

Eco-Enterprises and *Terminalia ferdinandiana*: “Best Laid Plans” and Australian Policy Lessons¹

A. B. CUNNINGHAM^{*,2,3}, S. GARNETT², J. GORMAN², K. COURTENAY⁴,
AND D. BOEHME⁵

²School for Environmental Research, Institute for Advanced Studies, Charles Darwin University,
Darwin, NT 0909, Australia

³Bush Products Project, Desert Knowledge Cooperative Research Centre, P.O. Box 3971,
Alice Springs, NT 0871, Australia

⁴Kimberley College of Technical and Further Education, P.O. Box 1380, Broome,
WA 6743, Australia

⁵Kakadu Wild Harvest, P.O. Box 277, Parap, NT 5020, Australia

*Corresponding author; e-mail: tonyc05@bigpond.net.au

Eco-Enterprises and *Terminalia ferdinandiana*: “Best Laid Plans” and Australian Policy Lessons. This paper reviews practical policy lessons from trade in a dietary supplement (or nutraceutical) processed from *Terminalia ferdinandiana* (Combretaceae), which contains extremely high levels of natural ascorbic acid (vitamin C). Most production is from wild harvest by Aboriginal people, who get USD 14 per kilogram (kg) for picked, sorted fruit. However, the main Australian company involved is struggling to get the 12 tons/year it requires, and could market much more. Although Aboriginal people ideally should benefit economically from harvest of *T. ferdinandiana*, there are major challenges to this objective, including Australia’s high labor costs compared to Asia, Africa, and Latin America where *T. ferdinandiana* can be grown. In addition, although Australia is a signatory to and plays a leading role in the international Convention on Biodiversity (CBD), this has meant little in practice so far. “Cultural branding” and certification of organic, wild harvested *T. ferdinandiana* fruit collected by Aboriginal people working in partnership with commercial companies offers a possibility for Aboriginal people to continue to benefit from wild harvest or enrichment plantings. However, even the establishment of commercial horticultural production within Australia faces several challenges. For Australia to maintain and develop the international market, future development of this bush food must include: (a) implementation of existing international and national policies on protection of genetic resources; (b) formation of a producer association to increase production efficiencies; (c) functioning partnerships between Aboriginal producers and commercial partners that guarantee and expand reliable supply and develop cultural branding and certification as marketing tools; and (d) scientific research into improving *T. ferdinandiana* fruit yields and production methods, based on improved resource management and efficient processing methods.

Key Words: *Terminalia ferdinandiana*, Wild harvest, Aboriginal, Bush food, Horticulture.

Introduction

Australia has two main reasons for developing eco-enterprises in remote rural Australia based on “bush products.” First is the need for more diverse and sustainable land uses, particularly in the vast

areas that are marginal for conventional agriculture, susceptible to drought, and liable to degradation by sheep and cattle. Second, there is increasing political pressure on Aboriginal families living in remote, rural Australia to diversify their income and reduce reliance on welfare payments. Gathering of “bush tucker” for local or commercial use potentially can contribute to solving both challenges. There is a real need, however, for better

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understanding of the factors that enable Australian bush product enterprises to be viable sources of income to Aboriginal families in remote Australia.

Small enterprise development based on plant products such as *T. ferdinandiana* can contribute to improving the situation in Aboriginal communities through creating an income independent of welfare payments. Getting out “on country” to harvest bush products also can have non-monetary benefits (Altman 2003). These include transfer of knowledge to young people as well as physical, social, and psychological benefits that may outweigh pure economic returns. For this to happen, however, policies are required that open this “window of opportunity” for viable bush produce enterprises.

Developing financially viable and ecologically sustainable “bush product” enterprises in Australia faces greater constraints than in many other parts of the world. Great distance from markets is a particular problem for perishable goods. In a country of 20 million people, national market opportunities are limited, and developing an international market for new products is costly. Not all bush products can be harvested sustainably. In Australia, potential harvesters have, until now, had a choice between labor-intensive harvest of bush produce and various forms of welfare payment. Natural resource harvesters in Africa, Asia, and Latin America usually do not have the luxury of choice. The average welfare payment for an Australian adult is USD 150 per week, over 30 times higher than the weekly income for harvesters in developing countries, many of whom have no social security and live on less than USD 1 per day. The point is not that welfare payment levels in Australia should be lower, but that economic realities mean that few Australian bush produce enterprises are viable in international markets, particularly when they are competing with similar products from countries with lower production costs. High Australian labor costs also influence the extent to which value-adding through processing or grading takes place. There are also environmental constraints. Most Australian soils are old, weathered, and infertile and the climate highly variable; of course, both factors affect the continuity of supplies.

Despite these constraints, some bush products have a competitive edge and find a niche market. Aboriginal woodcarvings, despite high prices compared to other parts of the world, are widely sold, providing a valuable income source for

remote communities (Koenig et al. 2005). Trade in didgeridoos (Taylor 2002) and West Australian sandalwood oil (Tonts and Selwood 2003) is equally successful. So are several “bush tucker” enterprises, with trade in 14 species having an estimated value of AUD 10 million to 12 million/year (Ahmed and Johnson 2000). Good marketing, quality production, and “cultural branding” are common factors in the success of these products, with carvings, didgeridoos, and sandalwood oil all having the added advantages of a long shelf life and relatively easy transportability. In this paper, we examine the history and potential of a relatively new bush product, the fruit of *Terminalia ferdinandiana*, a small tree endemic to northwestern Australia.

***Terminalia*: Uses, Opportunities, and Resource Management**

***TERMINALIA FERDINANDIANA*: Taxonomy, Distribution, Density, and Yields**

Terminalia ferdinandiana Exell., commonly known as gubinge, bush plum, billygoat plum, Kakadu plum, or salty plum, is a small to moderately sized semi-deciduous tree, and one of 28 *Terminalia* species or subspecies occurring across tropical Australia (Pedley 1995). Originally described as *T. edulis* (Muell 1860), *T. ferdinandiana* is closest to *T. carpentariae*, *T. hadleyana*, and *T. latipes*, of which it is sometimes considered a subspecies *T. l. psilocarpa* (Byrnes 1977; Wheeler 1992; Pedley 1995). Sometimes it is also combined with *T. prostrata* (Dunlop et al. 1995). In its narrowest definition, used here, it is restricted to the Top End of the Northern Territory and the Kimberley region of Western Australia (Pedley 1995). The taxonomy is even more uncertain due to the existence of natural hybrids such as between *T. ferdinandiana* X *T. cunninghamii*, *T. petiolaris* X *T. ferdinandiana*, *T. petiolaris* X *T. hadleyana*, and *T. petiolaris* X *T. platyphylla* (Keneally et al. 1996).

T. ferdinandiana flowers at the end of the dry season (September–November) and fruits from the middle of the wet season (January–June) to the early part of the dry season, depending on location. It occurs in open woodland and produces smooth fleshy ovoid drupes, 1.5–2.5 centimeters (cm) long and with a short beak. The fruits are yellow–green when ripe (Brock 2001), but can be highly variable in shape.

Densities of *T. ferdinandiana* in the eastern part of its range sometimes exceed 500 trees/

hectare (ha), with the highest densities being on or near the coast. On the coastal strip in the Darwin region, the density of *T. ferdinandiana* trees of fruit-bearing age (more than 2 meters [m] in height) was found to be 272 ± 169 trees per ha (Whitehead et al. 2006). In Maningrida, which is on the North Central Arnhem Land coast, the mean density of trees was measured along 30×500 m transects from the coast to 50 kilometers (km) inland. This area averaged 14.4 ± 24.3 trees/ha with the density being highest along the narrow coastal strip (82 trees/ha) and on clay soils 40 km inland (31 trees/ha) (Gorman et al. 2006; Whitehead et al. 2006). Another study found densities of 435–574 trees per hectare in coastal areas but very low densities at an inland site (Nitmiluk National Park, Katherine) (Woods 1995).

Conservatively estimated yields ranged from 15 to 24 kilograms (kg) per tree per season, with a maximum of 40 kg. This is the equivalent of 2,000–3,000 kg of *T. ferdinandiana* fruit per hectare at 100 trees/ha. Yields were generally found to be higher in a semi-horticultural setting (Woods 1995) with the amount of fruit and age of maturity of uncultivated wild trees varying considerably.

NEW PRODUCT, OLD MARKET

T. ferdinandiana fruits have a long history of Aboriginal dietary use. Commercial attention was drawn to the species as a source of natural ascorbic acid (vitamin C) over 20 years ago (Brand et al. 1982). But, unlike the more established markets for carvings, didgeridoos, sandalwood oil, and bush tucker, which have been in operation since at least the 1970s, commercial harvest of *T. ferdinandiana* only started in 1996. However, the final product—naturally occurring ascorbic acid—has been commercially available for a long time, enabling *T. ferdinandiana* products to link into an existing niche market. Of particular importance is the long history of traditional human use without any reported contraindications. This has made it relatively easy to register these products as complementary medicine with the Australian Therapeutic Goods Association (Garnett n.d.). The health food industry promotes natural sources of vitamin C due to its ability to reduce free radicals, measured in Oxygen Radical Absorption Capacity (“ORAC”) values, and the

higher bioavailability of natural vitamin C. According to Kakadu Wild Harvest, a private company harvesting and exporting *T. ferdinandiana* from Australia’s Northern Territory, over 17 health and cosmetics companies globally have identified *T. ferdinandiana* as an ingredient in new product development. In addition to high levels of vitamin C, *T. ferdinandiana* fruits also contain ellagic acid and gallic acid, which have antioxidant properties and anti-carcinogenic activity in human tissues (Stoner and Mukhtar 1995; Ohno et al. 1999).

Citrus fruit are the best-known everyday sources of natural vitamin C. These have a vitamin C content of about 0.5% by weight. An alternative source of natural vitamin C is Barbados cherry (or acerola) fruits *Malpighia glabra* (Malpighiaceae). Native to Brazil, Central America, and the Caribbean, the *M. glabra* fruits have an average vitamin C content of 1.7% wet weight (Johnson 2003); these fruits once laid claim to having the highest vitamin C content of any fruit (Clein 1956). This distinction is now held by *T. ferdinandiana*, which has a vitamin C content averaging 3.5% wet weight and levels as high as 5.5% have been recorded (Woods 1995).

The Marketing Chain: Northern Australia to North America

SUPPLY

All fruit is currently collected from wild trees, then sorted and frozen as part of the strict quality control measures in place to maximize quality and retention of vitamin C content. Pickers receive USD 14 per kilogram for sorted fruit.

Quantities of *T. ferdinandiana* fruit for which the Parks and Wildlife Commission have issued permits in the Northern Territory are erratic (Fig. 1). The source of this year-to-year variation is not understood given continuing high demand. As the amount paid in royalties is consistently lower than amounts for which permits were sought, harvests may have occurred on private (including Aboriginal) land and so royalties were not payable, realized harvests failed to meet expectations, or forms were filled inaccurately. If the number of permits sought indicates demand, then they are broadly consistent with the estimates of buyers cited below. It should be noted that there are several obvious errors in the data provided. In theory, permits are required before collection; but in practice, the AUD 1/kg royalty

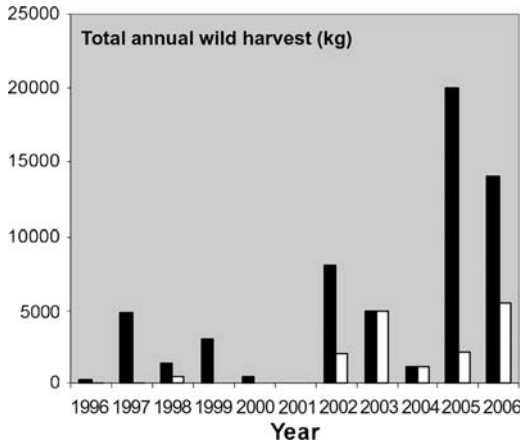


Fig. 1. Northern Territory permit data for the commercial harvest of *T. ferdinandiana*, 1996–2006. Solid bars show Wild Harvest Take Permit (allowed to harvest, in kg); open bars show Wild Harvest Return Permit (reported harvest, in kg).

payment and limited enforcement capability reduce the incentive to comply, compromising the usefulness of more detailed analysis. We were unable to obtain equivalent figures for Western Australia, but the Sydney-based company, Coradji Pty Ltd, purchased 10–12 tons of quality controlled, frozen product in 2004 from the Broome and One-Arm Point areas. In 2006, Coradji was seeking to purchase over 15 tons but only managed to obtain 8 tons (Quentin Blade pers. comm.); 11 tons in 2007, which was 1.0 ton higher than originally sought; and 5.0 tons during the 2008 season.

COMMERCIAL DEMAND

Coradji, the major buyer of the fruit of *T. ferdinandiana*, processes it using specialized equipment, and then sells the extracted natural source of vitamin C in a powder form to an American company, Mannatech Incorporated. In 2007, Mannatech, a publicly traded network marketing company based in Coppell, Texas, had sales of USD 412.68 million. Mannatech uses *T. ferdinandiana* extract, along with a variety of other ingredients, to produce *Ambrotose AO* capsules, which are a glycol-antioxidant supplement said to have antioxidant cell protection properties with immune support. There are numerous Australian companies that use *T. ferdinandiana* in soaps and other skin care products; additionally, these fruits are used to

enhance the flavor and nutritional value of gourmet products featuring Australian native food ingredients. One of the largest of these is Robins Australian Foods Pty Ltd, a member of and supply chain partner to Indigenous Australian Foods Ltd (IAF). IAF is an Aboriginal-controlled not-for-profit company limited by guarantee, which is a major link in the “grower/harvester to consumer” supply chain involving Robin’s Foods, Hela Schwarz, Coles Supermarkets, Voyages Hotel Group, and a range of other domestic and international food service and retail customers. IAF is the entity that purchases all raw and semi-processed native products on behalf of the supply chain. It enables and licenses all “downstream” manufacturers, wholesalers, and retailers in the supply chain to market the range of manufactured product as “products of Aboriginal Australian enterprise” and provide a vehicle for continuing development of native food plants for production within the chain. Suppliers of native plant products get paid per kilogram; moreover, a percentage of the profit from the final retail product goes back to IAF whose members decide on what research and development (R&D) or support activity to spend it on. Products from IAF are branded “Outback Spirit.” Coles Supermarkets now stock Outback Spirit products or stock keeping units (SKUs) in all 480 Coles stores around Australia, with national distributor Menora Foods providing the logistics support.

Policy Environment

A range of legislation and policies at a national level, in Western Australia, and in the Northern Territory have the potential to affect future commercial development of *T. ferdinandiana*.

NATIONAL POLICY ON BENEFITS FROM BIODIVERSITY

Australia’s policy goals are clearly set out in the National Strategy for the Conservation of Australia’s Biological Diversity (Objective 2.8), to

“Ensure that the social and economic benefits of the use of genetic material and products derived from Australia’s biological diversity accrue to Australia.”

The following initiatives are aimed at supporting this strategy.

- An inquiry into Access to Biological Resources in Commonwealth Areas (Voumard 2000);

- A nationally consistent approach for access to and the utilization of Australia's Native Genetic and Biochemical Resources (NCA) that takes National Competition Policy, the Trade Practices Act 1974, and the Native Title Act 1993 into account, which in October 2002 was endorsed by 14 Commonwealth, State, and Territory Ministers of Australia;
- A legal framework to manage access to and the use of genetic resources in Commonwealth areas (section 301 of the Environment Protection and Biodiversity Conservation Act 1999);
- The integration of genetic resources management into Australia's National Biotechnology Strategy.

At a jurisdictional level, the Northern Territory has recently signed the Biological Resources Bill 2006. This legislation aims to ensure that collection is ecologically sustainable and that a benefit-sharing agreement has been entered into that has been obtained on "mutually agreed terms with cooperation and approval of indigenous persons and/or communities holding traditional ecological knowledge."

Australia also has advantages over many other biodiversity-rich countries, which enables it to implement these policies in practice. These include a strong research capacity, low levels of corruption, a local biotechnology industry, and well-founded commercial and intellectual property law.

INTELLECTUAL PROPERTY

Intellectual property can be protected under Australian law by means of patents, trademarks, copyright and related rights, industrial designs, and plant breeder's rights. None of these apply to traditional knowledge of the properties of *T. ferdinandiana* largely because of the difficulty in protecting knowledge already in the public domain. Plant breeder's rights, which can recognize new, genetically distinct and stable plant lines, can be used only where evidence is produced that selection of high yielding varieties of *T. ferdinandiana* has been by a known breeder. Although an attempt to register a variety of *T. ferdinandiana* has been made by Cognis Australia Pty Ltd and Access Business Group International LLC for variety "DD26," no decision appears to have been made on whether it will be granted and

evidence from the tree used to establish the type will now be hard to obtain. Under the Plant Breeder's Rights Act (1994, sect. 64 (1)(f)), any decision will draw on advice from the Plant Breeder's Rights Advisory Committee on which one person represents "indigenous Australian interests in relation to new plant varieties and the source, use and impacts of new plant varieties."

Patents have more relevance to the processing of products, and three are current for processing of *T. ferdinandiana*. Thus, U.S. patent 20050048143 entitled "*Antioxidant compositions and methods thereto... measures the total antioxidant activity of... grape skin extract, green tea extract and bush plum*" while a "*method of preparing Kakadu plum powder*" is protected by U.S. patent 20050163880 and consists of "*disintegrating kakadu plum fruit; treating the disintegrated Kakadu plum material with enzymes to at least partially digest the material; juicing the kakadu plum material and drying the juice to produce a powder... containing at least about 15% [ascorbic acid]*" (United States Patent Applications 2003, 2004). Australian patent application 2004203276 is for a device to process the fruits of *T. ferdinandiana* using a milling process that extracts the seed and pulps the fruit (Australian patent application 2004).

Another approach to the protection of intellectual property, not yet available to Australia but recognized in international trade, is the use of what are termed "geographical indications" (WIPO 2003). The occurrence of *T. ferdinandiana* only within Australia suggests that geographical indications could be used to protect local knowledge of the plant. However, while there is debate at the Doha round of the General Agreement on Tariffs and Trades on potential links between restrictions on the use of products that can be identified by their place of origin and the protection of endemic biodiversity and Aboriginal knowledge (Guerra 2004), the Australian government has been arguing strongly that any extension of geographical indications should be voluntary or it would otherwise be a restriction on free trade (Council for Trade-Related Aspects of Intellectual Property Rights Special Session 2005). This is in contrast to initiatives in the United States and Europe where collectives of regionally based producers have managed to benefit from what are termed "farmer-owned brands" to protect local produce from competition (Hayes et al. 2004).

On a national level, Section 92 of the Australian constitution prevents imposition of restrictions on trade between the states and territories except for reasons of quarantine or if the species is listed as threatened in either jurisdiction. Movement of fruit in the Northern Territory is subject to the provisions of the Plant Diseases Control Act 2000. Other state and territory jurisdictions may impose an array of requirements, which may vary from time to time, for the transport of fruit across their borders. Nevertheless, at the time of writing, *T. ferdinandiana* is not known to carry disease nor is it threatened, so seed or other propagative material obtained legally within the Northern Territory or Western Australia can be sent to and grown in any other state or territory.

CONSERVATION LEGISLATION

T. ferdinandiana is not listed as threatened under relevant territory, state, or federal legislation, nor is it listed under the Convention on International Trade in Endangered Species (CITES). The Territory Parks and Wildlife Conservation Act 2000 specifies that collectors taking native plant products for commerce must obtain a permit (Sections 55–57). If any such property is vested in the territory (e.g., plants on public and leasehold land), they must also pay royalties (Section 116). The royalty for *T. ferdinandiana* fruit is AUD 1.00/kg (Territory Wildlife Regulations).

On Aboriginal land, traditional owners wishing to use plants commercially also require a permit but compliance with this legislation is irregular. Owners of Aboriginal or other freehold land may allow others to harvest from their lands under permits issued to the landowner. In theory, permits are required before fruits can be harvested commercially. Once this is done, ownership of the harvested fruits passes to the permit holder.

The Parks and Wildlife Commission does not require a permit for movement of wild harvested native plants into other jurisdictions, but those jurisdictions may seek evidence that the material was obtained lawfully. Ongoing commercial use would ultimately be regulated through a management plan made under the Territory Parks and Wildlife Conservation Act 2000. The principal test to be satisfied in such a plan would be that use dependent on wild populations is clearly sustainable (Section 32). Legal provisions are similar in other states.

Western Australia. After some initial uncertainty after declaration of the Native Title Act (Cth) 1993, natural resources in Western Australia as a whole are vested in the state under the Titles (Validation) and Native Title (Effect of Past Act) Act (WA) 1995. This means that picking or harvesting of indigenous flora in Western Australia is regulated in the Wildlife Conservation Act 1950. To take flora for commercial purposes from crown land requires a Commercial Purposes License obtained from Perth for AUD 100. Licensees are required to submit returns of the flora each year, and such returns must be up to date for license reissue. Protected flora taken from private property, whether it be harvested from natural or cultivated stands, may only be sold under a Commercial Producer's License or a Nurseryman's License, which can be obtained for AUD 25 from Perth, with returns every three months.

Northern Territory. Under the Territory Parks and Wildlife Conservation Act 2005 (TPWCA), *T. ferdinandiana* is defined as wildlife and a permit is required to take it or interfere with it for commercial purposes. A permit may be subject to conditions that include the manner in which a plant may be taken, kept, or transported; the maximum number, amount, sex, age, or size that is collected; the location from which it is collected; or marketing of a plant or a derivative or a product to which the permit relates, including the labeling.

When collecting, a permit holder, or any nominee (who must be identified on the permit), must carry a copy of the permit at all times and pay royalties (currently AUD 1.00/kg for *T. ferdinandiana*). Aboriginal collectors on freehold or Aboriginal land do not have to pay royalty for subsistence collection of plant products but are meant to for commercial collection (although difficulties in enforcement mean that royalties due on commercial collection are not currently collected either). The penalty for interference with wildlife without a permit is 500 penalty units or imprisonment for five years.

In practice, no attempt is made to manage commercial dealings in non-protected wildlife from cultivation and there is no requirement for permits to possess plants that are wildlife, whereas there is a permit required for animals that are wildlife. There is also no requirement for a permit

under the TPWCA to export non-protected wildlife such as *T. ferdinandiana* interstate.

BUSINESS ORGANIZATION

In Western Australia, most Aboriginal lands or pastoral leases held by Aboriginal people, are run by Aboriginal Corporations registered under the Associations Incorporation Act (WA) 1987. These must have at least five members but the members are generally not allowed to make any money from any trading that the association might undertake. Under the Associations Act (NT) 2005, associations in the Northern Territory with a minimum of five members can be formed for commercial purposes, as can associations formed under the Aboriginal Councils and Associations Act (Clth) 1976, provided 10 Aboriginal people apply jointly for such an association to be formed and it is agreed by a majority of those living in the area within which that association intends to operate.

“Best Laid Plans”: Potential Impediments to Industry Development

SOCIAL CONSTRAINTS ON COMMERCIAL PRODUCTION

Currently, the reliable supply of fruit is limiting industry growth; the market can absorb as much fruit as Aboriginal people can supply. However, a number of cultural and social factors have traditionally inhibited Aboriginal involvement in the cash economy, particularly in efficient production techniques such as horticulture. As noted recently by David and Denham (2006), an absence of horticultural traditions resembling those in Europe or even New Guinea has often been used to make a distinction between the Australian hunter-gather society and agricultural cultures. Aboriginal land management, however, has traditionally been highly sophisticated (e.g., Russell-Smith et al. 1997). Nevertheless, numerous attempts at imposing horticultural development on Aboriginal communities have collapsed when external incentives have been removed.

There are many possible reasons that horticulture has failed to attract ongoing support in Aboriginal communities, although there appears to have been no systematic analysis. Among the most important is the nature of the Aboriginal economy, which has been characterized as a

service/gift economy where it is better to spend money and gain social capital than keep it and gain economic capital.

This contrasts with the approach followed in a European commodity economy in which cash transactions are divorced from relationship enhancement (Redmond 2006). This type of relationship to cash has been sustained because Aboriginal people involved in the Australian pastoral industry largely received benefits other than cash before they were awarded equal pay in 1966; then they moved straight into the welfare economy where cash was provided without labor. Thus, cash has usually been available from sources that are more reliable and less vulnerable to social negotiation than crops that take a long time to mature and need constant protection and maintenance.

Two other factors have probably mitigated the widespread adoption of horticulture by Aboriginal people. The first is disputes over rights to land. Despite assumptions of organized patrilineal descent within the Native Title Act, there are a many ways in which rights to land can be asserted, particularly where original ownership has been disrupted (Elkin 1950; Povinelli 2006).

Disputed land tenure makes it difficult to determine who has rights to horticultural produce and, as such, can exacerbate traditional tension and conflict (Sutton 2001). This can sometimes be followed by destruction of assets as a means of reducing the power of rivals (Redmond 2006), something that discourages an investment of effort into vulnerable stationary assets such as crops and horticultural infrastructure. Rights to land also can lead to the assertion of rights to names. Thus, *T. ferdinandiana* sourced from the Northern Territory is commonly sold as “Kakadu Plum,” a name that is said to be disliked as much by the people of the Kakadu region as those who live elsewhere (H. Massarella pers. comm.). The names “Billy goat plum” or “Australian bush plum” are considered more acceptable while the name “gubinge” is widely used for fruit sourced in Western Australia.

The second factor is that horticulture usually requires permanent settlement. However, strong traditions of movement among Aboriginal people have been facilitated in recent decades by provision of vehicles and roads (Lea 2006). This enhances both the capacity and obligation to attend ever more distant ceremonies (Peterson

2000), meaning that Aboriginal people are often absent from their land and are unable to maintain high-input horticultural ventures for extended periods.

The primacy of tradition, however, can readily be overstated (Povinelli 2006) and, while some traditions have so far inhibited sustained nurturing of crops or collaborative production and marketing of product, development of policies that favor entrepreneurial Aboriginal people could still enhance the chance of *T. ferdinandiana* improving the wealth and well-being of Aboriginal people on whose land the tree grows naturally and/or in communities where horticulture has a sustained history. Thus, in Western Australia, small-scale cultivation of *T. ferdinandiana* has been initiated by Aboriginal producers working with the Kimberley College of Technical and Further Education on outstations or at large settlements such as Bidyadanga; there is an enthusiasm to take this forward among some individuals to increase production efficiency. In other communities, wild harvest for commercial purposes is becoming recognized as a useful source of income.

POLICY CONSTRAINTS ON ABORIGINAL ENGAGEMENT

Currently, for Aboriginal people to benefit from development of an industry based on *T. ferdinandiana*, they have to negotiate a dense thicket of legislation, particularly where it relates to undertaking activities on land under secure legal and customary tenure.

First, there is a legislative requirement that Aboriginal people act collectively rather than individually in relation to developing business on Aboriginal land. This contrasts with business development on other land tenures where association is voluntary and control of membership of an association rests with the individual.

Second, having formed an association, collection from the wild requires permits, frequent reporting, and payment of either fees or royalties. Thus, there is an incentive to become engaged in horticulture, at least in the Northern Territory; in Western Australia, permits for profiting from native plants grown in horticulture also have stringent reporting conditions.

The implications of enrichment planting of natural populations has not been considered in

legislation or policy, but there would appear to be a lower chance of government interference in development of a *T. ferdinandiana* business if the plants were grown outside the natural distribution in Queensland, especially as the Commonwealth government is resisting recognition of intellectual property rights embedded in their site of origin.

Finally, assuming fruit has indeed been collected for commercial benefit, production of a marketable product has to be negotiated with either U.S. or Australian patent holders of production technologies.

MARKET VULNERABILITY

Australia claims a commitment to becoming a “clever country,” rather than a “lucky country” riding resource booms through raw materials exports. However, Australia’s record of taking advantage of its endemic plant resources has been dismal. The economic potential of eucalyptus oils, for example, was recognized at an early stage, and these were first distilled and exported to England from Australia in 1789 (Boland 1991).

Today, however, over 90% of eucalyptus oils are produced by China, Chile, Portugal, Spain, and South Africa—not Australia. Macadamia nuts, long known by Aboriginal people, were exported to Hawaii for commercial production, and it was only in 1997, after intense research effort coupled with investment in varietal selection, commercial production, and mechanization, that Australia regained its position as the world’s major exporter. Despite these lessons, the same mistakes continue to be made, such as the recent export of West Australian sandalwood (*Santalum acuminatum*) seeds to China.

From a policy perspective and in terms of the Convention on Biodiversity (CBD), Australia has the advantage of national sovereignty over the genetic resources embodied in *T. ferdinandiana*, since the species is found nowhere else in the world. This should have simplified implementation of policy related to access and benefit sharing, as has been described for other species with commercial potential (Laird et al. 2000). However there already have been exports of both seed and tissue without any Material Transfer Agreements (MTAs) and such exports are apparently still legal. Ironically, Australia has played a key international role in developing MTA guide-

lines. Despite these advantages, legal movement of genetic material out of Australia is still possible.

The easiest route is by seed. Seeds of many Australian species can be obtained by mail order from Australian or foreign companies. For example, the French company B and T World Seeds (<http://b-and-t-world-seeds.com/>) holds a stock-list of 38,000 species of plant seeds, including *T. ferdinandiana*, which they obtain when required from Australian seed collectors (Matthew Sleight pers. comm.). For the Northern Territory, this will no longer be legal without permit after the passing of the Biological Resources Act 2006, but proof of origin will be difficult for taxa that occur outside the Northern Territory.

The other means of moving genetic material out of Australia is by tissue culture, which is the method two multinational companies, Amway and Cognis, attempted to undertake in 2004. Originally an Australian biotechnology company called Betatene, now owned by Cognis, had taken an interest in the vitamin C opportunity that *T. ferdinandiana* represented and, in partnership with another company Nutrilite (ABG), spent millions of dollars in the decade following 1994 in all aspects of research, from cultivation to processing.

Horticultural development occurred at a site near Darwin in the Northern Territory where production techniques were trialed and an orchard of 6,000 trees established. One of the original Betatene employees and one of the original Nutrilite researchers now hold current processing patents. *T. ferdinandiana* material was then supplied to another company, Amway. A direct-selling company of health and beauty products, Amway is part of the Alticor family of companies, which generated worldwide retail sales of USD 6.4 billion in 2005.

In addition to product manufacture in the United States, Amway has a factory in Guangzhou, China and two farming centers in the United States as well as two in Latin America (at El Petacal, Mexico and at Tiangu, Ceara, Brazil). Confidence in the product had evolved to a point of commercialization and Amway sent a team to Australia to develop a film based on *T. ferdinandiana* and Australian Indigenous uses. This was released and shown globally on the Discovery Channel in 2004. Although there was always the intention that benefit sharing with Aboriginal people would occur, no model for this

was ever developed or discussed with any Aboriginal group.

By May 2004, the companies believed they had identified chemotypes with high production potential and exported tissue culture to Amway's facilities in Brazil. At this point, a key Australian employee resigned in protest and Amway, challenged about the exports, appears to have withdrawn interest. It is believed the tissue culture material died, although this has not been confirmed. Nevertheless, although no longer buying *T. ferdinandiana* products, Amway maintains its process patent for production of *T. ferdinandiana* powder with a higher amount of naturally occurring ascorbic acid and high ORAC value and have registered a variety of *T. ferdinandiana* under Plant Breeder's Rights. The orchard was to be sold to ex-Betatene staff to continue the research operation as new owners of Cognis considered the research was outside their core business. However, this did not occur and cashews have replaced the orchard.

***Terminalia* in Australia: Implementing Policy in Practice**

There are three central lessons from this case study. First, despite Australia's many legislative and technical advantages, there is a major gap between policy and practice that needs to be resolved. Second, if Australia is committed to policy implementation, then policy makers should recognize that they are up against the substantial financial and legal muscle of multinational companies. And third, lessons from *T. ferdinandiana* could apply to any Australian bush product for which there is an international market.

LESSONS, NEEDS, AND RECOMMENDATIONS FOR THE SUCCESSFUL DEVELOPMENT OF A BUSH TUCKER INDUSTRY

To date, the indigenous *T. ferdinandiana* industry has been characterized by high labor costs, distant export markets, and reliance on wild harvest by Aboriginal people. We suggest that if Australia is to maintain its international market share in *T. ferdinandiana* production and Aboriginal people are to reap the benefit, we must avoid the familiar pitfalls of losing major market share of other Australian indigenous species, such as macadamia nuts (the major market share was lost to Hawaii), the cut flower industry (which lost

market share in kangaroo paw, wax-flower, and *Grevillea* production to many countries), and eucalyptus oil (major producers of which are now outside Australia). We make the following recommendations:

***IN SITU* AND *EX-SITU* CONSERVATION
OF THE *T. FERDINANDIANA* GENE POOL**

A. Conserve Wild Populations That Hold Genetic Diversity: The use of improved varieties of *Macadamia* and *Melaleuca alternifolia* (tea tree) plantings have been crucial to Australia regaining market share from Hawaii and the maintenance of Australia's market share of tea tree oil. Should the tree ever become established abroad, access to a wider *T. ferdinandiana* gene pool is also likely to be a crucial advantage for future development of this product over competitors that do not have this germplasm. At this stage, however, Aboriginal groups have expressed a reluctance to have different varieties compared for fruit quality. J. Koenig, H. Massarella, and J. Gorman (pers. comm.) maintain that:

- If any planting is done, it should be of locally derived plants regardless of quality;
- Any natural variant with stable desirable qualities within the top 1% of all plants, and thus registerable under Plant Variety Rights, might benefit a tiny proportion of the population if royalties on the PVR are payable, and could lead to disputes;
- Removal of material for cultivation *ex situ* will principally provide benefit to non-Aboriginal growers; and
- Varieties from other areas will inevitably mix with local varieties if grown in plantations or as enrichment plantings beneath naturally occurring stands.

B. Study Genetic Diversity of Wild Populations and Natural Hybrids: A taxonomic definition of the species is essential if any form of property right is to be asserted over the germplasm. To date, no genetic studies have been conducted on *T. ferdinandiana*, but it is already known to hybridize with several of the 22 species of *Terminalia* that occur across tropical Australia. This is a research priority, which should be combined with descriptions of phenotypic characters for each collection. During this study, we have identified 15 phenotypic characters (such as

hairiness of seedling and adult leaves, twig color, fruit color and shape, tree form, and seed shape and size), all of which should be recorded when collections are made for DNA analysis based on leaf chloroplast DNA.

**IMPLEMENTATION OF EXISTING INTERNATIONAL
AND NATIONAL POLICIES**

Retaining *T. ferdinandiana* genetic material within Australia as long as possible is fine in theory, but difficult in practice. Australia played an important role in developing international guidelines for the transfer of plant genetic resources from one country to another (termed "Material Transfer Agreements"). Although not legally binding, the Bonn Guidelines were adopted unanimously by some 180 countries. According to the Secretariat of the Convention on Biological Diversity (2002), this gives these countries "a clear and indisputable authority and provides welcome evidence of an international will to tackle difficult issues that require a balance and compromise on all sides for the common good." In the case of *T. ferdinandiana*, when tissue-cultured trees were exported from Australia's Northern Territory to Brazil, we can find little evidence that the Bonn Guidelines were followed, or of the will to do so. The new Northern Territory legislation offers greater hope that benefit sharing with confirmed assent will be required before export.

**FORMATION OF A *T. FERDINANDIANA* INDUSTRY
ASSOCIATION (INCLUDING BOTH PRODUCERS
AND BUYERS)**

In order to coordinate and consolidate production and increase production efficiencies, it would be strategic to form a *T. ferdinandiana* producers association that coordinates and consolidates a range of products within the same distribution range as *T. ferdinandiana* across Northern Australia. One of the reasons for the success of the cut flower, tea tree oil, and macadamia nut industries has been formation and coordination of producer associations (usually within each state) and under a peak national body. Examples are the Flower Industry Association of Australia (FIAA), Australian Tea Tree Industry Association (ATTIA), and Macadamia nut producer associations in Australia, the United States (Hawaii), and even Colombia (Asociación Nacional de Cultivadores de Macadamia (ASOMAC). With large

industries such as cut flowers, valued at AUD 46 million per year in 2004 (Lim–Camacho 2006) and macadamia nuts (AUD 80 million per year), these bodies are also able to raise their own R&D funds. Although the *T. ferdinandiana* trade is on a much smaller scale, R&D funds could still be available. A producers association should:

- Coordinate in order to compete (existence of a supportive industry organization) and share costs of research and development, marketing, and certification (through group certification schemes);
- Strengthen tenure over trees and land to prevent destructive harvest (chainsaw cutting in Broome area, disputes between families);
- Assist families and communities to develop appropriate governance regimes and flexible production techniques that suit their social and cultural circumstances while ensuring a regular supply of fruit;
- Balance increases in market expectations with production capacity;
- Raise research and development funds;
- Develop quality control protocols; and
- Coordinate to produce fruit in sufficient quantity at a competitive price.

FUNCTIONING PARTNERSHIPS BETWEEN ABORIGINAL PRODUCERS AND COMMERCIAL PARTNERS

The macadamia nut, tea tree (*Melaleuca alternifolia*), and cut flower industries have all gone the route of higher input production (varietal selection, plantations, mechanical harvesting). Under these circumstances, Aboriginal enterprises have not been able to compete and have not benefited from their traditional knowledge. In addition, the shift away from wild harvest to horticultural production has the potential to shift the benefits into the hands of a few large-scale producers who are not likely to be Aboriginal. What is therefore necessary is for commercial partners in Australia to develop partnerships with Aboriginal extended family enterprises that use cultural branding and certification as marketing tools, but are aware of national markets for bush foods so that Aboriginal producers can benefit from this market sector.

SCIENTIFIC RESEARCH TO IMPROVE *T. FERDINANDIANA* FRUIT YIELDS AND PRODUCTION METHODS

Priority research areas for *T. ferdinandiana* are

- Clarification of taxonomic identity;
- Understanding the sustainable take from wild populations;
- Development of appropriate methods of disease and pest control;
- Chemical characterization of constituents in addition to ascorbic acid;
- Harvest protocols to maximize concentrations of ascorbic acid and other desirable qualities;
- Post-harvest handling for a quality crop; and
- Market research.

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