



Forest  
Products  
Commission  
WESTERN AUSTRALIA



# WA Sandalwood industry development plan 2008-2020



Original draft prepared by Dr F H McKinnell, Consultant, February 2008. Modified May 2008 with input from Julia Levinson (Timber 2020, and representing Mt Romance Australia), Peter Jones (Environmental Consultant), Bethan Lloyd and Peter Wells (for the ASN), Melanie Harding (DEC), Paul Brennan, Jonathan Smith, Liz Barbour, Grant Pronk and Steve Ward (FPC).



## Foreword from the Minister for Forestry

Sandalwood oil comes from several species of the *Santalum* genus, and is well known for its importance to many Asian cultures and renowned worldwide for its pleasant fragrance.

Demand for sandalwood oil and the wood, particularly in Asia for incense sticks and religious carvings, has been strong for centuries. In fact, the economy of the early colony depended heavily on exports of WA's native sandalwood, *Santalum spicatum*. Today, demand remains high and WA has the good fortune of still having large areas of native sandalwood in the rangelands, which are sustainably harvested.

The increasing demand from the burgeoning populations of countries like China and India represents a significant opportunity for product from planted WA sandalwood tree farms. These tree farms would also help address the significant environmental challenges that exist in the Wheatbelt, while helping diversify farm incomes and rural economies.

This vision is not without its challenges. The domestication of sandalwood species has only recently commenced and the planting of tree farms of WA sandalwood has only begun in earnest in recent times. Market acceptance and value of the products remains to be tested. The gap between demand and available supply from natural stands, and the time lag before products from tree farms will flow to markets may present challenges for the industry, as buyers could look to substitutes and perhaps, synthetics.

But the early signs are encouraging - growth in the tree farms planted to date has been favourable. Oil production is variable, and more work is required to understand the factors that contribute to formation of the highly-valued heartwood and the biosynthetic pathway for oil production. A range of other research issues will also need attention, many of which are outlined in this plan.

This plan also identifies a number of actions that, if implemented, could help establish a new viable and sustainable industry for the Wheatbelt. I look forward to working with the industry as it moves towards realising its considerable potential.

A stylized, handwritten signature in black ink, consisting of a large, sweeping 'R' followed by a horizontal line.

Terry Redman MLA  
Minister for Forestry





## Foreword from the Chairman of the Australian Sandalwood Network

Australian sandalwood (*Santalum spicatum*) is growing in prominence as a tree crop in Western Australia's traditional annual cropping zones. This trend appears likely to continue given the low input cost nature of the production system, the tree's drought tolerance, wide adaptation to a number of soil types and robust growth in markets for tree products. It's one thing for a new crop to be adopted, it's another for industry structures to develop coherently around that crop to foster the development of new markets and determine the most logical path forward to benefit all stakeholders.

This Industry Development Plan (IDP) is a very logical initiative of the Forest Products Commission, the Australian Sandalwood Network (ASN) and a number of other key stakeholders. The ASN is very pleased to be involved in this planning process and looks forward to working to the findings of the IDP so as to maximise growth in the sandalwood sector for the great benefit of growers, the environment and ultimately Western Australia.

It seems ironic that a crop that essentially underwrote economic growth in the State's early pioneering days is now moving back to prominence. Western Australia is indeed very lucky to have a native tree crop which has such economic incentives surrounding its broadacre adoption.



Aaron Edmonds  
Chairman of the Australian Sandalwood Network

# Contents

Preface	4
Acknowledgements	4
Executive summary	5
1. Introduction	7
2. Global status of natural sandalwood resources	9
3. Current sandalwood production	11
4. Current global plantation resources	19
5. Marketing <i>S. spicatum</i> products	27
6. Tree farm management issues	31
7. Strategic directions for the <i>S. spicatum</i> industry in WA	37
Strategy 1: Secure the position of WA sandalwood in the market place	38
Strategy 2: Develop and maintain a strong research program to underpin industry development	39
Strategy 3: Improve the mechanisms for industry cooperation/promotion	40
Strategy 4: Expand and enhance the quality of the WA Sandalwood tree farm estate	41
Strategy 5: Seek Government support during the critical period to 2020 when the tree farm resource will be phased in	42
8. Abbreviations	43
9. References	45
Appendix 1: Key WA sandalwood growers, groups and firms	47
Appendix 2: Sandalwood Association of Australia (SAA)	48

## Preface

This Sandalwood Industry Development Plan (IDP) is targeted at development of the industry based on *Santalum spicatum*, the native Western Australian sandalwood. As indicated in the table which follows, it was prepared under the direction of a working group, and with input from a range of other key stakeholders.

Name	Representing
Dr Liz Barbour	Forest Products Commission (FPC)
Mr Jon Brand	Forest Products Commission (FPC)
Mr Paul Brennan*	Forest Products Commission (FPC)
Mr David Brocklehurst	Mt Romance Australia Pty Ltd
Mr Tim Coakley*	Wescorp Sandalwood Pty Ltd
Ms Monica Durcan*	AVONGRO Private Forestry Development Committee
Mr Aaron Edmonds*	Australian Sandalwood Network Inc (ASN)
Mr Tim Emmott*^	Greening Australia (initially, representing the ASN)
Mr David Groom	Rewards Group Ltd
Ms Melanie Harding	Department of Environment and Conservation (DEC)
Mr Peter Jones*	Renew Environmental Services Pty Ltd
Mr John Kaye*	Forest Products Commission (FPC)
Ms Julia Levinson*	Private Forestry Development Committee & Timber 2020 Inc
Mr Duane McDonnell	Forest Products Commission (FPC)
Mr Ron Mulder	WA Sandalwood Plantations Pty Ltd
Mr Grant Pronk*	Forest Products Commission (FPC)
Mr Jonathan Smith*	Forest Products Commission (FPC)
Dr Geoff Woodall	UWA Centre of Excellence in NRM

\* member of the IDP working group; ^ initial stages only

## Acknowledgements

In addition to input from all those listed above, Ms Lorna Timbers from Greening Australia, made an early contribution to the development of the IDP.

Funding was provided by the Wheatbelt Development Commission, Great Southern Development Commission, Forest Products Commission, Australian Sandalwood Network Inc, Wescorp Sandalwood Pty Ltd, Timber 2020 Inc<sup>1</sup>, Avon Catchment Council<sup>1</sup>, and the UWA Centre of Excellence in NRM.

---

<sup>1</sup> From funding it received from the State and Commonwealth Governments under the auspices of grants from NHT2 / National Action Plan for Salinity & Water Quality (NAP)

## Executive summary

Over the last ten years the establishment of tree farms of native WA sandalwood (*Santalum spicatum*) in the agricultural zone of southern Western Australia has accelerated. The objective of this development plan is to identify the strategies and recommend key actions required to ensure the growth of a sustainable and profitable industry based on this native species. The plan also takes account of an emerging industry in the tropical north of the State, based on irrigated plantations of Indian sandalwood, *S. album*.

Globally, sandalwood is highly-valued due to the presence of unique aromatic substances in the heartwood of some species and its importance to certain cultures and religions. The most valuable species is *S. album*, its oil keenly sought after for high value end uses such as perfumery. *S. spicatum* has lower  $\alpha$ -santalol oil content than *S. album* and is chemically more complex, and potentially the other compounds may have useful applications.

Prices for more valuable sandalwood species with higher oil content have escalated rapidly in the last 15 years in response to a steady decline in supply, which owes to a series of cultural and geographic influences in their countries of origin. While synthetics have entered the market for lower-value end uses, there is a strong cultural attachment to and preference for natural products in the main overseas market outlets.

Western Australia has exported material from natural or 'wild' stands of WA sandalwood for over 150 years. The level of harvest of the natural stands has been constrained to about 2000 tonnes/year for many years. The decline in available supplies of other sandalwood species from India, Indonesia and several Pacific Islands has presented Western Australia with an opportunity to assume a larger share of the global sandalwood market. The challenge for WA sandalwood is to take a share of that market in keeping with an increasing size of the planted *S. album* resource. Having land available for planting WA sandalwood and the technical resources to develop tree farms of it successfully, the State stands to benefit economically, environmentally and socially if this opportunity is taken.

The area of tree farms of WA sandalwood in the agricultural zone has increased steadily since 1999 to about 10,000 hectares in 2007. At the current rate of planting the tree farm estate is likely to reach 50,000 ha by the year 2020. Tree farms have been established by Government agencies (principally the Forests Products Commission - FPC), managed investment scheme (MIS) companies and by farmers, most of whom are members of the Australian Sandalwood Network Inc (ASN). Around 2,500 hectares of *S. album* plantations have been developed on irrigated land in the Ord River Irrigation Area (ORIA) over a similar period of time, funded by MIS companies<sup>2</sup>. No other country has embarked on a significant program of sandalwood establishment and, for a number of reasons, none is likely to do so in the near future.

The key product of value from the sandalwood tree is the heartwood, which contains most of the oil and scented wood. Generally this starts to develop when the tree is about 10 years of age, with the proportion of heartwood progressively increasing with age after that time. While research on this point is still in progress, the optimum rotation length for *S. spicatum* tree farms to produce wood of similar properties to the native rangeland material is likely to be at least 25 years. While some useful material can be harvested earlier, the proportion of heartwood and thus oil is much lower.

The silviculture of sandalwood tree farms is complex as all species of *Santalum* are root parasites, requiring viable host plants over the life of the tree farm enterprise.

---

2 Further information about the reasons for development of *S. album* plantations in the ORIA can be found in Wildlife Management Program 8 (Kealley, 1991).

Markets for sandalwood products are changing. Originally, the WA sandalwood industry was based on the export of logs to Asia for manufacture into incense products (agarbatti). Between 1922 and the early 1970s, logs were also sold to a local company<sup>3</sup>, which exported the oil. In recent years there has been development of value-adding onshore and diversification of products. Oil is again distilled locally and exported for use in perfumery, incense products are locally manufactured and there are exciting prospects for other end uses in the cosmetic and pharmaceutical industries. Today, the export of raw log material has become better focused on buyer requirements and there are now several distinct product lines.

Stable markets, a steady, sustainable supply of quality resource and adequate returns to suppliers of the raw material are keys to a successful and profitable industry. It is crucial that the industry maintains the quality of the product. If the proportion of low-grade juvenile material is not managed across the industry (eg increases too rapidly), there is a real risk that prices will fall below that required for maintaining grower viability. Careful blending of the higher quality material from rangelands and the developing tree farm resource will be essential to maintain quality control and ensure market transition and lasting success for the industry. This will require careful management of the native rangeland resource by Government. Provided this is done, Mt Romance Australia and Wescorp Sandalwood (pers comms) are confident the market can absorb tree farm industry output in the medium term. The critical period over which WA sandalwood needs to keep its place in the market is in the next 15-20 years, perhaps sooner, depending upon market penetration by supplies from *S. album* plantations in the ORIA.

The continuing development of the *S. album* resource on the ORIA has important implications for the *S. spicatum* tree farm industry in the State's south. While the prime focus of the *S. album* growers is oil production, the spent charge after oil extraction, which is at least 90% of the wood input (by weight), will compete in the vital incense market. As well, 60% of their production will be 'whitewood', which has the potential to impact on the *S. spicatum* industry. Cooperation therefore, between the sectors of the State's sandalwood industry is essential to ensure that all parties will benefit. An effective mechanism for industry cooperation should therefore be considered.

WA Sandalwood is unique in that its nuts have the potential for providing a secondary income source for tree farm owners - for seed for planting/replanting, as a 'bush' food, and a number of potentially profitable end uses, particularly in the areas of cosmetics and pharmaceuticals. However, the realisation of this potential requires urgent research to prove their market acceptance and value, and to develop efficient and economical techniques for nut harvest and handling.

There are many other areas of research that require urgent attention. Currently, research is fragmented and inadequate in relation to industry needs. Agreement on research priorities is essential, as are joint approaches to funding bodies. As much of the research involved is of public benefit, there is a strong case for State and Federal Government support.

The plan sets out the following strategies, each with supporting recommended key actions.

- Secure the position of *S. spicatum* in the market place.
- Develop and maintain a strong research program to underpin industry development.
- Improve the mechanisms for industry cooperation/promotion.
- Expand and enhance the quality of the *S. spicatum* farm estate.
- Seek State Government support during the critical period to 2020 when the tree farm resource will be phased in.

---

3 Plaimar



# 1. Introduction

## 1.1 Objective of this plan

This IDP is focused on tree farms of the Western Australian sandalwood, *Santalum spicatum*, although the effect of plantings of the exotic Indian sandalwood, *S. album*, in the Ord River Irrigation Area (ORIA) has to be taken into account, since the two species overlap in some areas of the market.

The objective of this plan is to identify the strategies and recommend key actions that are required to ensure the growth of a sustainable and profitable industry in Western Australia based on the production of the aromatic timber and other products from tree farms of *S. spicatum*. Achieving this goal will require a coordinated effort between growers both private and corporate, the processing industry and Government agencies. It will also require the strong support of the State Government over the next 10-15 years during a critical period when the tree farm resource comes on stream.

## 1.2 Factors driving this industry

The key drivers for the establishment and growth of the WA sandalwood tree farm estate are as follows:

- a continuing and growing market demand for the sandalwood timber and oil products, and the promise of an adequate return on investment to growers
- the need for a supplementary resource to be created if the industry is to continue, due to the constrained level of harvest of naturally occurring *S. spicatum* from the rangeland zone of the State
- recognition of the need to re-establish perennial vegetation to assist with development of more sustainable agricultural management systems
- increasing awareness of natural resource management and biodiversity issues in our rural landscape
- the need to diversify farm businesses and rural economies, and create new rural employment opportunities
- investment through MIS and other investment vehicles.

Internationally, the key driver is the decline in the supplies of *S. album* from India and other traditional sources in Indonesia and the Pacific, and growing populations and affluence in developing nations, particularly in India and China. As supplies of native Indian sandalwood becomes less available and if, as expected, the price continues to climb, there is a potential that synthetics could take over its main end uses or that users of sandalwood could change to other products. *S. spicatum* therefore, should establish itself as a reliable and preferred market source, or risk losing market share to synthetics and substitutes. A precipitate reduction in the current level of harvest of naturally occurring *S. spicatum* would almost certainly achieve that result.

### 1.3 Value of the *S. spicatum* industry

At the present time sandalwood exports from WA, which are based almost entirely on the harvesting of the rangeland resource of *S. spicatum*, are worth about \$15 million annually in royalty revenue to the State<sup>4</sup> (FPC, 2007a).

The total economic and employment value (direct and indirect) of the industry should not be underestimated. The harvest and processing of the natural rangeland *S. spicatum* resource currently employs about 100 people directly. Many of those employed are Indigenous people. Modelling by the FPC indicates that if the tree farm resource reaches 20,000 ha it would support an additional 144 persons (J Kaye, FPC, pers comm), the latter largely in the agricultural zone where depopulation in recent decades has been significant. Of these 144 persons, 25 would be engaged in establishment and management of tree farms, 10 in harvesting, and 105 in processing and value adding.

Provided a steady supply of high quality *S. spicatum* can be maintained, the preference in Europe and North America for natural products in cosmetics will assure the future market for the oil, and perhaps also for the nuts. There are promising indications that pharmaceutical uses of sandalwood products may become a significant market outlet. At the same time, lower grade sandalwood products will have a ready market in Asia in the incense industry, if the price is competitive<sup>5</sup>.

*S. spicatum* is a native plant, endemic to the agricultural and rangeland zones of WA. The species is relatively easy to establish in tree farms, is relatively cheap to maintain over the life of the tree farm, and has the potential to provide high value products. Virtually all the host plants used are native species from the region where the tree farms are being established. The expansion of *S. spicatum* tree farms in the agricultural zone will have important co-benefits for biodiversity (eg providing resources and habitat for native fauna).

Over the last 20 years the establishment of perennial vegetation on cleared agricultural land has become a feature of a more holistic approach to natural resource management in WA. *S. spicatum* can be readily fitted into these programs, thus providing a unique example of a commercial activity being able to provide environmental and nature conservation benefits. Importantly, in addition to being well adapted to the inland environment, the high-value of the wood means it can be planted at relatively long distances from processors and ports.

In the event that nut production becomes commercial, it will provide a valuable low cost, low input, secondary source of income for tree farmers. This would be especially valuable to farmers in poor seasons and would make the whole farm enterprise more profitable (AVONGRO, 2006).

Once a tree farm is approaching maturity it can be held as a sort of internal insurance policy against a bad season, or a decline in farm commodity prices. The unique value of a *S. spicatum* tree farm for a farmer is that it does not have to be harvested in any particular year. It can be left unharvested with the advantage of improving in value the longer it is left to grow.

---

4 Publicly available, reliable estimates as to the total value of the sandalwood industry to the WA economy were not available.

5 Agarbatti raw materials prices vary greatly depending on the product, ranging from cheap cedar woods to prized agarwood. About 5% of the market is supplied by sandalwood material (G Pronk, FPC, pers comm)

## 2. Global status of natural sandalwood resources

### 2.1 Australia

Only two native species of *Santalum* are harvested for the aromatic timber in Australia: *S. spicatum* from WA and *S. lanceolatum* from Queensland. Native WA sandalwood occurs at low density over a very large area of the rangeland zone of the State. The management plan for this species is currently under review. While recent regeneration activities by the FPC following harvesting have been successful, regeneration in older cutover areas has suffered from browsing by goats, sheep and rabbits and the effects of drought.

*S. lanceolatum* has been harvested in WA in the past, but not for the last 40-50 years. Even though its oil content is half that of *S. spicatum*, the fact that it can be sold from Queensland indicates that there is a demand for it overseas. There is undoubtedly a significant resource of this species occurring in WA but there has never been a resource inventory for this species, so the sustainable level of harvest remains unknown. However, the FPC intends to carry out an initial inventory assessment from 2009.

In Queensland the level of harvest from Crown lands has fluctuated around 300 tonnes/year over the last 10 years. There is no information as to the level of resource available. There is potential for additional tonnage from private land but the resource stocks there are also unknown. It is expected that output will gradually decline unless tree farms become established to replace wild stocks.

### 2.2 India<sup>6</sup>

India has been the world's main source of high quality *S. album* for many years, but the supply has shown a steady decline over the last 10-15 years. Many reports from India express concern at the loss of resource due to illegal harvesting and to the depredations of spike disease (a mycoplasma disease spread by insects. Note that transmittance of the disease is not yet well understood and hence border biosecurity measures should be a consideration, as the disease could be a threat to the Australian resource).

The situation has been exacerbated by the management approach taken over the last 100 years or so, which had the effect of actively discouraging rural populations from growing sandalwood. While there has been some easing of the restrictions recently, it will take many years before there is a positive effect on sandalwood resources. At the same time, pressures on land resources in India are extreme, and it is doubtful that it can ever regain its former supply levels.

### 2.3 Indonesia<sup>7</sup>

Indonesia has also been a significant source of *S. album*, from West Timor, Sumba and Flores, but the management of the resource has been poor and stocks have declined dramatically, to the point where the official legal harvest now contributes little to the international market. Some illegal harvesting does still take place, but as a world resource, it can be discounted for the foreseeable future. Population pressures in the eastern islands are likely to prevent a major resurgence of sandalwood supplies in the region.

---

<sup>6</sup> Source: F McKinnell, pers comm

## 2.4 Timor Leste<sup>7</sup>

Timor Leste also has native resources of *S. album*, but it has been very heavily exploited in the past and now little remains. It could once again become a supplier, as population pressures are less than in Indonesia, but it has internal problems that mitigate against an early resumption of this role. Occasional parcels of logs will become available.

## 2.5 Pacific region<sup>7</sup>

There are several sources of good quality sandalwood from the Pacific region: on Fiji and Tonga - *S. yasi*; on Vanuatu, and New Caledonia - *S. austrocaledonicum*; and in PNG - *S. macgregori*. Apart from New Caledonia, where the island administration has had a sandalwood management program in operation for some years, and there is a steady, although small, level of harvest, none of these countries can be relied upon to contribute other than occasional parcels of sandalwood for the next 30 years. There are promising signs that cultivation of sandalwood is gaining strength in Vanuatu and Fiji and they may well be able to achieve a regular harvest, but not for at least 30 years. On Hawaii there are at least two commercially useful species, but local regulations prevent harvesting at the present time.

## 2.6 Africa<sup>7</sup>

A tree with very similar properties to sandalwood, *Osyris lanceolata*, is harvested from Chad, Sudan, Ethiopia, Uganda, Kenya and Tanzania. Reliable data on the level of harvest and its management are impossible to obtain, but there is evidently little attempt at management of this resource so it is probably in decline. However, it is expected to remain part of the global resource for the next 5-10 years.

## 2.7 Summary

Overall, the global resources of the higher quality (in terms of oil content) species of sandalwood are much reduced. A variety of pressures in different countries will ensure that that there will be insufficient resources available to meet current and potential future market demands. Only in Australia is there plentiful land and developed technology for sandalwood tree farm establishment to potentially fill the gap between supply and demand. This situation presents Western Australia with an opportunity to secure a far larger share of the global sandalwood market, provided the industry develops strategically.

---

<sup>7</sup> Source: D Brocklehurst, pers. comm.



### 3. Current sandalwood production

#### 3.1 Background – legislative and Government institutional arrangements

The harvesting of *S. spicatum* is undertaken under the State's *Sandalwood Act (1929)*, the *Wildlife Conservation Act (1950)* (WCA), the Wildlife Management Program No. 8 'The Management of Sandalwood 1991-2001' (undergoing review), and the *Forest Products Act (2000)*. The Sandalwood Act states that a person must hold a licence under this Act to harvest ('pull the wood' of) wild stands of *S. spicatum* from both Crown land<sup>8</sup> and private property. This does not include planted tree farms on private property. However, under the WCA any person wishing to sell flora that is native to WA is also required to obtain a commercial licence, which includes the sale of wood and nuts of planted *S. spicatum*. Under the WCA, a Commercial Producers/Nurseryman's licence from the WA Department of Environment and Conservation (DEC) is required to sell material harvested from private property, while a Commercial Purposes Licence is required to sell material from Crown land tenures. Therefore two DEC licences may be required, one under the Sandalwood Act to harvest the wood, and one under the WCA to sell.

The Sandalwood Act and its regulations specify that to harvest living (green) *S. spicatum*, the trees must be greater than 127 mm in diameter at 150 mm above ground level on Crown land. This size limit maximises the core wood to sapwood ratio for efficient use of the resource, but also provides a means of conservation. No size restrictions are placed on private property harvest under the Act, but similar restrictions are imposed by DEC under licence conditions for harvest of private wild stands, for the conservation of the species.

The Governor by Order in Council has the ability to limit and restrict the quantity of *S. spicatum* (other than planted, tree farm-grown material) that may be pulled or removed from Crown land and private property under the Sandalwood Act. The current Order limits wild harvesting to a total of 1500 tonnes of green and a total of 1500 tonnes of dead material per financial year<sup>9</sup>.

In 2000 the Forest Products Act was passed and harvest of all forest products on Crown land became the responsibility of the Forest Products Commission (FPC). Crown land harvesting is undertaken under production contracts with the FPC and private property harvesting is managed by DEC. To harvest wild material from private property an application must be submitted to DEC in January-Feb each year, detailing the amount the applicant wishes to pull. Once the application is received, an inspection by a DEC Wildlife Officer takes place to confirm the resource and other aspects related to the application. Once the Minister for the Environment has approved private property quotas, licences are issued. Tree farm-grown material is not under the same restrictions as wild *S. spicatum* and hence a licence<sup>10</sup> under the WCA only need be applied for to sell wood/nuts that are going to be harvested, and there are no quota restrictions to the amount of tree farm-grown material that can be harvested. Also, non-commercial tree farm thinning/harvesting does not require a licence under the Sandalwood Act or WCA.

The Commonwealth *Export Control Act (1982)* refers to "prescribed goods", and "unprocessed wood" is listed as a "prescribed good" under that Act. The Act does not refer to processed wood and thus, there is no requirement for an export licence for processed wood. To issue a

---

<sup>8</sup> including pastoral leases

<sup>9</sup> in contrast to Wildlife Management Program 8, which proposed a combined total harvest at 2000t per annum.

<sup>10</sup> a Commercial Producer's/Nurseryman's Licence, most likely, given tree farm establishment is unlikely on Crown land, unless it is already cleared. On Crown land, a Commercial Purposes Licence would be required.

licence to export unprocessed sandalwood sourced in WA, the Commonwealth Department of Agriculture, Fisheries and Forestry (DAFF) needs to sight copies of DEC's Forest Produce (Sandalwood) Licence and the Commercial Producer's/Nurseryman's Licence (private land) or Commercial Purposes Licence (Crown land). The FPC has an export licence for 1000t/yr of unprocessed sandalwood (expiry 2016).

### 3.2 *S. spicatum*

The FPC managed production of wild *S. spicatum* from the WA rangeland resource has been fairly constant for many years, at about 2000 t/year of logs, in accordance with past management plans (Kealley, 1991). About 1300 tonnes is green wood and 700 tonnes is dead wood of lower value, although the proportion of each varies from year to year (FPC, 2007a).

Not all of this is available for export directly. About 550 tonnes/year of the higher quality part of the annual harvest of green logs is sold under contract of sale to Mt Romance Australia (MRA) at Albany for oil extraction (expiry 2016), and a further 60 tonnes to a local essential oils company Paperbark Essential Oils (expiry 2009). The FPC buys back a proportion of the spent change from MRA and re-sells it overseas through Wescorp, as an ingredient in a lower value powder product that is used in the incense market.

About 10 tonnes of *S. spicatum* oil from MRA is exported each year and is gaining acceptance in the international perfumery industry. Oil from *S. spicatum* is more complex chemically than that from *S. album* and may have a wider range of end uses with further research and development.

For a long time there was no production from private land but this has revived to some extent in the last 10 years (see Table 1). Long-term data are difficult to obtain, but the yield in recent years has been about 100 tonnes/year, much of it coming from relict populations in the agricultural zone. Ideally, if resources permit, these populations should be assessed for any outstanding genotypes.

**Table 1. Recent production of *S. spicatum* from private land in WA**

Type	2001/02	2002/03	2003/04	2004/05	2005/06	2006/07
Green (T)	36	37	31	36	n/a	n/a
Dead (T)	61	60	52	47	n/a	n/a
Total (T)	97	97	83	83	n/a	n/a

Source: WA DEC

In interpreting the production data in Table 1 it is important to appreciate that the WA production is the total tonnage of logs, ie heartwood plus sapwood, whereas the data from other countries is normally expressed as tonnage of de-sapped heartwood only.

### 3.3 *S. album*

While there are sound data for the production of *S. spicatum*, and to a lesser extent of *S. lanceolatum*, it is very difficult to get realistic (overseas) data for *S. album* and other commercial species, as a significant part of the harvest is illegal. RIRDC (2006) estimated that

the current total annual consumption of oil, from legal sources, is about 220 tonnes, although other sources quote lower figures. In India, the total annual production of oil was up to 50,000kg from a harvest of 1,000 tonnes of heartwood (D Brocklehurst, MRA, pers comm). However, the real total production is unknown due to a proportion of illegal harvesting and processing.

### 3.4 Other *Santalum* species or potential competitor species

Although its heartwood oil content is only 1%, *S. lanceolatum* from Queensland still finds a ready sale for the incense market. The harvest from Crown lands has fluctuated between about 120 to 400 m<sup>3</sup>/year for the last several years (see Table 2).

**Table 2. Removals of *S. lanceolatum* from Crown lands in Queensland**

Year	2000/01	2001/02	2002/03	2003/04	2004/05	2005/06
Volume m <sup>3</sup>	279	275	423	124	378	159

Note: Figures provided in cubic metres. Weight values not available.

Source: Queensland Department of Natural Resources and Water

There is some additional harvesting from freehold land but no data are available. The Queensland Nature Conservation Act restricts the level of annual harvest to 500 tonnes from Crown lands and 50 tonnes from freehold land. Unauthorised removals have been a problem in the past and still occur, to an unknown level.

Relatively small parcels of other Pacific region sandalwood species come onto the market from time to time. In each case the harvest appears to be opportunistic and probably averages not more than 150 tonnes/year.

From Africa another tree, known as false sandalwood, *Osyris lanceolata*, is being harvested at a level of about 1000 tonnes/year. A similar amount may be harvested illegally. Smaller quantities come from a different species in the West Indies.

### 3.5 Prices obtained for *Santalum* species

Prices for sandalwood globally have escalated rapidly in the last 15 years, in response to the steady decline in supplies of the more valuable species. Much has been written in recent years about the escalating prices being received for *S. album*. Price reports should always be treated with caution, as much higher than normal prices can often be paid for spot sales of special parcels of high quality material. The prices may refer to either whole logs or to de-sapped heartwood. The end use of the material has to be considered, as straight logs of carving quality wood will fetch a price far above that received for wood for oil extraction.

Prices for *S. album* at Government sales in India have increased from about US\$9,500/t in 1990 to about US\$40,000/t in 2005, presumably for de-sapped heartwood that contains the normal level of oil of about 6%. Wood with lower oil content will fetch a lower price. Much higher figures than US\$40,000/t are sometimes quoted without qualification as to the grade or condition (Anon, 2006). There is a danger that as the price escalates, the market will collapse and buyers, even for such expensive end uses as perfumery, will desert sandalwood and move on to other plant extractives or utilise synthetics. Reports of such high prices may also create unreal expectations for investors in tree farms, unless appropriately qualified.

The CIF<sup>11</sup> prices received for rangelands *S. spicatum* from WA have also risen over recent years (see Table 3) and are likely to continue to do so at a moderate rate, although traders report some price sensitivity at current levels (Coakley, 2006). The level varies with the quality of the material, which is now sold as several products.

**Table 3. Average value CIF of rangelands *S. spicatum* from WA (US\$)**

Year	2004		2005		2006		2007	
	Price	% Inc*	Price	% Inc	Price	% Inc	Price	%Inc
Green wood	4750	n/a	5363	12.9	6410	19.5	6712	4.7
Dead wood	4616	n/a	5079	10.0	5835	14.9	6110	4.7

\* Percent increase over previous year price. (G Pronk, FPC pers comm)

The average prices listed in Table 3 apply to *S. spicatum* from rangeland sources and include harvesting, transport, administration costs, and residual value. They cannot be directly applied to young sandalwood material from tree farms. Sandalwood from WA is sold locally and internationally. International prices are set in US dollars and vary according to log grade and negotiation with individual buyers. The equivalent Australian price also varies with movements in exchange rate, which have been significant in recent years. Prices achieved in recent years range from under US\$3,000/t for lower grades to over US\$10,000/t for high grades. Future prices will be further influenced by the quality of tree farm resource, and the effect of any over-production that exceeds demand.

The unprocessed products grades applied for trade in green<sup>12</sup> *S. spicatum* from rangeland sources in WA are as follows (G Pronk, FPC, pers comm), and the relative value of each is shown in Table 4.

- *Roots*: all root material able to be extracted
- *Butts*: to be cut off at 150mm above ground line. Butts must not be split
- *Large Loose Log*: minimum small end diameter (SED) bark off 150mm, minimum length 300 mm
- *Unclean Log*: minimum SED bark off 70mm maximum large end diameter (LED) 150mm, minimum length 300mm.
- *Small Green Log*: minimum SED bark off 25mm, maximum LED 70 mm, minimum length 150mm
- *Mini Green Log*: minimum SED bark off 15mm, maximum LED 25 mm, minimum length 150mm
- *3rd Grade*: less than 15mm bark off (branchlets) must be clean of bark and not contaminated with other species of wood

11 Cost, Insurance and Freight (CIF) is a common term in a sales contract that may be encountered in international trading when ocean transport is used. When a price is quoted CIF, it means that the selling price includes the cost of the goods, the freight or transport costs and also the cost of marine insurance. Source: Wikipedia: [http://en.wikipedia.org/wiki/Cost,\\_insurance\\_and\\_freight](http://en.wikipedia.org/wiki/Cost,_insurance_and_freight)

12 Grades for dead *S. spicatum* products are not included given this is unlikely to be derived from tree farms grown on shorter cycles



**Table 4. Relative market values of rangelands *S. spicatum* wood products from WA**

<b>GRADE *</b>	<b>RANK^</b>
Roots	1
Butts	2
Large Loose Logs (LLL)	3
Uncleaned logs (UCL)	4
Small UCL (SGL)	5
Mini UCL (MGL)	6
3rd grade	7

^ As applied to material from rangeland sources, 1 being the is most valuable

Export sales from WA use the grading system in Table 4, which ensures higher value products attract higher prices and that buyers know exactly what they are getting. Adherence to a standardised system like this for *S. spicatum* by all growers is essential to maintain buyer confidence in the product. A comparable or supplementary grading system may be necessary for tree farm resources.

### **3.6 Key market segments**

High prices are paid for butt logs with high heartwood content that are suitable for carving for a variety of decorative products. However the proportion of such log material is low for all species.

The next most valuable product is the oil of *S. album*, which is the main driver of international trade. It is used in Asia for religious ceremonies, and as a fixative in the perfumery industry and for flavouring chewing tobacco in India. In recent years there has been increasing interest in sandalwood oil in the aromatherapy and pharmaceutical industries, but there is as yet no substantive data on the relative size of these sectors. The main export markets for the oil are Europe, North America, India, the Middle East and China.

Lower quality sandalwood is powdered and used for a variety of purposes. The main use is in the incense industry – it is the largest consumer of sandalwood material.

Synthetics act to restrain the increase in sandalwood prices and the size of the market, particularly as it relates to incense. The high-end perfumery market is also showing some resistance to runaway price increases even though at the higher end of the scale there is a strong preference for natural oil. Careful marketing and durable relationships with buyers will be key factors in the future. Synthetics appear to be more of a threat in the lower end markets (ie for incense), which could affect the *S. spicatum* industry. This suggests the industry will need to be innovative and explore additional options, including local Australian markets.

### 3.7 *S. spicatum* nuts

It has been reported that producers of *S. spicatum* nuts as seed for planting are receiving prices in the range \$35-60/kg (AVONGRO, 2006). This is likely to continue for several years through demand from additional farm plantings and new players in the MIS field. In the long term, it seems likely prices for seed may decline as available quantity increases, and new markets will need to be explored. There has been interest in their use for human food, as an 'up-market' nut, but in this case the prices to the producer are likely to be around \$3-5/kg (AVONGRO, 2006).

There are, however, other attractive prospects for the development of new markets, ranging from human consumption (nut oil), cosmetics and possibly biodiesel (nut oil), and pharmaceutical products (oil from the wood or from the nut). The best prospects for a profitable end use for the nuts appear to be in the cosmetic and pharmaceutical industries. While the potential is undoubtedly there, a great deal of research is required to turn any of these prospects into reality. Servicing any market will also depend on having a reliable source of supply in sufficient quantity to be commercially attractive. A critical mass of tree farm resource is therefore necessary.

It is very difficult to estimate potential future nut supplies, as growers do not yet have reliable data on how nut production varies with tree age. Further, seasonal climate has a major effect on the level of production. An indication of how nut production might progress over the period 2008-2020 is given in Figure 1 below.

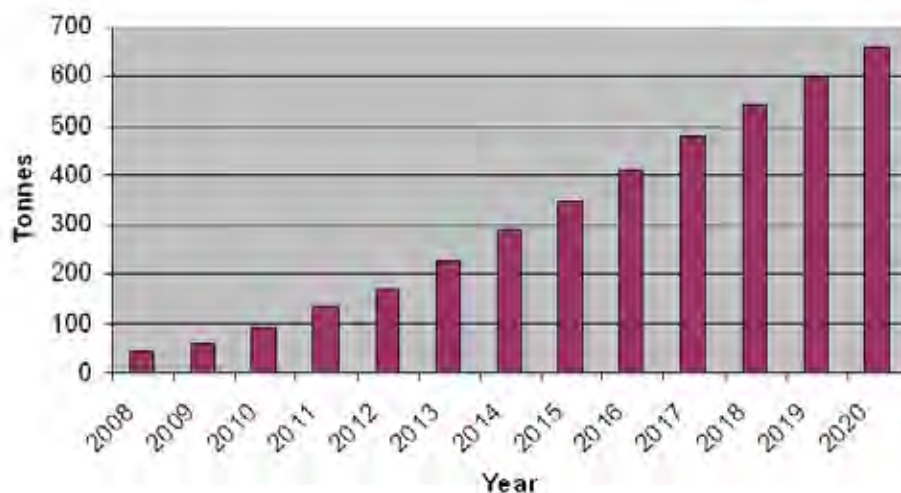
The following assumptions have been used:

- The nuts come only from farmer-based plantings, as it has been assumed the focus for MIS and FPC plantings will be oil and wood products, not nut collection.
- Only 50% of farm plantings are utilised, as it is assumed the remainder are not set up for nut production or are too remote for economic utilisation.
- Farmer plantings continue after 2007 at 1000 ha per year.
- Effective stocking is 300 stems per hectare.
- Production per tree is 0.33kg/year at ages 5-7, 0.50kg/year at ages 8-12 and 0.33 kg/year at ages 13-25, and nuts are available annually.



*S.spicatum* nuts with the husk still on.

**Figure 1. Estimated commercial nut production from *S. spicatum* to 2020**



If these assumptions are valid, then the graph indicates that the nut resource will not be a large one, at least until after about 2015. Unless very high value products are involved, such as cosmetics or pharmaceutical chemicals, the nut resource may not be a commercial proposition until after that time. This could change significantly if a higher proportion of farm plantings are utilised, and if the MIS companies and FPC decided to go into commercial nut production, even though their tree farms are not always designed to facilitate nut harvesting.

In view of the potential for development of a profitable market for nuts, it would seem a sound strategy for growers to arrange their tree farms to give them that option if it is desired, as this can be done without seriously affecting wood production by close attention to ground preparation and spacing the tree rows to facilitate access by harvesting machinery.

### **3.8 Issues for a nut industry**

Development of a profitable nut industry depends on further research to determine what products are likely to be a commercial proposition, and an efficient means of harvest and handling needs to be developed.

For pharmaceutical uses, for example, clinical trials need to be carried out to establish the efficacy of certain extractives for specified medical uses. Compounds need to be identified, then tested on laboratory animals, go through an approval process for human use and then on to testing on humans. Research of this kind typically takes some years to carry through to finality, so it needs to be commenced soon if the industry is to see a clear way ahead in this field.

For cosmetics, the research and development process could be much faster, but would require significant capital to assemble test quantities of nuts, extract the oil and then market it to companies in that field.

Development of an effective mechanical means for harvesting the nuts should be possible, but will require investment, and for it to work efficiently, changes might be required to establishment practices (eg site preparation standards, layout, spacing etc). Additionally, how the nut crop varies with age of the trees, or in response to various cultural treatments that could be applied, is largely unknown, and requires study.





## 4. Current global plantation resources

### 4.1 Area of *S. spicatum* in Western Australia

Commercial *S. spicatum* tree farms have been established only since 1999. After a slow beginning, the annual area planted has risen rapidly to over 3000 ha in 2007. So far, the area of tree farms planted by individual farmers has been small, but the FPC and MIS companies have played a valuable role in assisting to establish a critical mass of tree farm area. As at 2007, the area of tree farm established by the FPC was 2605 ha, by farmers 2879 ha, and by the MIS sector 4374 ha, a total of 9858 ha. It is possible this is a slight underestimate as there are likely to be additional areas for which no data were provided<sup>13</sup>.

These plantings have been scattered over a wide area. Data from the ASN inventory of private plantings, supplemented by some areas not included in the inventory and known FPC and MIS tree farms, have been used to prepare Table 5 and the map below (Figure 2), which shows the location of the plantings so far and the relative size of plantings in the vicinity of major towns.

**Table 5. Summary of areas of *S. spicatum* tree farm established to date in WA\***

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008**	Total
<b>FPC</b>	24	19	48	62	77	77	215	620	1463	1500	4105
<b>Private</b>	57	66	114	193	314	330	508	737	560	867	3746
<b>MIS</b>	0	760	236	79	0	71	368	1218	1642	1251	5625
<b>Total</b>	81	845	398	334	391	478	1091	2575	3665	3618	13476
<b>Cumulative Total</b>	81	926	1324	1658	2049	2527	3618	6193	9858	13476	

\* Data from ASN inventory 2007, FPC, MIS companies and Dr G Woodall.

\*\* Areas proposed for planting 2008



WA sandalwood tree farm near Narrogin, WA.

<sup>13</sup> There is also a small area planted in South Australia, not included here.

Figure 2. Location of *S. spicatum* tree farms in the WA agricultural zone

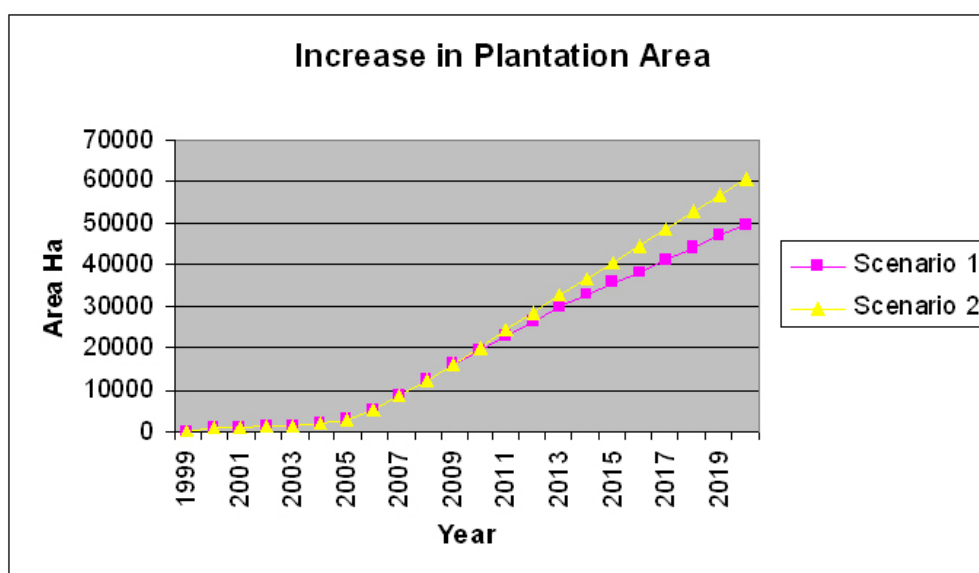


It can be seen that the plantings so far have been very scattered but tend to be more concentrated in the Avon catchment. For eventual timber harvesting, cartage distance should not present a significant problem, owing to the anticipated high average value of the log products. However, given their likely relative low value, for nut harvesting it may be advantageous to have the plantings more concentrated to minimise transport and handling costs.

It is very important, for resource planning purposes, to have an up to date inventory of *S. spicatum* tree farms on a state-wide basis. The establishment of such an inventory system, with an agreed data custodian and agreed procedures might be facilitated by a tree farm registration system that simultaneously satisfies DEC's regulatory requirements (ie proof that harvested sandalwood and nuts come from a licensed source). Up to date inventory data will also assist the industry to validate its sustainability credentials, which is a requirement under forest management certification schemes and increasingly a pre-requisite for market access in the trade of other forest products.

Future plantings of *S. spicatum* will depend on the maintenance of farmer interest, the continuation of the FPC planting program<sup>14</sup>, the activities of MIS companies, and other market supply and demand factors and how these affect price. Two scenarios are shown in Figure 3 below. Scenario 1 assumes that farmer plantings will average about 800 ha a year after 2008. FPC plantings are assumed to continue at 700 ha a year for the next 5 years, then terminate due to uncertainty over funding sources. MIS-funded tree farm activity is assumed to increase over the next two years, and will stabilise at about 2000 ha a year. Scenario 2 has the same assumptions for MIS activity but sees FPC and private plantings gradually achieve an average of 2000 ha year.

**Figure 3. Projected total area of *S. spicatum* tree farms to 2020 under two hypothetical scenarios**



14 The FPC's current *S. spicatum* plantings are mostly in sharefarms with private landowners, which have been funded jointly by the State and Commonwealth Governments, through the National Action Plan for Salinity & Water Quality, as part of the Strategic Tree Farming Project (2005-2008). It is likely that future plantings will be dependent upon continuation of this or a similar, replacement program.



Under Scenario 1, the total area of tree farms will increase to nearly 50,000 ha by 2020. Under the Scenario 2, the total area at 2020 would reach 60,000 ha. The data used to construct the graph may be varied, but the essential point is that even with a moderate scale of planting over the next 13 years, a very substantial resource will have been created. The approximate area of tree farms at 2020 for each ownership category would be as shown in Table 6:

**Table 6. Summary of aggregate planting areas (hectares) of *S. spicatum* under two possible scenarios**

Source	Scenario 1	Scenario 2
FPC	7,605	7,605
Private	12,500	23,500
MIS	29,500	29,500
Total	49,605	60,605

There is limited experience as yet of the quality and productivity of existing *S. spicatum* tree farms in different climatic zones, different soil types and different host arrangements, although plantings to date now provide a valuable resource for research in this area. Results are available from a limited area of DEC and FPC research trials. Experience with other species has shown that translating research results into operational practice is typically accompanied by lower yields, due to less than optimal sites and treatment, and sometimes use of seedlings of different genetic origin. The overall impacts of various inimical factors such as parrot attack, locusts and disease are also unknown. Based on results and estimates provided by the FPC, and after making allowance for these factors, it is likely that the average log yield from a tree farm of *S. spicatum* in the western agricultural zone (rainfall 400-600 mm) will be about 4 t/ha at age 30, while in the lower rainfall (300-400 mm) zone the average yield will be about 3 t/ha at the same age. These estimates should be used with caution. While they are based on research trials they do not include intensive management practices such as early rotation weed control.

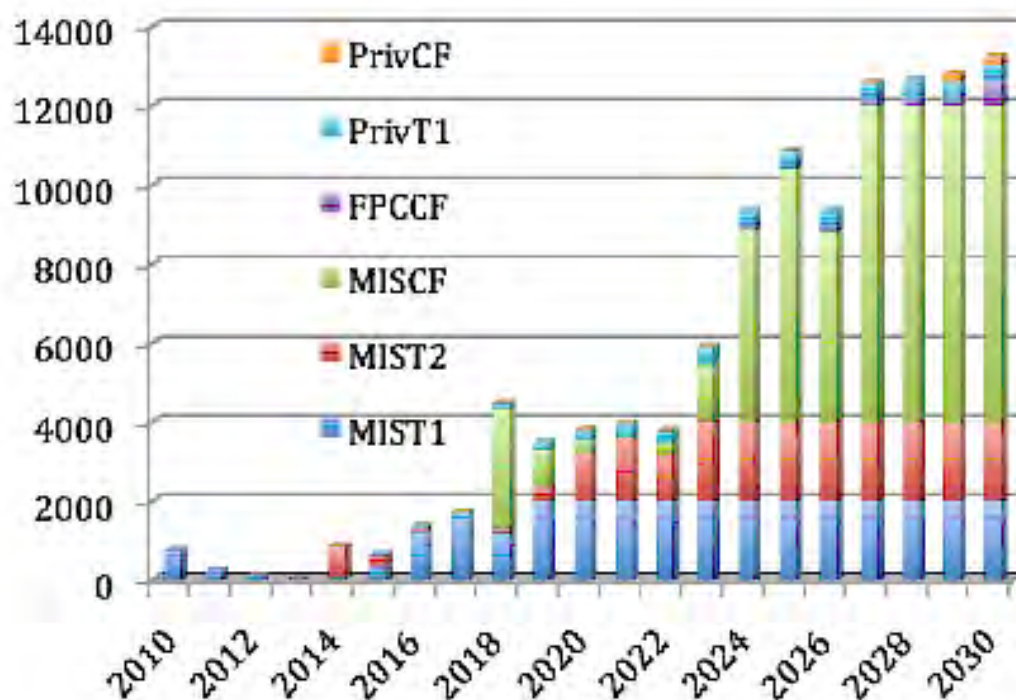
Estimates can be made of the potential production from the MIS tree farm resource, using the areas already planted each year, and using relatively higher yields, reflecting more intensive management. For scenario 1, depicted in Figure 4 below, MIS plantings were estimated to produce:

- 1000 kg/ha of logs from a thinning at age 10
- 1000 kg/ha of logs from a thinning at age 14
- 4000 kg/ha of logs from clear felling at age 18.

In contrast, a more conservative approach, and a different management regime was assumed for FPC and private plantings as these growers might adopt a longer rotation of 25-30 years to achieve higher heartwood and santalol oil content. For private growers an estimated yield of 500 kg/ha of thinnings at age 15 and 3000 kg/ha from a final harvest at age 30 was used, assuming they are likely to seek an early return. For FPC the assumed regime was a single felling at age 25 to yield a conservative 3000 kg/ha.



**Figure 4. Estimated log yield (T) of *S. spicatum* to 2030 by source (Scenario 1)**



\* T1=first thinning, T2=second thinning, CF=Final Harvest

Under this scenario, most of the production would come from the MIS plantings up until 2030. It is important to note that the magnitude of the log yield is critically dependent on the growth rate used for those plantings. For all plantings, seedlings have come from a variety of genetic sources, which may not have been well recorded in all cases. Although we cannot yet reliably estimate the proportion that will contain heartwood, it is fair to say that the bulk of the production from this source will be at the lower end of the quality scale shown in Table 4. This will pose a marketing problem if there is insufficient high quality material still available from the native rangelands harvest. The FPC and private plantings do not come on stream, and then in only a small way, until 2014, and they will also produce only low quality material until 2030.

It can be seen from Figure 4 that by 2018, only a decade away, the total annual production from tree farms could be over 2000 tonnes, equivalent to today's total rangeland harvest. Nearly all of this would be material with low heartwood content. A flood of low quality material from 2014 could cause a drastic decline in prices, perhaps reinforcing the merit of careful and coordinated marketing. From 2018, however, MIS plantings will commence to yield relatively better quality wood from final harvest. While some of this will undoubtedly produce oil, the by-product will be a mix of low grade white wood and some spent charge.

A possible way to maintain product quality might be to add in a proportion of native *S. lanceolatum* to the product mix to improve the lower product grades. Alternatively, blending a proportion of spent *S. album* pulp may improve the marketability of this material. This is yet to be tested in the market.

The other aspect that emerges is the very uneven harvest from year to year, if carried out to a rigid schedule, such as that suggested in Figure 4. It will be clear from this graph that to maintain a steady flow of product of consistent quality will require careful juggling of the harvest from different sources.

The other implication from this projection is that the ongoing availability of wood from the rangelands will be a vital factor in maintaining the overall product quality, at least until 2025. The graph also shows that, unless the FPC and farmer-based plantings are markedly greater than the annual 800 ha assumed here, then the MIS sector will always have the greatest resource of tree farm wood and hence the greatest influence on marketing arrangements.

The obvious question posed by these estimates, is whether the market can absorb this potential output at a reasonable price to the grower. We can estimate the potential output, using the area data from Scenario 2 above. At full production, a 60,000 ha tree farm estate could produce about:

- 4,000 t/year of first thinnings
- 4,000 t/year of second thinnings
- 16,000 t/year from final harvest.

Whether the traditional incense markets could absorb such a large quantity of low-grade material is uncertain. Even if the material from final harvests is directed entirely to oil production, the spent pulp will still fall back onto the incense market. Since the Asian market did absorb 15,000 tonnes/year of de-sapped heartwood of *S. spicatum* in the 1920s, it might well do so again. However, it is not known whether social and cultural changes over the last 50 years may have affected the potential demand. Keeping in close touch with the market to enable a prompt response to changing requirements is essential if the industry is to prosper. Arrangements for obtaining such information should perhaps be a subject for further discussion within the industry.

Such uncertainties reinforce the need to develop markets for the outstanding difference that *S. spicatum* has from all other commercial sandalwood species; namely, large nuts with a variety of potential markets and hence with useful commercial potential. The level of income from nuts will depend entirely on the successful search for high value end uses, and the development of efficient harvest and handling techniques. If such markets for the nuts do develop, then *S. spicatum* growers will be in an enviable position, being able to hold tree farms until they are mature and producing a large amount of heartwood, while still gaining a useful additional income from the nuts in the intervening period.

## **4.2 Areas established to *S. album* in Western Australia**

The *S. album* plantation program on the ORIA, funded through investors in MIS products, effectively began in 1999 and plantings have continued since (see Table 7). All these plantations are high cost operations, being intensively managed and irrigated. It is assumed that these plantings will continue as long as such schemes receive favourable tax treatment and can compete favourably for available land and water.

To estimate the potential resource into the future, the likely level of planting is assumed to be around 350 ha/year from 2008 onward to 2025. It is possible that the delays with the opening of ORIA stage 2 and 3 may cause some problems, but this is ignored for the sake of the yield projections made here. It is also possible that the establishment of *S. album* plantations might extend across northern Australia in the future, further complicating the market situation.

**Table 7. Area of *S. album* planted on the ORIA**

Year	Area (ha)
1999	197
2000	118
2001	153
2002	146
2003	127
2004	57
2005	399
2006	557
2007	660
Total to end 2007	2414

All the MIS plantings of *S. album* so far have schemes for final harvest at age 15. While this short rotation has the advantage of early returns to the investor, it does not allow the material to develop a heartwood and oil content that is equivalent to the older *S. album* from India. It follows that produce from the ORIA grown on such short rotations will not fetch the same prices as that grown in India. If some flexibility were possible with the age of harvesting, delaying harvest to at least 20 years may prove beneficial, as this will improve heartwood and oil content. However, the time of harvest may be fixed, depending upon the product disclosure statement and any associated tax product ruling conditions that were set by the Australian Tax Office.

An estimate of future output of oil and spent pulp from the ORIA can be made with the following assumptions:

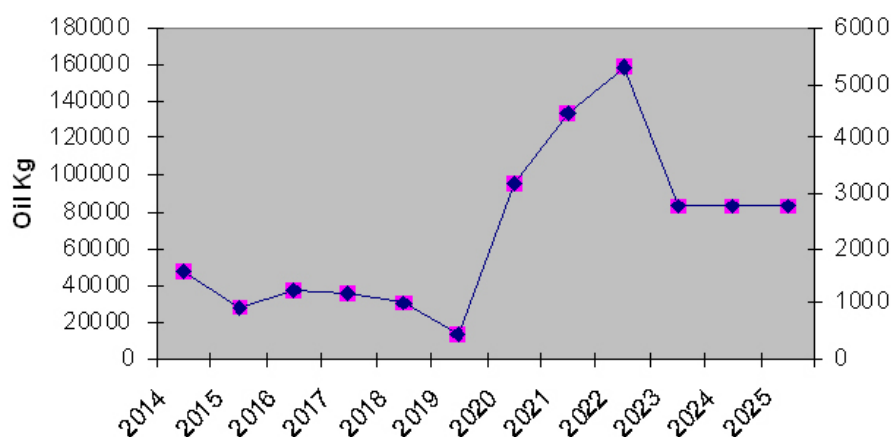
- harvesting does start as scheduled in 2014, ie at age 15
- plantations are clear felled at that age
- planting does continue after 2007 at 350 ha/year
- the RIRDC yield predictions are used, namely, heartwood yield of 8 t/ha at age 15 and oil content of 3% in the heartwood<sup>15</sup>.



WA sandalwood tree farm near Narrogin, WA.

<sup>15</sup> This infers that 97% of the wood, by weight, becomes spent charge

**Figure 5. Estimated oil and spent pulp yield from *S. album*<sup>16</sup> at the ORIA to 2025**



Clearly, *S. album* producers will have a similar lumpy harvest outturn that will occur in the southern WA *S. spicatum* tree farms.

While the details of the data used to construct the graph above may be debated, whatever figures are used, the conclusion is the same: a very large quantity of spent *S. album* pulp will come onto the market just when material from the *S. spicatum* tree farms is coming on stream. Whether the market can absorb this quantity, and at what price, is clearly going to be critical for the industry as a whole.

### 4.3 *S. album* research trials

Since May 2006, the FPC has established irrigated *S. album* research plots on Crown land in the Gascoyne region, with the help of the Department of Food and Agriculture (DAFWA) and neighbouring pastoralists. These trials are aimed at determining the suitability of growing *S. album* in this region and to examine some factors affecting sandalwood performance, including: host species, soil type and water quality (J Brand, FPC, pers comm).

The FPC also maintains and is continuing a series of older irrigated tropical forestry trials which includes *S. album*, in the ORIA, that were started in 1987. These are the oldest trials of *S. album* in Australia and hold great value in the information they can potentially yield for the industry.

### 4.4 Area of other Santalum or competing species

There is no information on what area of plantation has been established of other species in Indonesia, Timor Leste or the Pacific Islands. While some establishment is probably taking place, they are very unlikely to have a significant impact on the global sandalwood market. At the present time there are no known commercial plantations of *S. lanceolatum* being established in Queensland.

The same situation exists with other competitive species, such as the African 'sandalwood'. Reports from the region suggest that this resource is also declining, but no official data are available. Given the huge variation in the properties of the world flora, we must expect that the companies that utilise plant extracts will continue to search for new sources of material that can be marketed for fragrances, cosmetics or pharmaceuticals. Other competitors and substitutes for sandalwood could arise at any time.

<sup>16</sup> It is not yet possible to produce a similar graph for *S. spicatum*. Necessary work has only just been commenced by FPC.

## 5. Marketing *S. spicatum* products

Using the data presented earlier for current sandalwood production (all species), the likely annual global sandalwood output is probably about 6500 tonnes/year. While there are no definitive market survey data to confirm it, it is generally believed that the real supply and demand is far higher than this. Some of the increased demand is undoubtedly satisfied by the use of low-grade wood with added synthetic oil.

### 5.1 Demand for sandalwood

A critical question for growers of *S. spicatum* is the magnitude of the overseas market for their produce, especially for the lower grade incense material. No definitive market survey has ever been carried out by the industry, but on the basis of local industry discussions with overseas buyers, it has been estimated that the total annual size of the incense market is about 500,000 tonnes, most of which consists of some sort of cheap wood filler. This is mixed with real sandalwood, synthetic oils and other herbs to make up the final product. Wescorp Sandalwood (T Coakley, pers comm) believes that 50,000 tonnes of lower grade sandalwood could be absorbed by the market, provided it is marketed in an orderly fashion.

The incense market is very price sensitive, so it may not accept prices that are significantly above those now being achieved. Exchange rates may also influence prices. However, there seem to be grounds for confidence that the market can accept the solid wood output from a *S. spicatum* tree farm estate of 50-60,000 ha, provided it is carefully marketed. The industry should consider the merits of a cooperative approach to marketing, as this may well provide the best outcome for growers<sup>17</sup>.

With regard to the market for natural sandalwood oil, it is currently very strong and appears likely to remain that way. The oil is largely marketed overseas, to the perfumery trade, among others. *S. spicatum* oil therefore has gained acceptance into the very lucrative top end of the market. It appears that the only problem is being able to deliver enough of the product.

### 5.2 Current marketing arrangements in Western Australia

For many years there was been a single *S. spicatum* processing and marketing organisation in WA. FPC uses Wescorp as its marketing agent, which on-sells it to buyers in countries such as Taiwan, Hong Kong and Singapore, basically as material for the incense trade. More recently, the diversion of the better grade of product to the Mt Romance Australia and Paperbark Essential Oils companies has seen the development of oil extraction from *S. spicatum* and some value adding being done in WA instead of overseas.

At the same time, the sandalwood marketing organisation, Wescorp Sandalwood, responded to market signals by grading the solid wood output into several product lines, diversifying its markets and also developing onshore value adding activities through its New Mountain Sandalwood subsidiary.

---

<sup>17</sup> Several examples of successful grower co-operatives exist, including Wesfarmers (as originally conceived and operated), the Potato Marketing Corporation, etc.



### 5.3 Future marketing of *S. spicatum* products

With the changes looming in the mix of sandalwood resources and products in the State, it is timely to consider what sort of marketing approach would best suit the interests of the growers and the State in the future. Should WA continue with what is essentially a single desk system, or should a different approach be adopted?

The principles that should be borne in mind are:

- avoid giving buyers the opportunity to 'divide and conquer'
- make best use of the changing resource of sandalwood from WA
- obtain the best price for growers that will still maintain the position of the natural product in the face of competition from other sources or from synthetics
- compliance with relevant legislation such as the Trade Practices Act, and National Competition Policy.

Discussion with major players suggests that oil production for the perfumery trade is likely to be the main objective of *S. album* producers. Long-term contracts of supply may well be attractive to the buyers. The producers also will be competing in a market where oil from India will still be available. Their spent pulp after oil extraction is marketable for incense manufacture, although the price for that end use for *S. album* from Australian plantations remains to be seen. As it is a bulk commodity, selling spent pulp through a single desk accustomed to bulk handling and operating in that market may be the most efficient method of sale. As suggested above for *S. lanceolatum* (p23), there may be value in using spent *S. album* pulp to upgrade early thinnings from *S. spicatum* tree farms.



An arrangement of sandalwood products

For small growers of *S. spicatum* a different situation applies. A single desk marketing system, or their own cooperative, should suit them well, as they are accustomed to this approach for other agricultural commodities. Private growers need to consider the issues involved in marketing in the near future, so that they are ready to meet the situation when it arises. The pros and cons of different business models need to be debated and decisions taken.

For MIS tree farms of *S. spicatum*, presumably the most attractive market will also be the oil. They will have the same challenge as the FPC and private growers in marketing the large quantity of low quality material that they will have available. This situation will require careful and coordinated management to ensure that there is not a downward pressure on prices. A cooperative or a single desk marketer to handle the bulk of the lower quality log and spent pulp material may be the best approach, although to be successful, this would require strong industry cohesion and cooperation. At one time, the FPC bought back all spent charge from MRA and resold it through Wescorp. Following a change of extraction process, the FPC now buys back a smaller quantity, and MRA sells some of its spent charge itself. The pros and cons of alternative marketing arrangements should possibly be the subject of further debate within the industry.

Whatever marketing method is adopted, it is of critical importance that all exports from Western Australia are based on defined and agreed standard product lines. The need for this has been a lesson learned in many other exported commodities and it applies with equal force to *S. spicatum*.

Market penetration will also be facilitated if buyers are assured that all sources of sandalwood have been produced under some form of environmental management or similar certification system. While the FPC and MIS companies are aware of this need, and are taking steps toward or have already achieved certification, the ASN needs to encourage its members to follow suit.

The *S. spicatum* industry in WA has shown a marked trend towards increased local value adding in recent years. The potential outlined in this plan for a wider range of products indicates that there will be opportunities for increased value adding within the State and Australia as the industry develops.



## 6. Tree farm management issues

### 6.1 Tree farm performance

A critical factor for the continued attraction of *S. spicatum* tree farms for growers is achieving the expected production and financial outcomes. This will not happen unless there is good information upon which to base yield predictions (by product type), and 'best practice' during establishment and sound management thereafter. This suggests a Code of Practice and a set of technical guidance notes is required, and possibly as well, an effective extension service that brings appropriate advice direct to growers. Perhaps the FPC and/or ASN could carry out this function. *Western Australia's Strategy for Plantations and Farm Forestry 2008-2012* (WA Government, 2008) suggests this should be carried out by the FPC. However, neither organisation currently has the required resources (staffing and funding) for this important function. A remedy is urgently required.

As the industry expands, there will be a considerable demand for the seed of the host plants required for each region. At this time the main species is *Acacia acuminata* (jam). Shortfalls in jam seed have already arisen, due to adverse seasonal conditions. As the need to tailor the host species to the soil type and region becomes better appreciated, seed of other species will be needed, together with the nursery capacity to grow them. While much development work remains to be done to sort out the optimum mix of species for each region, host seed supply may become a significant issue – and present some new business opportunities.

*S. spicatum* will not grow well everywhere in the agricultural zone. Some sites, such as those prone to water logging, are not suitable at all. Severe frosts, below -5°C, will also severely affect both it and its hosts, so frosty hollows are to be avoided. Seasonal climate variation also has adverse effects. In some years, for reasons as yet poorly understood, seed crops are low. *S. spicatum* is also fire-sensitive, so sites must be established with this risk in mind and ongoing care must be taken to reduce the risk of fire damage. Drought, parrot attack and locust outbreaks are significant risks in obtaining successful establishment of the hosts and the *S. spicatum* seedlings.

Because *S. spicatum* and its hosts are local species being re-introduced to their local environment, there is a risk that their natural pests and diseases, which still exist in remnant bushland, could pose a threat to the viability of new plantings. An example is *Uromycaedium tepperianum*, a fungal rust pathogen of a variety of *Acacia* species, including those commonly used as *S. spicatum* hosts (APPS, 2008). Another is wood borers (Cossid moth larvae). Potential impact and management options, including searching for resistant *Acacia* hosts, should be subject to further research.

### 6.2 Financial aspects

The financials of tree farms are complex. Much depends on the motives and financial situation of the grower or investor, for example, whether tax benefits are a factor, whether a farmer counts his labour cost, whether land cost, the opportunity cost of foregone agricultural production and the 'non-market' benefits are included in the calculation. We also lack good data on the proportion of heartwood in trees of different ages, as well as the variation with age and site in oil content – these factors will affect the price sandalwood tree farm products can obtain in the market.

Estimates of the possible financial returns have been made by Jones (2002) and by AVONGRO (2006). The latter also provides a comparison of *S. spicatum* tree farms with and without a nut crop against a conventional wheat crop rotation. The document reports 20-year horizon projected NPVs per hectare for i) a traditional wheat-only, ii) sandalwood timber-only, and iii) sandalwood regime producing timber and nuts, as \$2,165, \$3,790 and \$5,790 respectively<sup>18</sup>. Such estimates assist farmers' and investors' decisions but need to be periodically updated to take account of changing knowledge and market circumstances. It would assist greatly if information were publicly available on actual prices paid for material sourced from tree-farms, once harvest gets underway and sales transactions are made.

### 6.3 Research and development

Some research into various aspects of the industry has been going on for some time, but the work is fragmented. There is no overall agreed research agenda that is supported by the industry as a whole. This is a weakness that needs to be addressed. This plan does not attempt to define that research program but does point out several areas where research is necessary to place the industry on a firm footing (and some have already been outlined above).

Development of an agreed set of research priorities might best be developed through discussion between relevant industry entities managing *S. spicatum* plantings, and these discussions may well benefit from inclusion of processor representatives as well. The logical next step, once having the research priorities identified, is to develop coordinated applications for research funding. Since the State as a whole, and especially rural areas of the State, will benefit from the successful development of the tree farm-based industry, Government financial support can be justified. Once the industry research program has been agreed, a coordinated approach to the Government should be made by the collective industry.

There is also no continuity of funding for research. Much of the research currently taking place is funded by short-term grants, whereas the basic information required by the industry, in addition to being of a public benefit nature, is rather long-term.

Historically it has not been the charter of the FPC to carry out public benefit research (see below), although the proposed amendments to legislation will provide for this possibility, and indeed the recent *WA Strategy for Plantations and Farm Forestry* charges the FPC with that responsibility as the State's lead agency for farm forestry (WA Government, 2008). Since this research is central to the long-term success of the tree farm-based industry, the FPC should receive direct public funding for this purpose (and the critical extension work mentioned previously), perhaps matched by industry, as is the case for many other industries<sup>19</sup>.

One of the more important, and urgent, areas of research is the development of a reliable growth model for *S. spicatum* that enables estimates to be made of the growth and product yield of different provenances at different ages and tree sizes in different areas. Some work has been done in the past, but more intensive sampling is necessary to supplement the limited data that are available.

The industry needs to know what proportion of the tree falls into each of the product categories at age 10, 15, 20, 25, 30 years etc, in different parts of the agricultural zone. With this

---

<sup>18</sup> These outcomes are of course dependent on the various assumptions used being valid.

<sup>19</sup> An example is Forest & Wood Products Australia. There are many other successful examples in the agricultural sector.



information, and information from actual sales, it will be possible to make better estimates of stand values, better decisions about when to harvest or thin a particular tree farm, and what quantity of each product can be expected. Such information would be an invaluable tool for making investment decisions and marketing.

As mentioned at several points in the foregoing text, basic research on the potential uses of the nuts, or nut products, is urgent, along with development of equipment and techniques for nut harvesting. This is information required by the whole industry. FPC may well play a part in carrying out some of the research, but the research program that is required will also require skills in biochemistry and pharmaceutical research that the FPC does not possess. Accordingly, partnerships with appropriate research institutions should be explored.

It is generally accepted that oil concentration is correlated with percentage heartwood and thus tree age, and that oil concentration decreases with height in the stem. However, the relationship between oil quality and concentration, and genetic origin is yet to be determined (J Brand, FPC, pers comm). It is possible that an intensive survey program may uncover individual trees with higher than usual heartwood or oil content. Such individuals could be the basis of a breeding program, to produce seed of known and improved properties. FPC is well placed to carry out this type of research.

A collaboration between DEC and FPC is slowly revealing an understanding of the genetic structure of *S. spicatum*. The first papers showed that the species has two distinct populations, the Wheatbelt and goldfields (Byrne et al, 2003a, Byrne et al, 2003b). A breeding population of the Wheatbelt population of *S. spicatum* is presently being collected and an archive is being established for genetic conservation and further breeding purposes. The age of native collections can not be reliably determined and so whilst oil analysis can be undertaken, the age of the wood can not be reliably determined. This work will lay the foundation for both the genetic conservation of the species and also the development of a high oil-yielding deployment population (L Barbour, FPC, pers comm).

Research into deployment systems has shown that *S. spicatum* is an out-crossing species unless there are no trees within the vicinity to cross with (Muir et al, 2007). This means that to maintain vigour, seed should be harvested from trees that are unrelated. To date, there has been little success with vegetative propagation (L Barbour, FPC, pers comm).

Of interest is the development of the understanding of jam (*A. acuminata*), the major host currently used with *S. spicatum*. It is generally believed the narrow-phyllode variant is better suited to lower rainfall areas of the eastern Wheatbelt (J Brand, FPC, pers comm). A genetic study revealed that this species can be divided into five types and two of these are so distinct that they could be classed as separate species (Broadhurst and Coates, 2002). Seed of this species (or group of types) is being readily moved around the Wheatbelt and it may be useful to assess possible effects on the genetic integrity of native stands.

There is some evidence that there may be synergies between *S. spicatum* and certain host plants that could affect the growth of the wood (Norris, 2005). Further, it has been suggested that a positive relationship could exist between the effectiveness (N-fixing ability) of the host-bacteria symbiosis and the growth of sandalwood (Norris, 2005). Continued research has led to the isolation and identification of high N-fixing *A. acuminata* rhizobia (Ruoss, 2007) and their development for use in commercial nursery systems.

A joint collaboration between the FPC and UWA has received funding to continue research on *S. spicatum* nuts. Nuts from populations across the Wheatbelt will be analysed for their oil and protein composition for product development. It is also possible that a variety of *S. spicatum* with consistent high yield of nuts could be identified and propagated. The FPC is also exploring techniques to efficiently harvest seed (L Barbour, FPC, pers comm).

While the general approach to tree farm establishment are well known, there is considerable scope for refinement of *S. spicatum* provenance and host selection for particular soil types and regions. As mentioned above, research into pest and disease risks and management may be required. New developments need to be rapidly spread among users so the communication process needs to be carefully designed and operated. A close link between researchers and growers, perhaps through a peak grower and/or industry body, would provide the maximum benefit to the industry. Additionally, there may be lessons to be learnt from horticultural research and operational techniques that apply to similar activities, such as those from the macadamia industry of the Australian east coast.

The FPC has already established key research relationships that cover the spectrum from laboratory to field for fast technical transfer and product development. These relationships should be given greater support and leveraged to accelerate the outcomes.

## **6.4 Land availability**

The area available for planting *S. spicatum* in the agricultural zone does not appear to be a constraint on the industry (however, see planning issues outlined below in 'Legislative aspects'). The total area of cleared agricultural land in the 300-600 mm rainfall zone is about 16 million ha. Even if the tree farm estate eventually reached 100,000 ha, the impact on agricultural productivity would be minimal, and it is likely that many tree-farms will be designed to integrate with ongoing farm operations.

## **6.5 Infrastructure and industry capacity**

It is important that collective industry 'know-how' and capacity to successfully raise seedlings, establish, protect, manage and harvest tree farms and transport raw material to *S. spicatum* processors is maintained and matches demand. Growers will need access to sufficient seed of the right type (both for the hosts and the crop). Harvested material will need to utilise the road system, which may be inadequate in some areas. Processors too will need access to labour, power, water and support services. Siting of processing plants will need to factor in location of plantings, available infrastructure and the location of end-product markets. Port access will be needed for exports. The industry may need to work closely together to advance its collective interests in ensuring these fundamental settings are 'right' and that the Government provides appropriate support and assistance.

## **6.6 Role of the Forest Products Commission**

The contribution of the FPC is very important to the success of the industry in WA. Its tree farm establishment program is assisting the industry to develop the critical mass that is important for commercial activities. It is also demonstrating the benefits that *S. spicatum* tree farms can deliver in terms of achieving natural resource management objectives. Similarly it is providing research into some of the silvicultural aspects of tree farm management that are vital to underpin the industry as a whole (see above and next).

The development of the *S. spicatum* tree farm system is in its infancy with most research been undertaken in the last five years. The FPC has established a research program that has laid the foundation to answer many of the critical questions to maintain industry sustainability. To date, most of this work has been funded by the FPC directly.

Some stakeholders have a view that the agency has a conflict of interest (e.g., RIRDC, 2006) as a grower and a service provider. However, in considering this, it is important to understand some background and context. The FPC was formed in November 2000 as a Government trading enterprise to grow, manage and sustainably harvest the State's native forest and publicly owned tree farm resources for the optimal financial returns to taxpayers. This commercial goal has necessarily been the primary focus of the agency. The recent Statutory Review (2007) recommended to Government that together with its obligations as a Government trading enterprise, the FPC should also undertake lead agency functions across the forestry sector. Subsequently, the WA Government agreed and in 2008 changes to the Forest Products Act were set in motion to include a broader lead agency role. This change has been cemented with the release of the *WA Strategy for Plantations and Farm Forestry* in 2008 (WA Government, 2008). However, at the time of writing this report the FPC had not yet been funded by Government to undertake these non-commercial lead agency functions.

## **6.7 Carbon sequestration**

The possibility of carbon credits being a source of additional income from growers has also been considered. Preliminary estimates of the biomass production from *S. spicatum* tree farms suggest that the potential for this is low because the level of standing biomass is low, and much of it is contained in host species which are not long-lived (Dr P Ritson, FPC, pers comm). While biomass calculation for a pine forest, for example, is relatively straightforward, it is complex for *S. spicatum* tree farms with their highly variable mix of host and parasite. At best, should a carbon credit market develop, the value to growers appears likely to be an additional, perhaps marginal benefit, rather than a primary driver.

## **6.8 Legislative aspects**

The Sandalwood Act currently considers *S. spicatum* and *S. lanceolatum* to be the same for the purposes of limiting the annual harvest. If it were considered useful to harvest the latter in WA, an amendment to the Order in Council, as required under the Act, would be necessary to allow its harvest over and above the current restrictions on the *S. spicatum* harvest.

The Wildlife Conservation Act also controls the sale of both wild and cultivated native plants in WA (see section 3.1 'Background – legislative and Government institutional arrangements' above). Under this legislation a licence issued by DEC is required for the sale of the wood or nuts of *S. spicatum* from private property. However, no licence is required to harvest tree farm sandalwood and it is not currently under the sort of restrictions imposed on the level of harvest of rangelands sandalwood. It is unclear why a licence should be required for sale of trees (native or not) planted with the intent of harvest and sale. This situation creates considerable uncertainty for growers and investors. Industry development might be better facilitated if there were a system of one-off registration of a tree farm of a native species, which automatically permitted any subsequent sale from harvesting operations. This registration could be effected and incorporated at the planting approval stage, rather than falling under another, separate statute or process (ie it should perhaps not fall under the Wildlife Conservation Act).

But the approvals stage and associated planning framework itself presents additional legislative / regulatory impediments to expansion of the *S. spicatum* tree farm estate. There is a strong further element of sovereign risk arising from the current uncertainty surrounding what is a compatible use in different zones, and the sorts of development conditions that might be applied by local governments. These can differ considerably from one local government to another. This has been identified as one of 10 key industry development actions requiring urgent attention in the recent *WA Strategy for Plantations and Farm Forestry* (WA Government, 2008). The action requires that the FPC work with other agencies (particularly the Department of Planning and Infrastructure (DPI) and key stakeholders (principally industry and local governments) to develop a far more consistent, efficient and equitable process. However, because of resourcing constraints within DPI, work on the issue is not progressing that quickly. Currently, guidance exists for local planning policy in the form of 'Planning bulletin 56' (WAPC, 2003), but this is not binding on local governments and does not resolve the matter. There is a view that the most effective way to deal with the issue is through a State Planning Policy that ensures conformity and uniformity across different local governments.

## 6.9 Natural resource management benefits

Multiple natural resource management benefits may be provided through establishment of *S. spicatum*, in particular. Such tree farms can improve landscape aesthetics, diversify rural income streams, and provide resources for new industries and jobs whilst helping to protect and enhance natural assets in the medium to lower rainfall parts of WA's agricultural zone. The strategic placement of mixed species plantings that connect and buffer remnant native vegetation may assist in their conservation and create new habitat and food such as seeds, pollen and nectar for local fauna. In addition, tree farms may aid in the remediation of salinising landscapes through on-site recharge management and improvement in water quality, assist in wind erosion control for crop and stock protection and improve soil productivity through the introduction of leguminous host plants.



*S. spicatum* tree growing with its *Acacia* host.



## 7. Strategic directions for the *S. spicatum* industry in WA

To assist the development of strategies and key actions for this plan, the material presented earlier in this paper has been subjected to a gap analysis. The results are shown below (Table 8), listed under the major topics, together with a rating of the risk posed to successful industry development from failure to address the issue.

**Table 8. Principal issues affecting industry development**

Topic	Issue affecting the industry	Importance to the industry		
		High	Medium	Low
<b>Markets</b>	Supply may exceed demand	H		
	Unable to maintain present natural stand product quality	H		
	Fragmented marketing system	H		
	Standard product grades not used		M	
	Market and pricing information for growers/ investors lacking	H		
	Lack of environmental management system/ forest certification		M	
<b>R&amp;D</b>	Prioritised and agreed program	H		
	Poor level of funding	H		
	Inadequate genetic knowledge		M	
	Research on nut properties	H		
	Unable to reliably forecast growth & product yields	H		
	Efficient nut harvest technology		M	
<b>Industry cooperation</b>	Need to understand how to maximise yield and value recovery		M	
	Ineffective industry consultative body to advance collective interests	H		
	Failure to cooperate in planning of harvest	H		
	No tree farm inventory/registration		M	
	Lack of technical guidance/operating standards; grower advisory service		M	
	Insufficient seed supplies	H		
<b>Government support</b>	Resourcing for FPC lead agency role	H		
	Planning framework risks/obstacles, inequities, costs	H		
	Orderly integration of rangeland and tree farm resources	H		
	Lack of funding for research	H		

The data and issues outlined in the foregoing sections of this plan have been distilled into five strategic directions, each with several supporting key recommended actions. These strategies and key actions are fully compatible with the *WA Strategy for Plantations and Farm Forestry* (WA Government, 2008).



## Strategy 1: Secure the position of WA sandalwood in the market place.

Recommended action	Who	When	Comments
1(a) Provide a constant flow of market information to growers to maintain a high level of market intelligence (including substitutes and prices).	Peak industry body (PIB)	Annual - timing after Chinese New Year	Need consistent grade specifications (in development by SAA). Confidentiality of private transaction information?
1(b) Explore marketing mechanisms to discourage substitution by synthetics and moderate wood product supply to optimise returns to growers.	Growers, PIB	Ongoing	Trade Practices Act; National Competition Policy.
1(c) Maintain supply from harvest of natural <i>S. spicatum</i> to ensure quality and continuity of supply during the critical phase-in period of tree farms (2010-2020).	DEC/FPC	Ongoing	Maintain supply from native stands while tree farm resource comes on stream.
1(d) Agree on and implement standardised <i>S. spicatum</i> product grades and nomenclature as new tree farms come on stream.	Growers, PIB	ASAP	Buyer confidence.
1(e) Explore the potential for marketing <i>S. lanceolatum</i> and amending the regulations to allow this harvest over and above the <i>S. spicatum</i> harvest, at least during the critical phase-in period for tree farms.	DEC/FPC	Resolve by end 2009	Participation of PIB? Precursor is FPC inventory – field work is scheduled for 2009.
1(f) Maintain the market advantage of a renewable, sustainably managed natural product through wider adoption of EMS and forest certification.	PIB	Ongoing	Encourage widespread adoption of certification eg ISO14001 EMS, FSC, AFS (CITES required for Middle East market access).
1(g) Actively work on developing a wider range of markets for <i>S. spicatum</i> oil, and nuts/nut products.	PIB	2009	PIB to coordinate development of marketing strategy.

## Strategy 2: Develop and maintain a strong research program to underpin industry development.

Recommended action	Who	When	Comments
2(a) Agree on priority directions for research for the industry and coordinate research efforts.	PIB	Planning document before end 2008	Discussion around priorities/timing/co-ordination is in progress. Ideally a collective approach will minimise duplication of effort and optimise outcomes from available funds.
2(b) Jointly seek funding for priority research projects.	PIB	from 2008/2009	Needs to be co-ordinated. Who will do though? SAA currently 'voluntary' – see 3(c).
2(c) Improve the knowledge of <i>S. spicatum</i> genetics, especially of relict populations in the agricultural zone.	FPC/DEC	See 2(a). As resourcing permits	Some work underway. Need to consult with other growers (may have independent work in progress).
2(d) Secure funding for research on <i>S. spicatum</i> nut properties and efficient harvest technology.	PIB	As resourcing permits	Plan/submission to identify who would undertake.
2(e) Develop improved varieties of <i>S. spicatum</i> with improved oil content in the wood, earlier heartwood formation, higher nut yield and better apical dominance.	FPC/others	See 2(a). As resourcing permits	FPC 'industry good' – lead agency function - requires funding. Others may be pursuing own R&D as well?
2(f) Improve knowledge of sites-species matching ( <i>S. spicatum</i> and hosts).	FPC/others	See 2(a). As resourcing permits	
2(g) Improve ability to model and predict productivity and product yield across a range of sites and ages.	FPC/others	See 2(a). As resourcing permits	Other possible providers (eg CSIRO) but needs co-ordination to avoid duplication.
2(h) Maintain vigilance and improve knowledge of managing pests and diseases.	PIB co-ordinates	See 2(a). As resourcing permits	See WA blue gum example – IPMG.
2(i) Seek Government funding for public benefit aspects of the sandalwood research and extension program.	PIB/FPC	ASAP	Role of PFFMAC? Also discuss with regional development commissions?

### Strategy 3: Improve the mechanisms for industry cooperation/promotion.

Recommended Action	Who	When	Comments
3(a) Develop and maintain mechanisms/body for effective industry representation to advance its collective interests, promoting the benefits of the industry to relevant external stakeholders.	PIB	ASAP	Part of this activity would be for the PIB (see 3(c) - SAA in interim?) to seek a seat on PFFMAC without delay.
3(b) Develop a tree farm inventory and registration system that monitors growth in the industry (see 5c also).	FPC/DP&I	As resourcing permits	See 5(c) and P&FFS Action 8. SAA has commenced some related work?
3(c) Formulate an active not for profit peak industry body to take carriage of identified action items.	SAA members or sub-group	ASAP	SAA currently voluntary not funded/resourced adequately. If not SAA, industry participants to explore other options. See appendix 2.
3(d) ASN explore opportunities to secure funding for Executive Officer / Industry Development Officer role.	ASN	ASAP	ASN not funded /resourced adequately to assist members. Needs assistance during transition to self-funded status. Look at OMA, other models.

#### Strategy 4: Expand and enhance the quality of the WA Sandalwood tree farm estate.

Recommended Action	Who	When	Comments
(a) Revise or develop a Code of Practice (CoP) to raise awareness of relevant legislative requirements.	FPC/PIB	As resourcing permits	FPC P&FFS lead agency role – as resourcing permits. Modify current FIFWA/AFG CoP for Timber Plantations in WA (2006). Does it cover adequately already?
(b) Revise or develop a set of technical guidance notes to encourage adoption of best management practices by growers; maintain an advisory service to support small <i>S. spicatum</i> growers, to ensure the prompt communication of research results to growers, and to train growers in growing and harvesting techniques for the standard log market product grades, and promote the benefits of <i>S. spicatum</i> tree farms to farmers.	FPC/ASN	As resourcing permits	FPC P&FFS lead agency role – as resourcing permits. Utilising networks (eg NRM Regions, PFDCs, LCDs) and drawing on other expertise as appropriate (eg DAFWA).
(c) Work towards secure seed supply of best available <i>S. spicatum</i> and host species provenances.	FPC/DEC/PIB	Ongoing	Will be informed by field performance and genetic knowledge. See 2(f) also. Industry to consider formation of an equivalent of the Southern Tree Breeder's Association (blue gum, radiata pine).

**Strategy 5: Seek Government support during the critical period to 2020 when the tree farm resource will be phased in.**

Recommended Action	Who	When	Comments
(a) Industry support FPC to obtain funding for its lead agency functions, in particular to enable it to undertake the actions identified in the <i>WA Strategy for Plantations and Farm Forestry</i> , that will facilitate development of the WA sandalwood industry.	All through PIB	ASAP	And through PFFMAC.
(b) Review the planning framework to ensure a more consistent and equitable approach is taken to considering development approvals by local governments and reduces sovereign risks and transaction costs (eg through a State planning policy for plantations and farm forestry).	FPC/PIB	ASAP	And through PFFMAC. See Action 8 <i>WA Strategy for Plantations and Farm Forestry</i> (FPC to work with DP&I and relevant stakeholders).
(c) Review the mechanism for approval of sale of harvested material from tree farms (eg approval automatically effected / incorporated at planting approval stage – see 3(b) also)	PIB/DEC	Now	And through PFFMAC. Note the Wildlife Conservation Act to be replaced by Biodiversity Conservation Act – opportune time to seek necessary amendment(s)?



## 8. Abbreviations

ASN	Australian Sandalwood Network Inc, membership largely consisting of small private growers in the Avon catchment, inaugurated in 2007 (formerly known as the Avon Sandalwood Network).
CIF	Cost, insurance and freight (CIF) is a common term in a sales contract that may be encountered in international trading when ocean transport is used. When a price is quoted CIF, it means that the selling price includes the cost of the goods, the freight or transport costs and also the cost of marine insurance.  Source: Wikipedia: <a href="http://en.wikipedia.org/wiki/Cost,_insurance_and_freight">http://en.wikipedia.org/wiki/Cost,_insurance_and_freight</a>
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora.
DAFF	Commonwealth Department of Agriculture, Fisheries and Forestry.
DAFWA	WA Department of Agriculture and Food.
DEC	WA Department of Environment and Conservation, formerly Department of Conservation and Land Management (CALM).
DPI	WA Department of Planning and Infrastructure.
FPC	WA Forest Products Commission.
IDP	Industry Development Plan.
IPMG	Industry Pest Management Group (operates in the WA blue gum sector).
MIS	Managed Investment Scheme. Through these investment product offerings, investors purchase woodlots that offer up-front tax advantages and future returns from harvested products.
MRA	Mount Romance Australia Pty Ltd, Albany, WA.
ORIA	Ord River Irrigation Area, near Kununurra, north-east Kimberley, WA.
PIB	Peak industry body.
PFFMAC	WA Plantations and Farm Forestry Ministerial Advisory Committee.
SAA	Sandalwood Association of Australia. Formed in 2007, representing all sandalwood growers in Australia. See Appendix 2.
WCA	<i>WA Wildlife Conservation Act (1950)</i> administered by DEC.



## 9. References

- Anon. (2006). *Market Overview - The Australian Sandalwood Industry*. Australian Agribusiness Group.
- Wood, A (2008) *Pathogen of the Month - January 2008*. Australasian Plant Pathology Society (APPS), South Africa.
- AVONGRO (2006). *Sandalwood Economics*.
- Brand, JE, JED Fox, G Pronk and C Cornwell. (2007). Comparison of oil concentration and oil quality from *Santalum spicatum* and *S. album* plantations, 8-25 years old, with those from mature *S. spicatum* natural stands. *Australian Forestry* 70(4):235-241.
- Broadhurst, L & Coates, D (2002). Genetic diversity within and divergence between rare and geographically widespread taxa of the *Acacia acuminata* Benth. (Mimosaceae) complex, *Heredity*, 88, 250-257.
- Bryne, M, Macdonald, B, Broadhurst, L, & Brand, J (2003a). Regional genetic differentiation in Western Australian sandalwood (*Santalum spicatum*) as revealed by nuclear RFLP analysis, *Theoretical and Applied Genetics*, 107, 1208-1214.
- Bryne, M, Macdonald, B & Brand, J (2003b). Phylogeography and divergence in the chloroplast genome of Western Australian Sandalwood (*Santalum spicatum*), *Heredity*, 91, 389-395.
- Coakley, T (2006). *Market Update by Wescorp International*. Avon Sandalwooder, Autumn 2006.
- Forest Products Commission (2007a). Annual Report 2006/07.
- Jones, P (2002). *Estimating Returns on Plantation Grown Sandalwood (Santalum spicatum)*. Sandalwood Information Sheet Issue 3, Forest Products Commission.
- Jones, P (2004). *Sandalwood markets*. Avon Sandalwooder, Autumn 2004
- Kealley, IG (1991). *The Management of Sandalwood*. Wildlife Management Program No 8, Department of Conservation and Land Management.
- Muir, K, Byrne, M, Barbour, E, Cox MC and JED Fox (2007). High levels of out-crossing in a family trial in Western Australia Sandalwood (*Santalum spicatum*). *Silvae Genetica* 56(6) 222-230.
- Norris, L J (2005). Effect of root nodule bacteria on the performance of plantation grown *Acacia acuminata* and *Santalum spicatum*, unpublished Honours thesis, *Curtin University of Technology*, Perth, Western Australia.
- RIRDC (2006). *Australia's Sandalwood Industry: An Overview and Analysis of Research Needs*. RIRDC Publication 06/131.

Ruoss, S B (2007). Investigation of root nodule bacteria (RNB) of *Acacia acuminata*, a preferred host of *Santalum spicatum* a hemi-parasitic tree, unpublished Honours thesis, *Curtin University of Technology*, Perth, Western Australia.

WA Government, 2008. *Western Australia's Strategy for Plantations and Farm Forestry: 2008-2012*.

WAPC, 2003. *Planning Bulletin Number 56 – Farm Forestry Policy*, WA Planning Commission, February.

## Appendix 1: Key WA sandalwood growers, groups and firms

Code	Company name	Species (as at 2007)	Investment method	Indicative ha (as at 2007)
TFS	Tropical Forestry Services Ltd*	Album	Album Managed Investment Scheme	1200
ITC	Integrated Tree Cropping Ltd*	Album	Album Managed Investment Scheme	900
	Mr Paul Mock	Album	Album private investors	100
	Santalol Pty Ltd *	Album	Album private investors	100
	Kimberley Timber Company Pty Ltd	Album	Album private investors	100
	Capricorn Timber Plantations Pty Ltd	Album	Album private investors	100
ASN	Australian Sandalwood Network Inc.*	Spicatum	Farmer growers	5000
	Rewards GroupLtd*	Spicatum	Managed investment scheme	2000
	WA Sandalwood Plantations Pty Ltd*	Spicatum	Private Investors	1000
FPC	Forest Products Commission*	Spicatum	Strategic Tree Farming	5000
MRA	Mt Romance Australia Pty Ltd	Processor	n/a	n/a
	New Mountain Sandalwood Pty Ltd	Processor	n/a	n/a
	Wescorp Sandalwood Pty Ltd*	Processor	n/a	n/a
	Paperbark Essential Oils	Processor	n/a	n/a

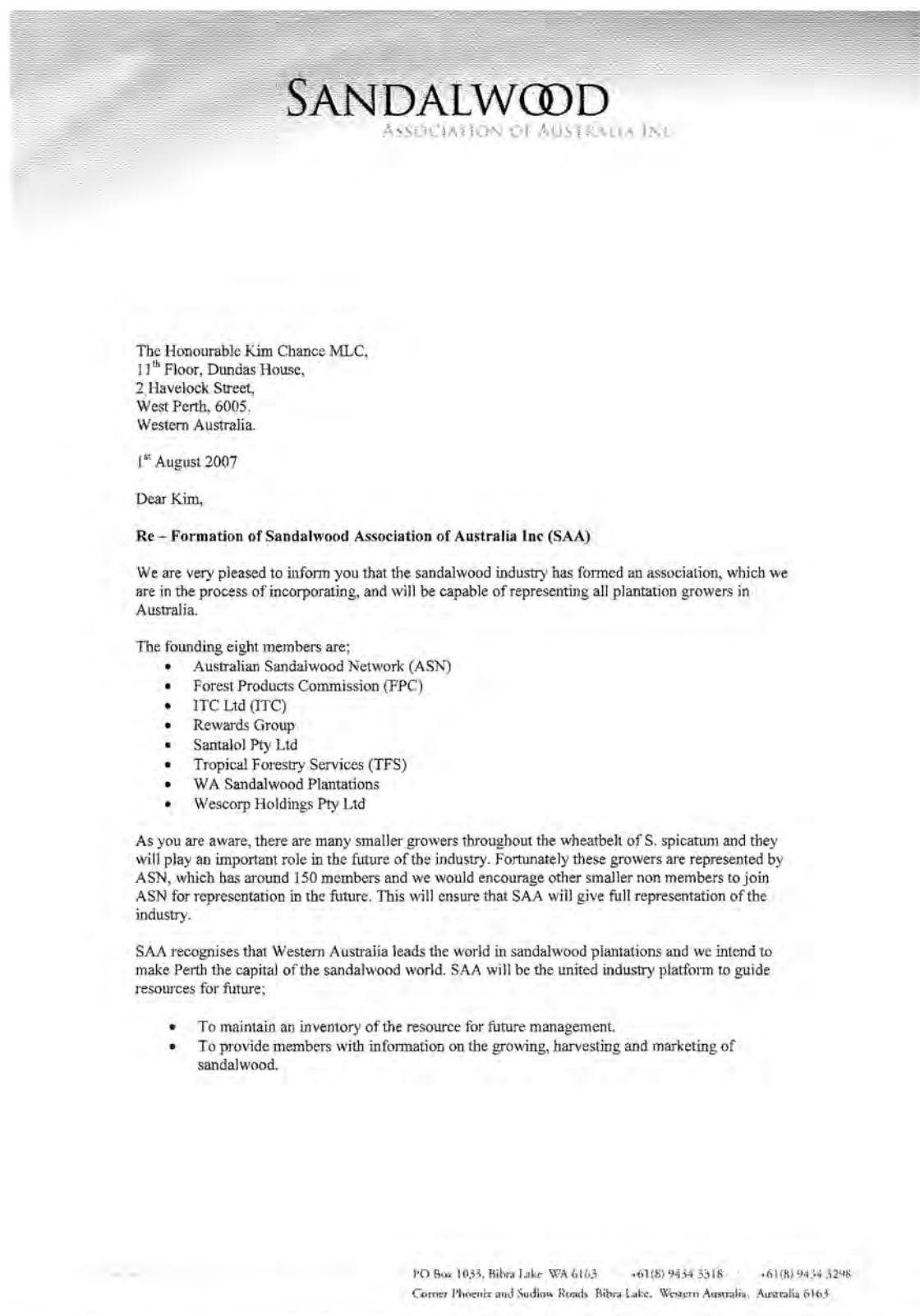
\* Entities so marked are also members of the Sandalwood Association of Australia – see Appendix 2



## Appendix 2: Sandalwood Association of Australia (SAA)

The earlier section on strategies and recommended key actions indicates a significant role for a peak industry body (PIB). Action 3(c) recommends the industry should consider what shape this PIB should take. Relevant to this discussion is some background information about the SAA. Presented here is a copy of a letter (August, 2007) from the SAA to the WA Minister for Forestry, advising of its formation and outlining its membership and intended activities.

Note that the SAA includes growers of both Indian and WA sandalwood, and processors.



# SANDALWOOD

- To facilitate and support research into sandalwood production, genetics, harvesting techniques, marketing, and product value adding developments.
- To promote the sandalwood industry in the wider community.
- Standardise the terminology used for different grades and products of sandalwood, in line with international practice.
- Represent members at all levels of industry and government.
- To promote industry development through involvement with research, education and training opportunities.
- To promote Australian sandalwood to national and overseas markets.

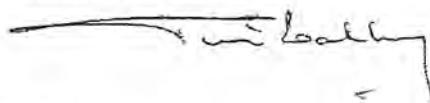
Our first task is to create an actual inventory of the plantings of both sandalwood species with a view to understanding the volumes of future harvests and how they can be managed and marketed. This is being put together now.

Our next task is to identify and prioritise where further research needs to be focussed and reduce the possibility of duplication and non-commercial research.

The SAA will work, because all parties have agreed to respect each other "intellectual property", but at the same time develop future research that will benefit all members. The members are very passionate about their product and industry and are committed to the formation of SAA and the role it has to play.

We will be in touch with you and your staff in the future and will undertake to keep you informed of our progress.

Yours sincerely,



Tim Coakley  
Acting Chairman



## Further information

Further information on this Industry Development Plan and the WA sandalwood industry can be obtained from:

### **Australian Sandalwood Network**

Phone: (08) 9574 5882  
Fax: (08) 9574 5882  
Website: [www.sandalwood.org.au](http://www.sandalwood.org.au)

### **Forest Products Commission**

Phone: (08) 9475 8888  
Fax: (08) 9475 8899  
Website: [www.fpc.wa.gov.au](http://www.fpc.wa.gov.au)

