interval carries only a low risk of spoilage of the fruit due to sprouting or pest attack. The palm rows would be 7–8 m apart, allowing for movement of an adapted rake that could direct the fruit into a holding bin. The fruit could be processed on an appropriate scale to yield VCO of high value. As production grew in a given region, the fruit would be delivered to the site of the cane mill, where an industrial-scale coconut processor would operate.

Local establishment and management costs

Establishment

A number of steps would have to be followed if coconut were to be established and brought into production in northern Australia, as follows:

- A specialised nursery is needed to raise seedlings in large poly-bags to reach about 12 months of age. Initially, seeds would need to be imported, possibly as embryos that are transplanted into surrogate nuts. A possible source of high-value embryos could be the coconut research centre on Santo Island in Vanuatu. The cost of raising such planting material to the field-ready stage is not known (at least AUS$25/palm), but the technology for embryo transplanting has been developed by University of Queensland (Samosir and Adkins 2005).
- Early management of the field planting could involve continuing to grow cane between the rows of young palms for 2 years, with a row spacing of 7–8 m. In the absence of an intercrop the ground cover would require regular mowing combined with chemical ring-weeding close to each palm. Cultivation for weed control between the palms is advised against as feeder roots are active close to the soil surface.

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- Young palms are fairly susceptible to attack from the *Brontispa* leaf beetle but simple protection can be provided by applying pesticide to the emerging ‘spear’ (the youngest frond not yet opened). There is the possibility of other insects such as locusts damaging the coconut leaf and, if needed, there should be robust protection against grazing animals that find the leaf of the coconut particularly attractive. The feral rat and some species of native rat (e.g. the large white-tailed rat) could damage immature fruit on the palm. The best protection against rats is a metal sheet wrapped around the trunk to deny the pest any grip when attempting to climb the palm.
- Depending on the fertility status of the soil, there will be a requirement for addition of fertiliser to achieve the potential growth of the young palm. At the very least some nitrogen, phosphorus and potash will be needed. The amount can be determined by foliar diagnosis, which works very well for coconut. The coconut has a particularly high need for potash; however, this nutrient is vulnerable to leaching, particularly from light-textured soils where rainfall is high. Close to the coast there may be a significant amount of salt delivered in the rainfall, which will increase the leaching of potassium. Fertiliser application is therefore best done two or three times/year, placing it close to the young palm but enlarging the area of application as the palm grows (Foale 2003).
- Tall palms are generally cross-pollinating as the active stages of the separate male and female flowers do not coincide. Both wind- and insect-borne pollen usually abound, so there is little risk of poor pollination where there are many palms together. Fruit set falls in response to the stress of water deficit. Persistent rain for several days can also prevent pollination and cause failure of fruit setting. There is a tendency for the coconut palm to experience alternating periods of high and low yield, as a large maturing crop evidently suppresses fruit set in younger bunches and vice versa.

Harvesting and processing

Appropriate harvesting and processing technology would have to be developed if coconut was to become productive in northern Australia:

- Mechanical collection of fallen fruit is indicated for an oil production enterprise in the Australian context of high labour cost. An interval of 2 months between collection events would be suitable. Climbing or the use of a cherry picker may be economical where there is a market for fresh fruit for drinking.
- The whole mature coconut fruit comprises a layer of shock-absorbing husk surrounding the shell and kernel. The fruit can be transported and handled in bulk, and stored in an exposed heap for 1 or 2 weeks before processing, without loss of yield or quality of the oil. Fruit that has a visible shoot should be separated, as enzyme action of the seedling on the kernel has already affected the chemistry and flavour of the oil. Such fruit could provide excellent pig or cattle feed.
- The most practical processing option for a large turnover involves a feed-race that pushes the fruit lengthways through a band saw. A water jet directed at the centre of the kernel in the half nut lifts the kernel out in one piece. The kernel pieces are then shredded finely and this material is passed through a fluidised-bed drier to a press which extracts the VCO. This is a continuous flow process involving an interval of only a few minutes from fruit opening to oil pressing. Up to 25,000 fruit/shift (7–8 hours), producing about 2,000 L of oil, could be processed with an installation costing AUS$5–6 million.
- There are small-scale options for VCO production, but as these are quite labour intensive they are more suited to a ‘cottage-scale’ operation. For example, the DME system of Kokonut Pacific Pty Ltd has a potential throughput of 400 fruit in an 8-hour shift operated by three skilled workers. The output would be around 40 L of cold-pressed VCO for an investment in equipment of AUS$1,200 plus the cost of labour to construct the drier.
- In several Asian countries the traditional method of separating the VCO from the kernel is to employ fermentation of extracted coconut milk. The activity of yeasts in the milk at ambient temperature (around 28 ^{o}C usually) breaks down the natural stabiliser that keeps the oil suspended in fresh coconut milk, such that the oil rises to the surface. This appears to be particularly a cottage-based process although large volumes can be accumulated by entrepreneurs to build marketing strength. Quality control, particularly of free fatty acid, would be a challenge where many suppliers are contributing.
- The principal by-products of VCO production are the residue of the kernel following separation of

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80% of the oil during processing, and the husk and shell. In the water-jet process, machinery is provided to hammer the husk and shell and then separate the three components (fibres, coir pith and shell fragments) over a sieve. An air draft allows the shell fragments to fall through the sieve, while the fibre and pith are blown and shaken into separate bins. The shell can be directed to charcoal and activated carbon production while the husk components have horticultural and industrial uses. The pith or cortex goes into potting mixes and the fibre may be used for matting to protect steep landscape surfaces and the edges of road cuttings, besides the traditional domestic matting uses.

- The residual kernel has potential value as human or livestock food. Where VCO has been produced by pressing dried shreds, the residue contains more than 20% oil. If the water content is reduced below 8% this has an extended shelf life. Fine grinding of the residue to a flour-like particle size provides an attractive additive to combine with wheat flour for breadmaking, as well as being successful in many other baked products. The potential for other cooking uses are many for both this fine material and the coarser material direct from the expeller, as has been explored most thoroughly in the Philippines. The high residual oil is a valuable component for supplements in the diet of small children in the tropics, containing high energy as well as a valuable protein content at 10% or more concentration.
- The best-known product from coconut plantations for over a century up to the present is copra, the dried kernel that can be stored and transported for a period of months without significant loss of its oil content. The oil quality may suffer, however, if the period is prolonged, because a small fraction of coconut oil is unsaturated and vulnerable to release of free fatty acids. In addition, the risk of invasion by insects and microorganisms increases over time and these can cause significant loss of oil quality.

Copra can be pressed at high temperature to produce a lower grade oil that needs refining, bleaching and deodorising before it is suitable for conversion to soap, detergent, shampoo or skin lotion. The price of copra at the farm gate is currently equivalent to about AUS$0.25/L of oil. Some farmers selling to a VCO factory are paid the equivalent of AUS$0.40 for the fruit needed to produce 1 L oil, while the VCO from those fruit may be worth AUS$3–4 at the factory door. It is too early to estimate production costs for a large-scale VCO production unit operating in tropical Australia. A notional calculation of the gross return to the farmer, based on production of 10,000 fruit/ha and a price of AUS$0.10/fruit at the factory door provides a figure of AUS$1,000/ha equivalent of coconut palms. This is based on a spacing in field strips that gives 160 palms/ha of land actually occupied by the strip. The factory operator in this case has an outlay of AUS$1.00/L for raw fruit.

Potential benefits of a significant coconut enterprise in tropical Australia

A coconut industry in northern Australia could have the following impacts in this region:

- Sugarcane farmers, whose product is harvested over a few months each year, would have the benefit of a regular monthly flow of income over the whole year from another product. The deep-rooted coconut palm would be expected to extract deeper water from the profile than sugarcane during periods of low rainfall. Replenishment, after a dry period, of the deep soil layers beneath the coconut strips across the paddock would provide increased buffering against early run-off following heavy rainfall. There will be some reduction of sugarcane growth adjacent to the coconut rows but protection of the cane against destructive wind will be a compensating effect of the palms. Even cyclone Larry (northern Australia, 2006) caused only limited damage to the coconut palms in its path, whereas practically every other crop or forest was devastated.
- If coconut products, particularly VCO for the food and high-value cosmetic markets, become a viable component of the Australian economy, the existing misguided aversion of the consumer and health professional to coconut would more readily be broken down. When coconut is a home-grown commodity, the consumer might become more sceptical towards the negative message about the effect of coconut on health that has been promulgated by marketers of rival food oils. Production within Australia is unlikely to expand to anywhere near the potential demand for coconut once its reputation has been restored, such that demand for imports of high-quality coconut

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products from our neighbours is also likely to increase substantially.

- Australian food-science research would become more open to investigating the benefits of coconut in the diet, and less likely to accept at face value the existing bad reputation. A home-grown industry would also be in a position to contribute to basic study of the benefits of coconut oil that are currently buried in scientific journals published in other countries.

Conclusion

Ecologically, the coconut palm would be quite productive on good-quality sugarcane land in the coastal wet tropics of Queensland. Diversification of their production base might appeal more to hard-pressed farmers than leaving the industry to adopt another production system (e.g. bananas) that is more risky.

The lack of a coconut tradition in Australia makes it more difficult for farmers to consider the prospects for this crop, indicating that concerted research is needed to develop low labour technology and to demonstrate the financial viability of coconut as a new crop.

Adoption of coconut as a commercial crop would assist in liberating coconut oil from the false negative image that has been forced upon it by rival vegetable food oils, particularly soy, thereby enabling the market for coconut foods to grow in the community.

References

Foale, M.A. 2003. The coconut odyssey – the bounteous possibilities of the tree of life. ACIAR: Canberra.

Samosir, Y. and Adkins, S. 2005. Embryo transplantation and *ex-vitro* germination for germplasm exchange and the production of high value, endosperm mutant coconuts. In 'Tree of Life – New Trends in the Millennium, proceedings of an international conference', ed. by T.S.G. Pieris and C.S. Ranasinghe. Coconut Research Institute of Sri Lanka.