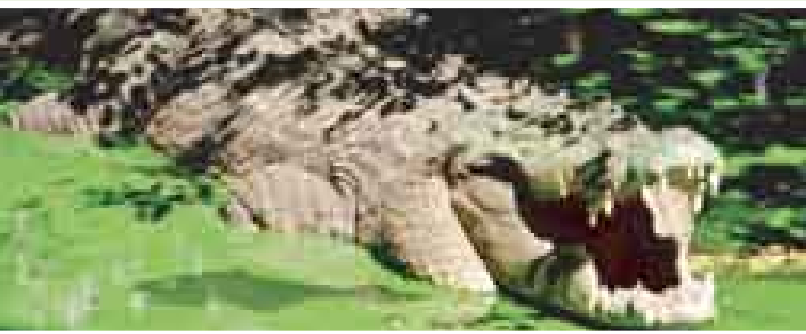




Australian Government  
Rural Industries Research and  
Development Corporation

# Emerging Animal and Plant Industries —*their value to Australia*—



**RIRDC** Innovation for rural Australia

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Crocodile, Crocodylus Park, Northern Territory



Selection of tropical fruits

# Foreword

Australia's rural industries make a fundamental contribution to the Australian economy and way of life. In addition to the major industries, numerous new and emerging rural industries bring opportunity, diversity and resilience to rural Australia. Detailed information on the volume and value of these industries is hard to come by. This book brings together available information about many of Australia's new rural industries. And, for the first time, it gives us a picture of their overall worth – in aggregate more than \$673 million.

The Rural Industries Research and Development Corporation invests in new and emerging industries on behalf of government and industry stakeholders. New industries provide opportunities to be captured by rural producers and investors. They also provide avenues for farmers facing adjustment pressure to diversify and manage change. The establishment of new industries contributes to community resilience and regional development. Increasingly, new industries are also contributing to a distinctive regional character in rural Australia.

New industries face a number of challenges – developing product quality and quantity, developing markets and supply chains, and industry leadership. Many of these issues are underpinned by research and development. Often, too, they are hampered by a lack of basic statistical information, which is why RIRDC has invested in this report.

The importance of this report is that it provides that basic statistical information for the new and emerging industries. As well as indicating the high aggregate value of the 'new and emerging sector', the report provides detailed statistical information for each new industry. It will be a useful basis for those contemplating investment or formulating policy and will help to inform RIRDC as it plans its research and development priorities into the future.

**Peter O'Brien**

Managing Director

Rural Industries Research and Development Corporation

*"...emerging rural industries bring opportunity, diversity and resilience to rural Australia."*

*"...for the first time, it gives us a picture of their overall worth – in aggregate more than \$673 million."*

*"Increasingly, new industries are also contributing to a distinctive regional character in rural Australia."*

*"The importance of this report is that it provides that basic statistical information for the new and emerging industries."*

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# Highlights



Goat cheese selection from Kervalla . Source: *Thirty Australian Champions*, RIRDC, 00/141.



Coffee cherries ready for picking at Skybury Coffee Plantation, Queensland

- This publication profiles 27 emerging animal and plant industries, and for the first time gives us a picture of their overall worth to the Australian economy—conservatively estimated at \$673 million.
- The emerging industries examined in this report represent about 2.2 per cent of the gross value of Australian farm production in 2003–04.
- These figures represent only a subset of emerging industries (ie those listed in this report) and are conservative estimates of value.
- New and emerging animal and plant industries make significant contributions to the regions in which they operate by bringing diversity and resilience to the sector. They also contribute to the increasingly important niche and specialty food markets.
- The importance of this report is that it provides basic statistical information for new and emerging industries. As well as indicating the high aggregate value of the ‘new and emerging sector’, the report provides detailed statistical information for each new industry.
- Of the emerging industries examined, those with a Gross Value of Production over \$30 million per annum include game birds, kangaroos, macadamia nuts, Asian vegetables, tropical fruits and olives.



Kalamata olives. Source: *New Crop Industries Handbook*, RIRDC, 04/125.



Crocodile products.

# Executive Summary

## Scope and Purpose of the Report

The Australian food industry uses an increasingly diverse range of plant and animal products. While the key characteristics of traditional agricultural production in Australia are well documented, there is a vast array of agricultural commodities produced in Australia for which there is relatively little public information. The purpose in this project is to help address this gap in the availability of public information on the less well-documented industries.

## The Target

The report is targeted at industry and government interests in improving productivity, trade and R&D for new animal and plant species.

## Background

The existence of public information on prospective agricultural industries is important. New and emerging industries have a key role in providing growers with the ability to spread risk through diversification, thereby offering regional resilience. They can also confer regional distinctiveness - such as tropical fruits in Far North Queensland. The lack of reliable statistics about emerging industries can hamper their development. The availability of information can significantly influence the availability of commercial funds because lenders

and potential investors require access to reliable statistics. Only when statistics exist can effective policies be developed for the emerging agricultural industries, such as in targeting research and development and in promotion activities.

Emerging industries are often difficult to identify, particularly during their early development phase. Some are not necessarily producing new products. For example, goats have been farmed for milk for centuries, and have been in Australia since first settlement by Europeans. However, with recent initiatives to establish an organised industry, it could be classified as an emerging food industry. Other foods, such as wasabi and rambutan, are new to Australia, while others (such as crocodiles and bush foods) are indigenous to Australia but unfamiliar to the food market.

Official statistics produced by the Australian Bureau of Statistics are an important source of information but do not cover a range of agricultural commodities produced in Australia. While there are other sources of information on emerging industries, these are often difficult to access and to establish comparable, robust statistics on the industries.



Crocodile green curry

With increasing diversity of animal and plant production as producers seek to diversify away from traditional crops and livestock, there is an ongoing challenge to ensure that these products are incorporated in rural statistics.

Many of these emerging industries in Australia produce a diverse range of products. For example, goat industries can produce meat, fibres, milk, leather and a range of other by-products. RIRDC classifies around 80 different agricultural commodities as coming from emerging industries. Information on these emerging agricultural industries and new products from existing industries is highly valued by the industry, by trade and consumers in Australia and overseas. Around 50 per cent of the value of emerging livestock products comes from export sales.

## The Aims

This project provides a set of supply and utilisation tables for each of those agricultural industries in Australia that are defined as 'emerging' by RIRDC (excluding the organic industry), taking into account that each of these industries may produce a number of different products. Information is also provided on the nature of the international market for each commodity because an understanding of this is important in guiding the gathering of appropriate information. For example, where no price data are available in Australia, international sources can provide reasonable indicator prices that can be employed.

## Methods Used

### Production valuation

The definition of gross value of production used in this analysis is that of the Australian Bureau of Statistics. According to ABS (2001), the gross value of commodities produced is the value placed on recorded production at the wholesale prices realised in the market place. The 'market place', in general, is the metropolitan market in each State. In cases where commodities are consumed locally, or where they become raw material for a secondary industry, these points are presumed to be the market place.

The value of livestock slaughterings and other disposals is published as one figure but include two distinct components: value of livestock slaughtered; and value of net exports — that is, the total value of livestock intended for slaughter in adjacent State(s) where available (at present these can only be identified between the Northern Territory and adjacent states) and livestock exported overseas, whether for slaughter or breeding, minus the value of imports of livestock.

A feature of many emerging animal industries is that they are

in the process of building up flock or herd numbers. At this stage of industry development, there is usually little production that requires slaughter of animals (for example, meat and hides) and very strong intra-industry trade and prices with breeding livestock. This trade, however, is traditionally not considered as part of the value of the industry for estimation purposes so is not included in this analysis.

It should be noted that the value of production of an industry will often be less than the value of the industry's exports. This is because there is substantial value added through processing before products are exported. For example, the tanning process with animal skins adds considerable value.

### Data sources

The Australian Bureau of Statistics is a key source of Australian information for this project, particularly for trade data.

Another highly useful source of information for a number of commodities is the Levies Revenue Service (LRS), an organisation within the Australian Government Department of Agriculture, Fisheries and Forestry. The LRS is responsible for both the

collection and distribution of levies to the various statutory research and development corporations, statutory marketing authorities, Animal Health Australia and the National Residue Survey. LRS is also responsible for the distribution of the Australian Government's matching levy for research and development contributions. The LRS collects over 60 different levies and charges from a client base of over 10 000 levy payers. The nature of levies being applied on the products from emerging industries is outlined in Appendix B. More information on the LRS and levy arrangements is available at [www.affa.gov.au/levies](http://www.affa.gov.au/levies).

The other key sources of information in Australia are state departments responsible for agriculture and key industry representative bodies. The Department of Business, Industry and Rural Development in the Northern Territory was particularly useful in this respect because its activities have an orientation toward developing industries.

Knowledge of the supply chain for each commodity gives some indication of where the best place is to gather statistics for that industry. For example, the centralised nature of the marketing systems with the goat fibre industries (mohair and cashmere) made gathering of production statistics reasonably straightforward.

The meat processing industry has readily identifiable points for gathering data because meat must be processed through a limited number of licensed processing establishments. Furthermore, there are regulatory bodies in each state that collect statistics on animal slaughter numbers for monitoring purposes.



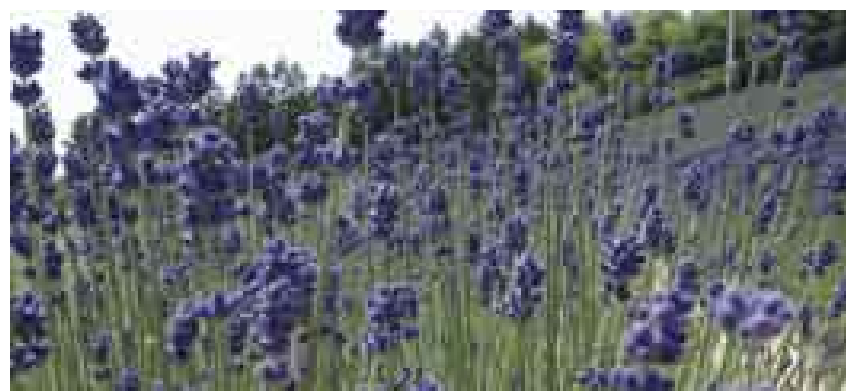
Mechanically harvesting coffee



## Results

The contribution of each industry to the Australian economy in terms of value of production and exports is presented in Table 1.

It should be noted that the value of exports can be more than the value of production because of value adding throughout the supply chain.



Lavender

**Table 1: Estimated values of production and international trade for selected Australian emerging industries: financial year 2003-04 or calendar year 2004**

Commodity	Value of production \$'000	Value of trade *	
		Exports \$'000	Imports \$'000
<b>Animal industries</b>			
Alpacas	481	–	–
Buffaloes	2 036	1 839	–
Camels	119	82	–
Crocodiles	3 982	5 196	–
Emus	1 033	929	–
Deer	4 216	5 743	1 331
Game birds	83 923	4 495	0
Game pigs	8 905	11 356	–
Goats			
– meat goats	50 569	59 231	–
– cashmere goats	125	57	40
– mohair	1 992	1 268	–
– dairy goats	4 106	–	1 980
Kangaroos	37 579	45 841	–
Ostriches	2 637	4 320	–
Possums	87	93	0
Rabbits, farmed	2 194	4	27
<b>Total, animal industries</b>	<b>203 984</b>	<b>140 454</b>	<b>3 378</b>
<b>Plant industries</b>			
Asian vegetables	135 600	6 000	
Australian native foods	3 305	100	0
Coffee	3 280	37 306	168 682
Essential oils**	21 632	38 030	22 696
Joboba	531	–	275
Macadamia nuts	151 455	106 176	4 034
Olives	33 750	2 933	152 576
Pasture seeds	49 893	56 316	18 636
Pyrethrum	5 580	14 532	1 114
Sesame seed	15	167	16 447
Selected culinary spices	5 500	9 255	38 291
Selected exotic tropical fruits#	36 676	789	589
Wildflowers and native plants	22 500	19 128	–
<b>Total, plant industries</b>	<b>469 717</b>	<b>290 732</b>	<b>423 340</b>
<b>Total</b>	<b>673 701</b>	<b>431 186</b>	<b>426 718</b>

\* Includes re-exports and re-imports.

\*\* Value of production includes only eucalyptus, sandalwood (oil and wood), tea tree and lavender oil; exports and imports include all essential oils.

# Durian, longan, lychee, mangosteen, papaya and rambutan. (–) Negligible.

## Implications

In reality, the selected industries encompass a range of stages of development. For example, the exotic tropical fruit industry is at a very early stage of development, with domestic and export growth prospects based on producing something that is familiar to many Australians of Asian origins and to an increasingly affluent population throughout Asia. At the other end of the scale, the sizes of the goat fibre (cashmere and mohair) industries in Australia are considerably smaller now than they were a decade ago.

Moreover, many of the emerging industries have long and sometimes chequered histories in Australia. For example, an Australian coffee producing industry emerged then virtually disappeared at least once over the past century. It appears to be 'emerging' again because mechanical harvesting has offset the labour cost impediment to industry development and because of an increasing willingness among coffee drinkers to pay premiums for 'Estate grown' coffees with pleasingly distinctive flavours.

In 2003-04, the gross value of production of the selected animal industries was an estimated \$204 million, and they earned export revenue of \$140 million. The biggest of these industries were the kangaroo, game bird and meat goat industries, together accounting for 84 per cent of the total value of production and 78 per cent of total exports. With the exceptions of the dairy goat and deer industries, the emerging animal industries face little competition from imports (Table 1). This is partly because of Australia's strict quarantine laws on livestock products. However, competition from New Zealand

in the domestic venison market is increasing.

The gross value of production of the selected emerging plant industries in 2003-04 was an estimated \$470 million, largely contributed by the more mature emerging industries — that is, the Asian vegetable, pasture seed, macadamia, exotic fruit (mainly lychees) and wildflower industries (Table 1). Most of the emerging plant industries are export oriented, with total exports in 2003-04 of \$291 million.

Some emerging plant industries face strong competition from imports, particularly the coffee, olive, sesame seed and spices industries. The total value of these imports was \$427 million in 2003-04. There is likely to be increasing competition from Thailand for the Australia tropical fruits industry following favourable import risk assessments and the signing of the Australia-Thailand Free Trade Agreement.

In the case of seasonal products such as tropical fruits, the Australian industry niche appears to lie with supplying fresh product outside the main production periods of the main exporting countries that appear to have substantially lower production costs

Together the selected emerging industries had an estimated gross value of production of \$674 million, equivalent to 2.2 per cent of the total value of Australian farm production in 2003-04. They earned estimated export revenue of \$431 million, or 1.6 per cent of total farm export revenue in 2003-04. These shares are likely to grow in future years because — as the term 'emerging' suggests — many of the emerging industries appear to have strong growth prospects.

There are also several reasons why these values are underestimated. For instance, export statistics used in this report to the wildflower industry could considerably understate the value of exports to some countries. This is because prices received are only known when flowers are sold at auction in the destination country.

Additionally, the social values of at least some of these emerging industries are considerably higher than the estimates presented in Table 1. With some animal based industries, this is because they involve the harvesting of feral populations of animals in Australia — for example, feral pigs and camels — that have adverse environmental impacts.

The industries based on the use of Australian native plants as flowers and food could be contributing to the conservation of rare Australian plants through ensuring that they are cultivated more widely than their natural habitats.

Reafforestation using oil mallee and sandalwood trees and in Western Australia is helping both control salinisation of agricultural lands and reduce greenhouse gases.

Due to resource constraints, some emerging industries are not included in this compendium. These include the dairy sheep, herb and plant fibre (such as hemp and flax) industries.

## Recommendations

It is recommended that the statistics presented in this report are expanded and updated periodically to measure both trends in Australia and internationally as a guide for industry, government and future R&D.

# Introduction

An increasingly diverse range of plant and animal products are used in Australia. While the key characteristics of mainstream agricultural production in Australia are well documented, there is a vast array of agricultural commodities produced in Australia for which there is relatively little public information. The purpose in this project is to help address this gap in the availability of public information on the less well-documented industries.

The existence of public information on emerging agricultural industries is important. The lack of reliable statistics about emerging industries can hamper their development. The availability of information can significantly influence the availability of commercial funds because lenders and potential investors require access to reliable statistics. Only when statistics exist can effective policies be developed for the emerging agricultural industries, such as in targeting research and development and in promotion activities.

Emerging industries are often difficult to identify, particularly during their early development phase. Some are not necessarily producing new products. For example, goats have been farmed for milk for centuries, and have been in Australia since first settlement by Europeans. However, with recent initiatives to establish an organised industry, it could be classified as an emerging food industry. Other foods, such as wasabi and rambutan, are new to Australia, while others (such as crocodiles and bush foods) are indigenous to Australia but unfamiliar to the food market.

Official statistics produced by the Australian Bureau of Statistics are an important source of information but do not cover a range of agricultural commodities produced in Australia. While there are other sources of information on emerging industries, these are often difficult to access and to establish comparable, robust statistics on the industries.

With increasing diversity of animal and plant production as producers seek to diversify away from mainstream crops and livestock, there is an ongoing challenge to ensure that these products are incorporated in rural statistics. According to the Rural Industries Research and Development Corporation (RIRDC), the estimated annual value of emerging livestock products in Australia exceeded \$200 million in 2003-04 (RIRDC 2004), while estimates of the value of many plant based emerging industries do not appear to be available.

Many of these emerging industries in Australia produce a diverse range of products. For example, goat industries can produce meat, fibres, milk, leather and a range of other by-products. RIRDC classifies around 80 different agricultural commodities as coming from emerging industries. Information on these emerging agricultural industries and new products from existing industries is highly valued by the industry, by trade and consumers in Australia and overseas. Around 50 per cent of the value of emerging livestock products comes from export sales.

The aim in this project is to produce a set of supply and

utilisation tables for each of those agricultural industries in Australia that are defined as 'emerging' by RIRDC (excluding the organic industry), taking into account that each of these industries may produce a number of different products. Information is also provided on the nature of the international market for each commodity because an understanding of this is important in guiding the gathering of appropriate information. For example, where no price data are available in Australia, international sources can provide reasonable indicator prices that can be employed.

The organic food industry has been excluded from this project because its differentiating features relate to the inputs and processes used rather than the outputs. Australian aquaculture and mariculture industries have also been excluded from this project because the gaps have been relatively well serviced by other studies (see, for example, Love and Langenkamp 2003).

The output of this project is a compendium of statistics that meets a need for basic information about emerging agricultural industries in Australia, while the intended outcome is better information and decision making in a dynamic segment of the agricultural industry.



Wasabi

# Method

## Production valuation

The definition of gross value of production used in this analysis is that of the Australian Bureau of Statistics. According to ABS (2001), the gross value of commodities produced is the value placed on recorded production at the wholesale prices realised in the market place. The 'market place', in general, is the metropolitan market in each State. In cases where commodities are consumed locally, or where they become raw material for a secondary industry, these points are presumed to be the market place.

The value of livestock slaughtering and other disposals is published as one figure but include two distinct components: value of livestock slaughtered; and value of net exports — that is, the total value of livestock intended for slaughter in adjacent State(s) where available (at present these can only be identified between the Northern Territory and adjacent

states) and livestock exported overseas, whether for slaughter or breeding, minus the value of imports of livestock.

A feature of many emerging animal industries is that they are in the process of building up flock or herd numbers. At this stage of industry development, there is usually little production that requires slaughter of animals (for example, meat and hides) and very strong intra-industry trade and prices with breeding livestock. This trade, however, is traditionally not considered as part of the value of the industry for estimation purposes so is not included in this analysis.

It should be noted that the value of production of an industry will often be less than the value of the industry's exports. This is because there is substantial value added through processing before products are exported. For example, the tanning process with animal skins adds considerable value.

## Data sources

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Another highly useful source of information for a number of commodities is the Levies Revenue Service (LRS), an organisation within the Australian Government Department of Agriculture, Fisheries and Forestry. The LRS is responsible for both the collection and distribution of levies to the various statutory research and development corporations, statutory marketing authorities, Animal Health Australia and the National Residue Survey.

LRS is also responsible for the distribution of the Australian Government's matching levy for research and development contributions. The LRS collects over 60 different levies and charges from a client base of over 10 000 levy payers. The nature of levies being applied on the products from emerging industries is outlined in Appendix B. More information on the LRS and levy arrangements is available at [www.affa.gov.au/levies](http://www.affa.gov.au/levies).

The other key sources of information in Australia are state departments responsible for agriculture and key industry representative bodies. The Department of Business, Industry and Rural Development in the Northern Territory was particularly useful in this respect because its activities have an orientation toward developing industries.



Swamp-Riverine buffalo, Northern Territory



*Alternative Meats—Novel flavours, products and safe delivery, RIRDC, 05/140*

Knowledge of the supply chain for each commodity gives some indication of where the best place is to gather statistics for that industry. For example, the centralised nature of the marketing systems with the goat fibre industries (mohair and cashmere) made gathering of production statistics reasonably straightforward.

The meat processing industry has readily identifiable points for gathering data because meat must be processed through a limited number of licensed processing establishments. Furthermore, there are regulatory bodies in each state that collect statistics on animal slaughter numbers for monitoring purposes.

For plant-based industries, a key potential collection point for information is the major markets that exist for fruit, vegetables and flowers in each of the mainland state capital cities — that is, Sydney, Melbourne, Brisbane, Perth and Adelaide. A reporting service for these markets is provided by the Ausmarket Consultants group ([www.ausmarket.net.au](http://www.ausmarket.net.au)).

The FAOSTAT database of the Food and Agriculture Organisation of the United Nations (FAO) ([apps.fao.org](http://apps.fao.org)) was the main source of international information on production and trade for many, but not all, of the emerging industries.

The UN Commodity Trade Statistics Database (Comtrade) and the European Commission's EUROSTAT database provided some additional trade information for products that were not provided by FAOSTAT — for example, game pigs, game birds, pasture seeds, durian fruit and cashmere products.



*Sleeved and packaged kangaroo paw ready for export*

The US Department of Agriculture (USDA) also has some useful world data — for example, on macadamias.

Where no FAO or USDA data were available, knowledge of the supply chain can help identify international sources of information.

For example, reflecting that South Africa is the main world producer and exporter of mohair, an industry body in that country gathers a range of statistics on the world mohair industry.

Another example is statistics from the flower auction system in Japan (the most important market for Australian wildflowers) provide far more detailed information on the nature of Australian wildflower shipments to Japan than do Australian export statistics.

Finally, the most important sources of information were industry participants, particularly industry associations.

These information sources are acknowledged throughout the report. A list of key industry contacts is provided in Appendix C.

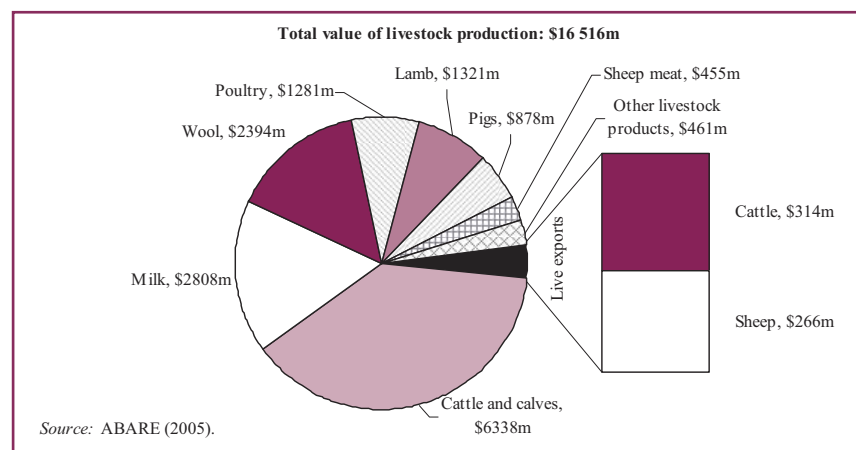
# Emerging animal industries

The emerging animal industries in Australia produce a range of products including meat, fibre, skins and oil. The estimated value in Australia of the emerging animal industries examined in this report is around \$204 million. To put this figure into context, the composition of the value of total livestock production in Australia in 2003–04 is shown in Figure A. More statistics on the production and exports of the Australian livestock industries are provided in Appendix A.

Part of the emerging animal industries is based on using previously unexploited wild resources — for example, kangaroos and feral goats and camels. Others are based on farming of animals that are native to Australia — for example, crocodiles and emus — that cannot legally be commercially harvested from the wild because of conservation concerns.

There is also farming of introduced animals — for example, alpacas, buffalo, deer, goats, ostriches and rabbits. The opportunity for rabbit farming in Australia has largely opened up because of the collapse of the industry based on the harvesting of wild rabbits following the release of rabbit calicivirus.

Some farmers of emerging animal products appear to be attempting to diversify their production away from more traditional agricultural products. There is a strong ‘lifestyle’ element to many of the emerging animal industries, with production occurring on hobby



**Figure A: Value of livestock industries in Australia, by sector, 2003–04**

farms. Early entrants to emerging animal industries have often been able to benefit from supplying the lucrative market for breeding stock that characterises emerging industries in their early stages of development.

The emerging animal industries seem to be benefiting from changes in consumer tastes and preferences that are related to growing incomes. That is, as incomes grow, there is increasing demand for more distinctive and healthier products.

Most of the emerging animal industries produce meat that easily meets the distinctive quality criteria. And many of these meats are claimed to be healthier than traditional meats because they have lower fat contents — for example, kangaroo, rabbit and crocodile meat.

Leathers produced from the skins of these animals, such as ostrich and crocodile, also have distinctive characteristics that make them valuable. The oil from emus and velvet from deer, for example, can

have health-related uses. Fibres from alpacas and goats (cashmere and mohair) are highly priced luxury products, demand for which is being increased through income growth.

The emerging Australian goat meat industry is benefiting from growing populations and increasing consumer incomes in countries where there is a traditional preference for goat meat, particularly in countries with Islamic populations.

The emergence of a dairy goat industry reflects changes in the ethnic composition of the Australian population that has led to an increasing diversity in the Australian diet. There is also a health related aspect to the demand for goat milk products because there are some who are allergic to bovine milk products.

There are some new and emerging animal industries that are not dealt with in this report, including dairy sheep and snails. The industries not dealt with are very small in size at this stage.

# Alpacas

Alpacas are native to South America and were initially imported from Peru, Bolivia, Chile and North America. There are two main alpaca types: Huacaya and Suri. With tight restrictions on the export of alpacas from South America there is a worldwide shortage of good alpaca breeding stock.

Alpacas are a source of leather, fibre and meat. The alpaca fibre is soft, light, warm and comfortable when worn next to the skin. Its qualities and limited supply put it in the luxury fibre category. It is processed into a range of high quality garments — suits, jackets, skirts, sweaters, scarves and headwear — and home wares such as rugs, blankets and continental quilts (as filling). Alpaca fibre comes in a range of natural colours including white, silver, many shades of grey and fawn, chocolate brown and jet black. The global alpaca fibre market at present is around 3500 tonnes (Australian Alpaca Association Inc. 2003).

In South America, alpaca farming is concentrated in the Altiplano – the high altitude regions of Southern Peru, Bolivia and Chile. Alpacas not only battle a harsh climate — burning sun by day, freezing conditions at night — but also receive



Suri type alpaca

few of the benefits of modern animal husbandry (Australian Alpaca Association 2002). In their homeland of South America, Peru has approximately 2.5 million alpacas, Bolivia around 500 000 and there are only some 50 000 in Chile and Argentina combined. Alpacas have flourished in countries such as Australia, Canada, New Zealand and the United States under

more temperate climates than their homelands and with more sophisticated animal husbandry techniques.

Prices for alpaca fibre generally differ according to fibre diameter and colour, with fine, white types commanding the highest prices (Figure B). Alpaca fibre tends to coarsen as animals age.

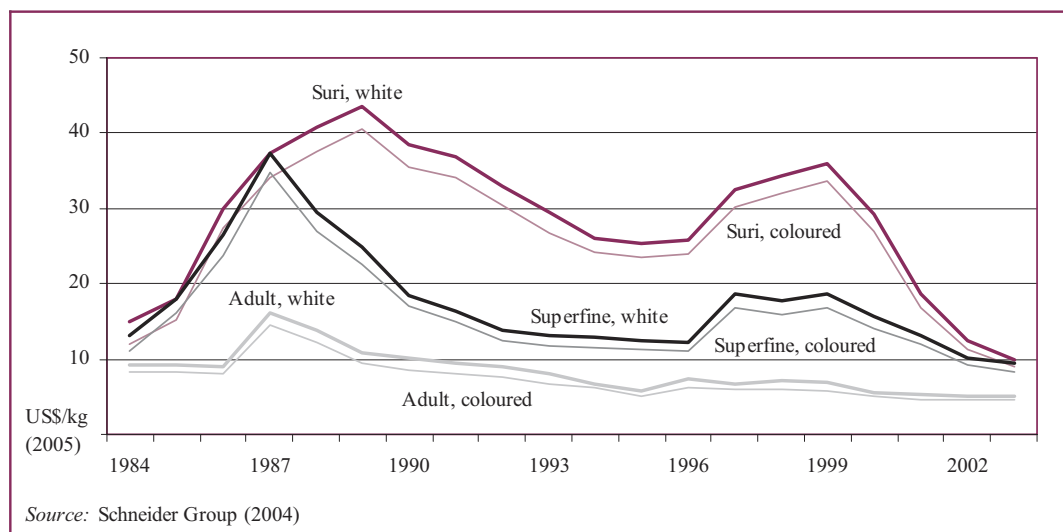


Figure B: Trends in international prices for alpaca fibre in constant (2005) US dollars

## Australian alpaca industry

The Australian alpaca industry was established in the late 1980s and has grown to a flock size of around 37 000 in 2003, mostly consisting of the Huacaya alpaca type (Table 2). Reflecting that the Australian industry is in a herd building phase there is very little meat production at this stage and a substantial trade in breeding stock. In 2004, an estimated 60 tonnes of fibre worth \$481 000 was produced. (The unit value of production is low compared with indicator prices because a significant part of the clip has no commercial value at this stage.)

The industry projection is that alpaca numbers in Australia will grow to 1.2 million by 2020, producing nearly 2740 tonnes of fibre and over 900 tonnes (dressed weight) of meat (Australian Alpaca Association Inc. 2003).

Over the four years to 2004, average alpaca fibre prices have ranged from around \$60 a kilogram for fibre 20 microns and lower (superfine) to around \$2 a kilogram for fibre over 30 microns (extra strong) (Table 3). For 2003, the composition of production and the price profile for alpaca fibre in Australia is shown on the next page in Figure C. With almost no grease in alpaca fibre, processing yield is usually around 95 per cent (Australian Alpaca Association Inc. 2002). Differences in fibre prices also occur based on the type of alpaca. For example, the average prices for Huacaya alpaca fibre in 2001 was \$24 a kilogram and was \$60 a kilogram for Suri alpaca fibre (Wondu Holdings 2001).

Reflecting the herd building phase of the Australian industry and the worldwide scarcity of breeding

**Table 2: Alpaca products: supply, disposal and value in Australia**

	Unit	2001	2002	2003	2004
<b>Production</b>					
Alpaca numbers	'000	na	31	37	37
Average herd size	no.	na	20	25	25
Fibre production					
– Volume	tonnes	na	37.8	45.7	59.9
– Gross value	\$'000	na	317	387	481
– Unit gross value	\$/kg	na	8.39	8.48	8.03
Meat production*	kg	–	–	–	–
<b>Exports</b>					
Fibre					
– volume	tonnes	–	–	–	–
– value	\$'000	–	–	–	–
– unit value	\$/kg	–	–	–	–
Meat					
– volume	t	0	0	0	0
– value	\$'000	0	0	0	0
– unit value	\$/kg	0	0	0	0
<b>All alpaca</b>					
Total gross value of production	\$'000	na	317	387	481
Total export value	\$'000	–	–	–	–

\* Dressed weight. na Not available. (–) Negligible.

Sources: ABS (2005); Australian Alpaca Association Inc. (2003); Australian Alpaca Fleece Ltd; ABARE.

**Table 3: Average prices of alpaca fibre sales by Australian Alpaca Fleece Ltd\***

Fibre type	2001	2002	2003	2004
	\$/kg	\$/kg	\$/kg	\$/kg
Superfine	62	60	59	60
Fine	30	25	25	20
Medium	19	18	18	15
Strong	8	7	7	7
Extra strong	3	2	2	3
Average price	20	19	18	17

\* Formerly Australian Alpaca Cooperative Ltd. Prices includes the goods and services tax of 10 per cent.

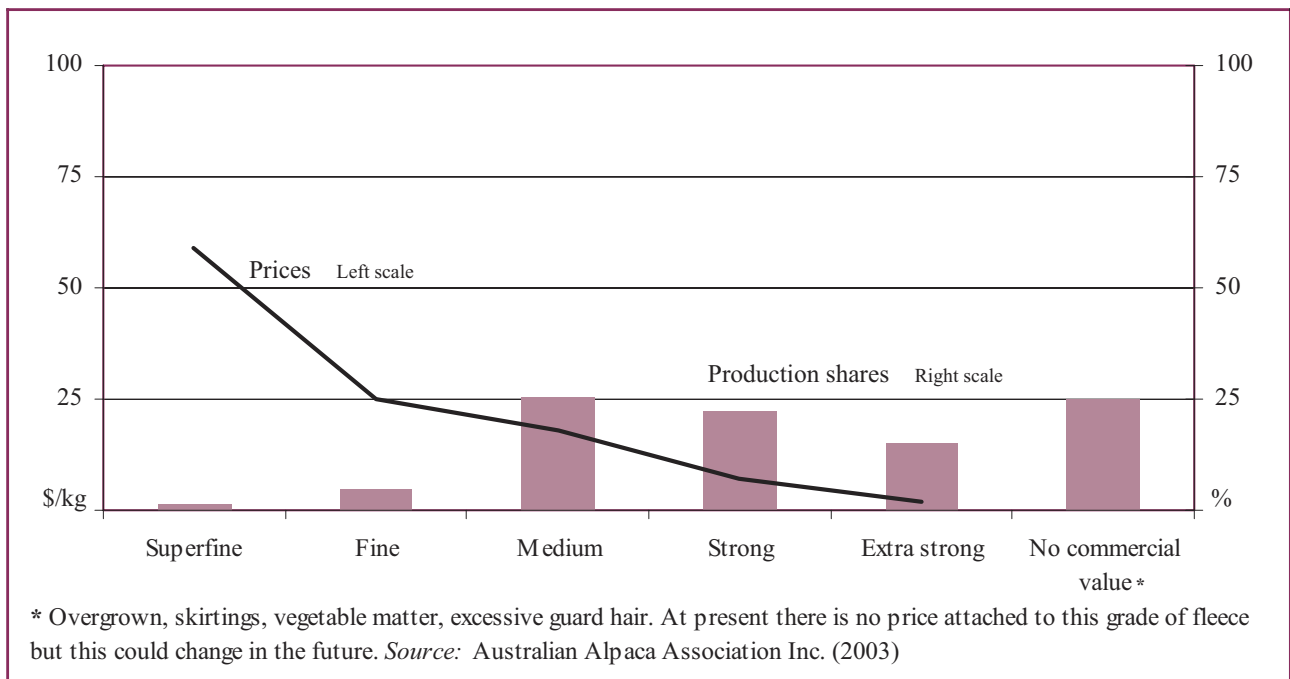
Source: Australian Alpaca Association Inc. (2003); Australian Alpaca Fleece Ltd (2004a).

stock, prices are very high for suitable breeding alpacas. Average prices received at the 10<sup>th</sup> national show and sale in 2003 were around \$20 700 for females and \$62 200 for males.

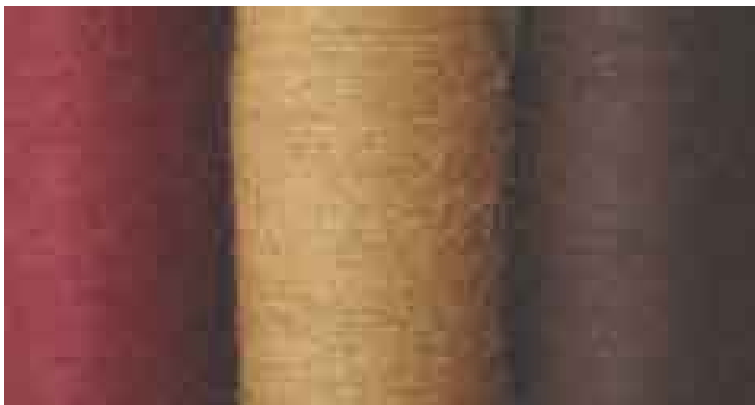
The key marketer of alpaca fibre in Australia is the Australian Alpaca Fleece Ltd (AAFL), an industry owned company established in March 2004. AAFL collects and

classes alpaca fleeces then sells them to 'strategic partners who market their products nationally and internationally in the home ware and fashion areas of retailing' (Australian Alpaca Fleece Ltd 2004b). AAFL replaced the Australian Alpaca Cooperative which was established in 1995 under the *Cooperatives Act 1995*. AAFL markets around 85 per cent of the Australian alpaca clip.





**Figure C: Profile of alpaca prices and production in Australia, by broad fleece type, 2003**



Alpaca yarns top, and alpaca fleece bottom

### Further information about alpacas

- Australian Alpaca Association website ([www.alpaca.asn.au](http://www.alpaca.asn.au)), information from the industry representative body in Australia.
- Australian Alpaca Fleece Ltd website ([www.australionalpacafleece.com.au/home.asp](http://www.australionalpacafleece.com.au/home.asp)), information on the marketing of alpaca products.
- International Alpaca Association website ([www.aia.org.pe](http://www.aia.org.pe)), information on alpacas, mainly in Peru, including some Peruvian export data.
- The Alpaca Marketplace website ([www.alpacamarketplace.com](http://www.alpacamarketplace.com)), listing of alpacas (and llamas) for sale in Australia.
- The Schneider Group website ([www.gschneider.com/brochure/specialfibres.php](http://www.gschneider.com/brochure/specialfibres.php)), prices and other market information for alpaca fibre.

# Buffalo

Annual world trade in buffalo meat has averaged 255 000 tonnes a year in the five years to 2003, all but a small part of which came from India (FAO 2005). An average 38 000 live buffaloes a year are also traded internationally. Buffalo meat is used for human and pet food, with the hides a valuable co-product. Buffaloes are also an important source of milk in some countries.



Buffalo cheese

There are three broad types of domesticated buffalo throughout the world. These are: the River type, the milking animal of the Indian sub continent; the Swamp type, widely used throughout south east Asia as a draught animal; and the Mediterranean type, used for both draught and dairy purposes (Australian Buffalo Industry Council 2004).

## Australian buffalo industry

Buffalo were introduced to the Northern Territory in the early 19<sup>th</sup> century. A large feral buffalo population soon became established, peaking in the 1980s at around 350 000, before strict disease eradication measures against bovine tuberculosis in early 1990s. The buffalo population in the



Buffalo - Northern Territory

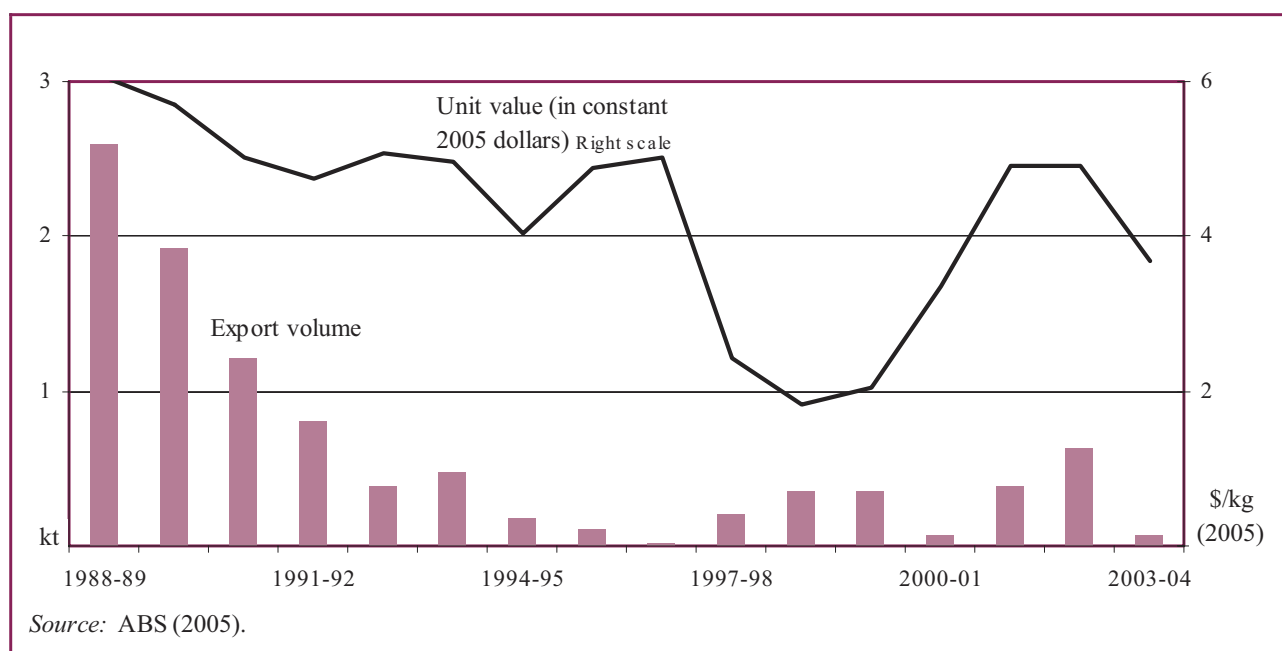
Northern Territory was declared free of bovine tuberculosis in 1997. It is estimated that there is currently a feral buffalo population in the Northern Territory of around 40 000 and a domesticated herd of around 15 000 on 29 farms (Neil Ross, Northern Territory Buffalo Industry Council, personal communication, 6 June 2005). There are also very small buffalo herds in all the other states.

The buffalo herd in the Northern Territory is made up mainly of the originally introduced Swamp type. Riverine buffalo were imported in the mid 1990s and have been crossed with the Swamp buffalo to produce faster growing animals. Most of the Riverine buffalo in Australia are located at a buffalo dairy enterprise in Victoria.

Buffalo meat is claimed to be leaner and lower in cholesterol than beef (Australian Buffalo Industry Council 2004). To assist marketing, the Australian buffalo industry has instituted a label called TenderBuff™ for buffalo meat that meets its specified quality standards for the restaurant trade. Estimated production for the restaurant trade in Australia in 2004 was 17.5 tonnes (Neil Ross, personal communication).

In 2003-04, the value of the Australian buffalo industry was slightly over \$2 million, based on meat production of 78 tonnes and live buffalo exports numbering 2194, mainly to Brunei (Table 4). Virtually all of this production occurred in the Northern Territory. The decline in buffalo slaughterings in 2003-04 was largely due to the closure of a meat processing works in the Northern Territory.

ABS (2005) figures indicate Australian exports of buffalo meat from the Northern Territory have grown strongly since the end of the disease eradication program but they are not yet as large as prior to the program (Figure D). However, it should be noted that these figures are somewhat larger than the Northern Territory production figures that come from reliable sources, suggesting some misclassification of beef as buffalo meat. Based on the ABS figures, the main export markets for Northern Territory buffalo meat are Japan (72 per cent of the total volume in the three years to 2003-04), Indonesia (11 per cent), Chinese Taipei (5 per cent) and French Polynesia (3 per cent). Export prices have also risen sharply in recent years.



**Figure D: Volume and unit value of Northern Territory buffalo meat exports**

**Table 4: Buffalo products: supply, use and value in Australia**

	Unit	1999-00	2000-01	2001-02	2002-03	2003-04
<b>Production</b>						
Slaughterings	no.	1944	589	1 294	1 896	700
Gross value of meat	\$'000	809	329	796	1 475	454
Meat production	t	253	83	145	211	78
<b>Exports</b>						
<b>Live</b>						
- volume	no.	2 324	3 184	3 168	4 054	2 194
- value	\$'000	1 048	1 974	2 165	3 505	1 582
- unit value	\$/hd	451	620	683	865	721
<b>Meat</b>						
- volume		361	68	383	623	72
- value	\$'000	635	201	1 714	2 872	258
- unit value	\$/kg	1.76	2.97	4.47	4.61	3.57
<b>All buffalo</b>						
Total value of exports	\$'000	1 683	2 175	3 879	6 377	1 839
Gross value of production	\$'000	1 857	2 303	2 961	4 981	2 036

Sources: ABS (2005); Levies Revenue Service; DBIRD (2003b, 2005a); ABARE; Adam Lourey, Department of Business, Industry and Resource Development, Northern Territory, personal communication, 1 March 2005.

### Further information about buffalo

- Department of Business, Industry and Resource Development, Northern Territory website ([www.primaryindustry.nt.gov.au](http://www.primaryindustry.nt.gov.au)) provides a range of information including production, interstate movements and exports.
- *Pastoral Market Update* ([www.primaryindustry.nt.gov.au](http://www.primaryindustry.nt.gov.au)), monthly statistical bulletin on number of live exports of buffaloes, camels, deer, goats and other livestock via Darwin port.
- Australian Buffalo Industry Council website ([buffaloaustralia.org](http://buffaloaustralia.org)) provides a range of information about the buffalo industry in each Australian state and territory and a free quarterly newsletter *Buffalo News*.

# Camels

Camels (*Camelus dromedarius*) are used in many parts of the world as a beast of burden and as a source of milk and dung. Camels are also slaughtered for meat for human consumption and petfood. Other camel products include leather, camel wool and camel oil. There is also a camel racing industry.

There is a significant world trade in live camels (Figure E) but only a very small recorded trade in camel meat. From a trough in 1990, world trade in live camels grew, on average, by 7.5 per cent a year over the period to 2003.

In the three years to 2003, the value of the world live camel trade averaged US\$25 million (FAO 2005).

The main importers of live camels are Egypt, Kuwait, Libya, Saudi Arabia and Qatar. The main suppliers of live camels in world trade are Mauritania and Pakistan.



Camels - from Capture and Handling of Camels Destined for the Abattoir, Central Australian Camels Industry Association Inc. 2nd edition 2002.

## Australian camel industry

The Australian camel industry is largely based on the harvesting of feral camels in the arid central regions of Australia. It is believed that the feral camel population numbers around 400 000 in

Australia, with 50 per cent located in Western Australia, 25 per cent in the Northern Territory and most of the remainder in western Queensland and northern South Australia (CACIA 2004).

The main source of income for the Australian industry is trade

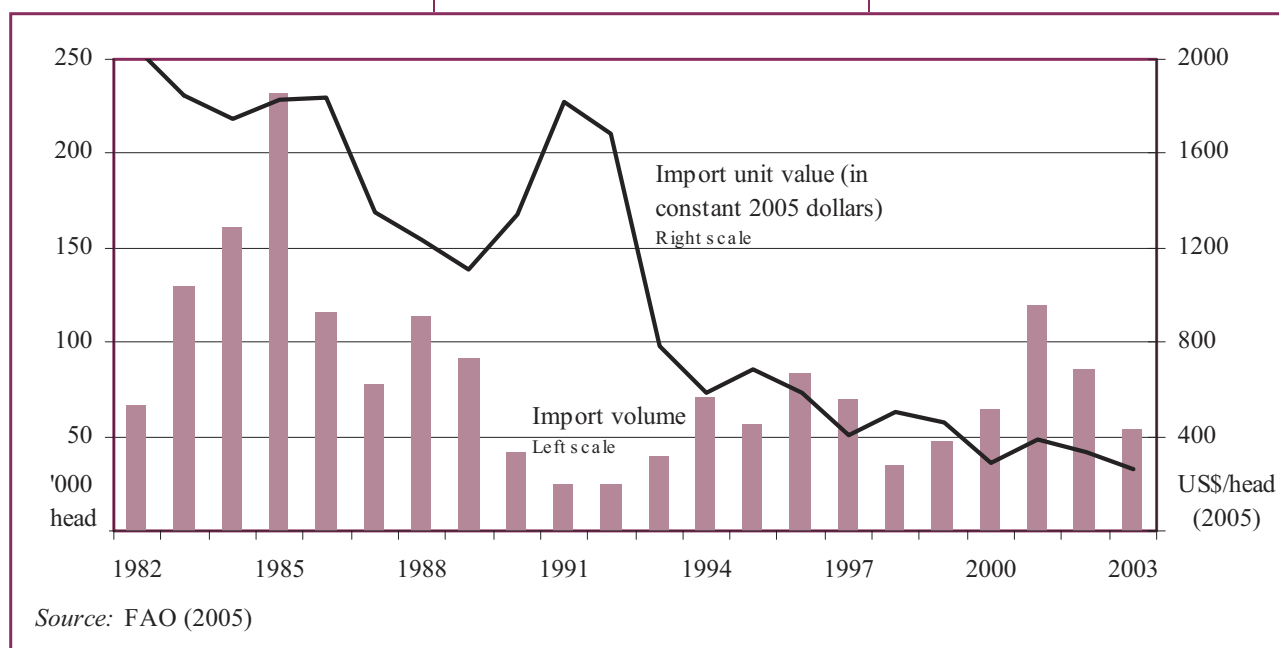


Figure E: World trade in live camels

in live camels (Table 5). Income from tourism is also important to the industry. Slaughter of camels for human consumption commenced at Alice Springs in the 1980s. Warfield and Tume (2000) identified annual camel meat production of 35–50 tonnes in the late 1990s that was sold in South Australia and the Northern Territory through supermarket chains. However, there does not appear to have been significant camel meat production in Australia in recent years.

In the three years to 2003-04, shipments of live camels were made to Malaysia (57 per cent of total), Brunei (35 per cent) and Saudi Arabia (7 per cent) (DBIRD 2005a).

An industry representative body is the Central Australian Camel Industry Association Inc (CACIA), made up of members from the pastoral industry, meat industry, Aboriginal communities, tourism operators, transport operators, contractors and government agencies.

**Table 5: Australian camel products: supply, use and value in Australia**

	Unit	2000-01	2001-02	2002-03	2003-04
Production					
Slaughterings	no.	46	48	50	51
Meat production	tonnes	13	13	14	14
Gross value	\$'000	33	34	36	36
Exports					
Live*					
– volume	no.	197	415	130	115
– value**	\$'000	141	297	93	82
– unit value	\$/hd	715	715	715	715
Meat					
– volume	tonnes	0	0	0	0
– value	\$'000	0	0	0	0
– unit value	\$/kg	0	0	0	0
All camel					
Total export value	\$'000	141	297	93	82
Gross value of production	\$'000	174	331	129	119

\*Via Darwin port only. \*\*Based on an average live weight of 550 kilograms a camel and \$1.30 a kilogram live weight (Peter Seidel, Central Australian Camel Industry Association, personal communication, 11 February 2004).

Sources: ABS (2005); DBIRD (2003b, 2005a).

### Further information about camels

- *Australian Camel News* ([www.austcamel.com.au/acn\\_home.htm](http://www.austcamel.com.au/acn_home.htm)).
- Central Australian Camel Industry Association Inc website ([www.camelsaust.com.au](http://www.camelsaust.com.au)) provides a range of information including trading specifications for live camels and camel meat, and a code of practice for the welfare and husbandry of camels.
- FAO's online database ([apps.fao.org](http://apps.fao.org)) provides a range of data by country including: camel numbers and meat production; volume and value of trade (live and meat); and camel milk production.
- *Pastoral Market Update* ([www.primaryindustry.nt.gov.au](http://www.primaryindustry.nt.gov.au)), monthly statistical bulletin on number of live exports of buffaloes, camels, deer, goats and other livestock via Darwin port.



Camel leather products and meats. From Camel Selected Meat Cuts and Information. Central Australian Camel Industry Association Inc. 1st edition. 1997

# Crocodiles

Skins are the main product from crocodiles, with meat an increasingly valuable co-product. There are also by-products of feet, teeth and skulls (DBIRD 2002). In Australia, tourism is an important activity for some crocodile enterprises, accounting for an estimated 30 per cent of total revenue of these enterprises surveyed in 2001 (Wondur Holdings 2002). Because of its attractive appearance, suppleness and durability, leather from crocodiles is a premium leather that is used in products such as fashion accessories (shoes, belts, handbags), wallets and luggage. Crocodile meat is a succulent white meat that is low in fat and high in protein.



Crocodile skin, Crocodylus Park, Northern Territory

According to FAO (2005), an average of 1.3 million crocodiles and alligators were harvested annually worldwide in the three years to 2002. Colombia accounts for 54 per cent of this total, the United States around 21 per cent, Zimbabwe about 6 per cent and South Africa 4 per cent. Australian



Farmed crocodiles

production represented only 0.8 per cent of the world total.

Trade in crocodiles and alligators is subject to the Convention on International Trade in Endangered Species (CITES) to which Australia is a signatory, along with around 150 other countries. The protected species status of crocodiles means that permits are required in Australia for crocodile products exported to, or imported from, overseas. Permits are issued by the Australian Government Department of Environment and Heritage.

The nature of world trade in crocodilian meat and skins is summarised in Table 6. Most skins are derived from the *caiman* species while most meat comes from *crocodylus* species. (It should be noted that the data in Table 6 from CITES (2005) includes re-exports which explains why a country such as Switzerland can appear as an exporter.)

## Australian crocodile industry

There are 14 commercial crocodile farms across the Northern Territory, Queensland and Western Australia involving both

freshwater (*Crocodylus johnstoni*) and saltwater (*Crocodylus porosus*) crocodiles. In Western Australia and the Northern Territory, crocodile farming involves captive breeding supplemented by regulated sustainable harvesting of eggs and juveniles from the wild but it is solely captive breeding in Queensland. There are six commercially operating crocodile farms in the Northern Territory, six in Queensland, and two in Western Australia (Love and Langenkamp 2003).

Farmed crocodiles are harvested when their belly skin measures at least 35 centimetres; this takes from 18 months to 3 years (Porosus Pty Ltd 2004).

The total value of Australian crocodile product exports in 2003 was \$5.2 million, 98 per cent of which was related to skins (Table 7). France and Japan take most of Australia's crocodile skins, with shares of total value of 70 per cent and 17 per cent, respectively. The main export markets for Australian crocodile meat were Malaysia (43 per cent share in 2002 and 2003, by value), Hong Kong (17 per cent), Japan (13 per cent), New Zealand (13 per cent) and the Netherlands (7 per cent).

**Table 6: World trade in crocodylian meat and skins\***

Genus Meat (tonnes)	Volume*	Main exporters	Main importers
<i>Alligator</i>	13.2	United States (100%)	Hong Kong (58%), Canada (20%), Japan (16%), United Kingdom (7%)
<i>Caiman</i>	negligible		
<i>Crocodylus niloticus</i>	299.3	South Africa (48%), Zimbabwe (18%), Zambia (18%)	Hong Kong (49%), South Africa (24%), United States (11%), Netherlands (11%), China (9%)
<i>Crocodylus porosus</i>	72.8	Australia (89%), Papua New Guinea (10%)	Japan (75%), Australia (10%), CN (4%), Germany (3%)
<i>Other Crocodylus</i>	68.5	Papua New Guinea (61%), Thailand (35%), Mexico (4%)	Australia (61%), China (20%), Germany (6%), Hong Kong (5%), Japan (4%)
Skins ('000)			
<i>Alligators</i>	464	United States (68%), Singapore (5%), Switzerland (6%), France (5%), Italy (5%)	France (35%), Italy (14%), Singapore (14%), Mexico (7%), United States (6%)
<i>Caiman</i>	1515	Colombia (53%), Singapore (21%), United States (6%), Bolivia (3%), Paraguay (3%), Venezuela (3%)	Singapore (21%), Mexico (17%), United States (15%), Thailand (9%), Spain (7%)
<i>Crocodylus niloticus</i>	267	Zimbabwe (43%), Singapore (18%), South Africa (13%), Zambia (9%)	Singapore (25%), France (16%), Thailand (15%), United States (11%), Japan (8%), Italy (5%)
<i>Crocodylus porosus</i>	30	Australia (37%), Papua New Guinea (32%), Singapore (11%), Indonesia (6%)	Japan (34%), France (30%), Australia (15%), Singapore (8%), Italy (6%)
<i>Other Crocodylus</i>	34	Papua New Guinea (38%), Indonesia (20%), Thailand (18%), Singapore (10%), Japan (8%)	Japan (65%), Singapore (7%), Thailand (7%), Korea Rep. (6%)

\* Includes re-exports.

Source: CITES (2005)

**Table 7: Crocodile products: supply, disposal and value in Australia**

Item	Unit	2000-01	2001-02	2002-03	2003-04 p
Production					
Meat		93.1	51.9	42.3	52.5
Skins	no.	23 865	12 490	10 062	8 816
Gross value		11 084	6 089	5 279	3 982
		2001	2002	2003	2004 p
<b>Exports</b>					
Raw hides and tanned skins, freshwater crocodiles					
– volume	no.	na	225	279	na
– value		na	41	66	na
– unit value	\$/skin	na	183.71	235.59	na
Raw hides and tanned skins, saltwater crocodiles					
– volume	no.	na	13 233	21 480	18 244
– value		na	2 919	5 015	4 801
– unit value	\$/skin	na	220.6	233.46	263.16
Leather					
– volume	no.	na	2 540	350	3 924
– value		na	1 028	2	41
– unit value	\$/skin	na	404.76	5.71	10.57
Meat and edible offal					
– volume		na	10.5	10.8	na
– value		na	205	114	na
– unit value	\$/kg	na	19.58	10.51	na
Total export value		na	4 194	5 196	na

Sources: ABS (2005); DBIRD (2003b); Adam Lourey, Department of Business, Industry and Development, Northern Territory, personal communication, 1 March 2005; Peter Peucker, Queensland department of Primary Industries, personal communication, 9 May 2005; ABARE.

### Further information about crocodiles

- Department of Business Industry and Resource Development, Northern Territory website ([www.primaryindustry.nt.gov.au](http://www.primaryindustry.nt.gov.au)) provides a range of information about crocodile farming in the Northern Territory.
- FAO's online database ([apps.fao.org](http://apps.fao.org)) provides data by country for crocodile and alligator production.
- Crocodile Capers ([www.dpi.qld.gov.au/News/371.html#croc](http://www.dpi.qld.gov.au/News/371.html#croc)), newsletter from Queensland Department of Primary Industries covering industry news and research findings for crocodile producers, researchers and manufacturers

# Emus

The emu (*Dromaius novaehollandiae*), a native of Australia, is the world's second largest living bird (only the ostrich is larger). An adult emu can weigh over 50 kilograms.

Commercial farming of emus began in Western Australia in 1987 and has spread to all other states and to some other countries, most notably the United States. Wild harvesting of emus is prohibited in all states. In 2001, there were around 145 establishments producing emus (Peter McInnes, RIRDC, personal communication, 23 November 2002) but the number had declined to around 50 in 2004.

The main products from emus are meat, oil and skins for leather. Emu meat is a low fat, low cholesterol, high protein red meat. Emu oil, rendered from emu fat, is sold as a medicinal oil for the relief of joint pain, soft tissue injury and dermatitis, as well as a base for a range of cosmetics (O'Malley and Snowden 1999). Body and leg skin is used to make a high quality exotic leather.

An emu can produce 14 kilogram of meat, 4 litres of oil, 0.75 square meters of body skin and two leg skins (Kent 1994). More recent information suggests that meat yield is 12 kilograms and the oil yield 6 litres. Based on a model emu farming operation in Australia, Hassall and Associates (2000) found that oil would make up around 45 per cent of the total revenue of this operation; meat 42 per cent; leg skin 3 per cent; hides 8 per cent; and trim 2 per cent.



Farmed emus. RIRDC emu research project DAT-19A in Tasmania

Emu oil is a valuable product from emus and seems to be exported to a number of countries, particularly the United States. In the United States in April 2005, Australian produced emu oil in 55 gallon (265 litre) containers was quoted at US\$70 a US gallon (equivalent to \$A24 a litre) (DDM Wholesale 2005).

At this stage, however, it has not been possible to locate reliable data for Australian emu oil production and exports. So that the value of Australian emu production is not understated, an estimate is made of the volume of Australian production and exports of emu oil. With this calculation, it is assumed that the domestic price of bulk emu oil price is \$22 a litre; each emu slaughtered produces 6 litres of oil; and 80 per cent of Australian production is exported.

A similar estimate is made with emu skins where also no reliable data are available. At present, there is only limited demand

for Australian emu leather in international markets though MacNamara et al. (2003) point to the potential in the US and Chinese markets if improvements can be made in the tanning process. It is assumed that one-third of emu skins from slaughtered birds are used; the domestic price for raw, salted skins is \$60; and that 50 per cent of all skins produced are exported in raw, salted form.

Emu production in 2004 increased substantially from the drought affected levels of 2003 (Table 8). Nevertheless, emu production is considerably below the peak production level of 21 000 birds slaughtered in 1996. The value of emu production in 2004 was only slightly above \$1 million.

In the three years to 2003, more than half of Australia's emu meat exports went to the United States with the other main markets being Hong Kong, Singapore and Malaysia.



**Table 8: Emu products: supply, disposal and value in Australia**

	Unit	2001	2002	2003	2004
<b>Production</b>					
Slaughterings	no.	7 031	4 000	3 714	6 258
Gross value	\$'000	1 112	635	459	1 033
Meat production*	tonnes	84.4	48.0	44.6	75.1
Oil production**	kL	42.2	24.0	22.3	37.5
<b>Exports</b>					
Meat and edible offal					
– volume	tonnes	na	9.6	38.8	17.5
– value	\$'000	na	68	148	134
– unit value	\$/kg	na	7.06	3.82	7.63
Oil					
– volume	tonnes	33.7	19.2	17.8	30.0
– value	\$'000	817	465	431	727
– unit value	\$/kg	24.20	24.20	24.20	24.20
Skins and leather					
– volume	no.	1 160	660	613	1 033
– value	\$'000	77	44	40	68
– unit value	\$/kg	66.00	66.00	66.00	66.00
Total export value	\$'000	na	576	620	929

\*Assumes a dressed weight of 12 kilograms a bird. \*\*Assumes oil production of 6 litres a bird slaughtered.

Sources: ABS (2005); Levies Revenue Service; ABARE.



Above: Emu in holding pen and above, leaving the pens for the paddock. RIRDC emu research project DAT-19A in Tasmania.

# Deer

The main products from deer farming are venison and velvet antler, the immature antler that is widely used in traditional Asian (particularly Chinese) medicine. Other parts of deer are also used in traditional Asian medicine including the pizzle, tail, sinews, heart and blood (Tuckwell 2001).

Most of the world's venison comes from feral herds in northern Europe, north America and the Russian Federation and from farmed deer in New Zealand (Pearse, SriRamaratnam and Dake 1994). The main sources of velvet are Russia, China, the Republic of Korea and New Zealand.

New Zealand is the largest producer of farmed deer, with around 1.7 million deer in 2004, or about half the world's farmed deer population (Deer Industry New Zealand 2004).

In 2003-04 (year ended 30 September), New Zealand exported nearly 23 000 tonnes of venison; 228 tonnes of velvet; 461 000 deer hides; and 148 000



Fallow deer

square metres of deer leather. The total value of these exports in 2003-04 was NZ\$237 million, of which venison made up 76 per cent, velvet 13 per cent, hides 4 per cent, leather 4 per cent and other co-products 4 per cent.

Germany accounts for almost half of New Zealand's venison exports, with the rest of Europe accounting for a further 40 per cent. Around half of New Zealand's velvet exports went to the Republic of Korea in 2003-04, with China and Hong Kong accounting for another 21 per cent and 22 per

cent respectively (Deer Industry New Zealand 2004).

New Zealand exports of venison reached record levels in 2003-04, which put downward pressure on venison prices (Figure F). Deer velvet prices, as indicated by New Zealand unit export returns, have declined sharply in recent years (Figure G).

## Australian deer industry

The composition of the Australian herd is approximately 50 per cent fallow deer, 40 per cent red deer, 7 per cent rusa, and 3 per cent elk/wapiti (Tuckwell 2004).

Unlike sheep and cattle, which are generally sold through the saleyard or direct to the abattoirs, deer are sold direct to processors. A processor will purchase animals direct from the farmer and arrange the transport, slaughtering, boning, packaging and marketing. Around 85 per cent of all

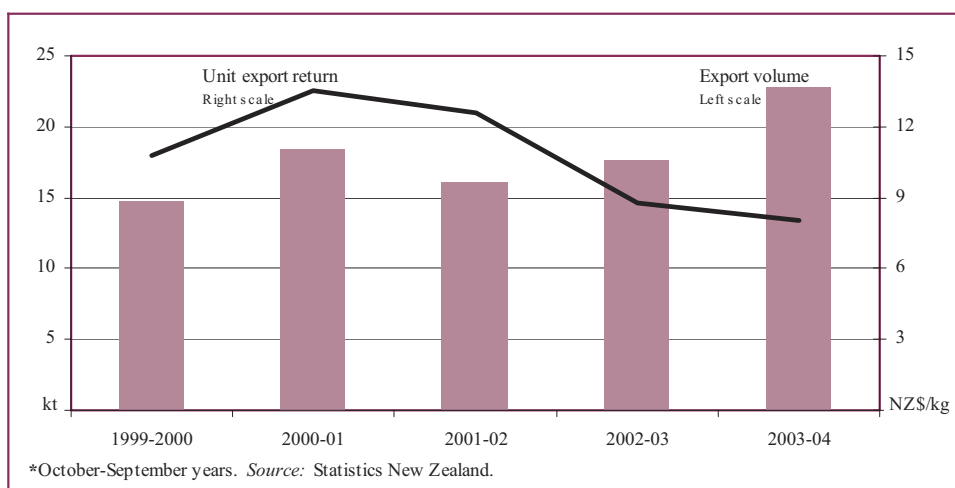
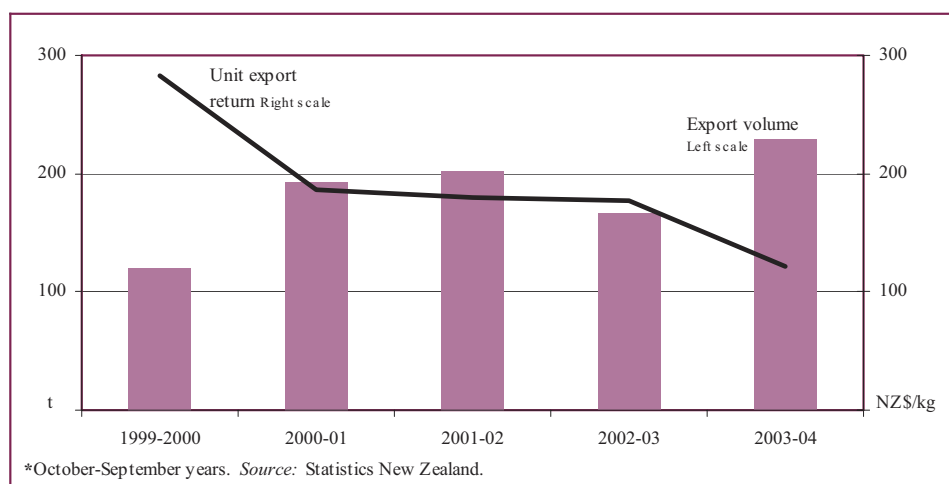


Figure F: New Zealand exports of venison\*



**Figure G: New Zealand exports of deer velvet\***

venison produced in Australia is exported, principally to Europe. Australia also imports venison from New Zealand. In 2004, New Zealand venison exported 728 tonnes of venison to Australia, up from 231 tonnes in 2000 (Deer Industry New Zealand 2005).

The New Zealand deer industry sees Australia as a growth market for its venison.

Australian velvet is sold through pooling arrangements or at the farm gate. The largest pooling arrangement accounts for around 60 per cent of total Australian velvet sales (Tuckwell 2004) and is operated by Deer Horn and Co-Products Pty Ltd, a wholly owned company of the Deer Farmers Federation of Australia.

Deer velvet makes up around a quarter of the value of deer products in Australia (Table 9). The main export markets for Australian velvet are Hong Kong, China, Korea, Chinese Taipei and New Zealand.

The Deer Farmers Federation of Australia represents farmers, processors, transporters, breed organisations and any other party involved in the deer industry.

**Table 9: Deer products: supply, disposal and value in Australia**

	Unit	1999-00	2000-01	2001-02	2002-03	2003-04
<b>Venison</b>						
Production						
- slaughterings	no.	50 923	44 330	41 223	46 652	35 518
- volume	tonnes*	1 959	1 737	1 490	1 505	1 250
- gross value	\$'000	5 269	6 147	6 316	3 177	2 848
- unit value	\$/kg	2.69	3.54	4.24	2.11	2.28
Exports, live deer						
- volume	no.	274	540	1 859	1 813	1 211
- value	\$'000	31	82	313	136	107
- unit value	\$/hd	113.82	152.54	168.53	74.90	88.22
Exports, venison						
- volume	tonnes*	1 665	1 476	1 266	1 280	1 063
- value	\$'000	7 292	7 675	7 646	5 278	4 384
- unit value	\$/kg	4.38	5.20	6.04	4.12	4.12
<b>Velvet antler</b>						
Production						
- volume	kg	na	43 319	17 225	26 146	28 686
- value	\$'000	na	1 435	1 525	2 006	1 261
- unit value	\$/kg	na	33	89	77	44
Exports						
- volume	kg	na	19 625	14 923	23 478	25 054
- value	\$'000	1 585	992	1 528	1 957	1 252
- unit value	\$/kg	na	51	102	83	50
<b>All deer products</b>						
Gross value of production	\$'000	na	7 664	8 154	5 318	4 216
Value of exports	\$'000	8 908	8 749	9 487	7 371	5 743

\*Hot carcass weight.

Sources: Tuckwell (2004); Australian Bureau of Statistics (2005); Levies Revenue Service; ABARE

#### Further information about deer

- Deer Industry Association of Australia ([www.diaa.org](http://www.diaa.org)), range of production and marketing information for deer in Australia.
- Deer Industry New Zealand ([www.deernz.org](http://www.deernz.org)), information on production and prices for deer products in New Zealand.

# Game Birds

Birds usually referred to as game birds include turkey, goose, duck, pheasant, plover, quail, grouse, partridge, guinea fowl, spatchcock and squab (pigeon). They have been traditionally harvested from the wild but most of the game birds consumed are now raised on farms.

World production of meat from game birds was an estimated 10.6 million tonnes in 2004 and consisted mostly of meat from turkeys, ducks and geese (Figure H). This puts game bird production at about one-sixth of the size of world chicken meat production. The United States produces nearly half of the world's turkey meat and China accounts for around two-thirds of world



Squab

exports in the three years to 2003), the United States (22 per cent), Brazil (10 per cent), Netherlands (8 per cent) and Italy (7 per cent). The main exporters of duck meat are China (18 per cent share of world exports in the three years to 2003), Thailand (14 per cent), Hong

Kong, China (10 per cent), France (10 per cent) and Hungary (8 per cent).

## Australian game bird industry

There are game bird industries in all states in Australia but the main producing states are New South Wales and Victoria (Leech, Shannon, Kent, Runge and Warfield 2003).

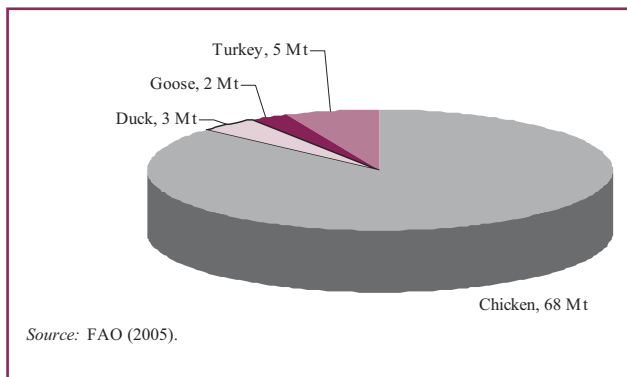


Figure H: World production of birds for

duck meat production.

World exports of game bird meat have been growing strongly since 1990 (Figure I). At the same time, unit export returns for game bird meat have been trending downwards in response to productivity improvements with bird production. The main exporters of turkey meat are France (28 per cent share of world

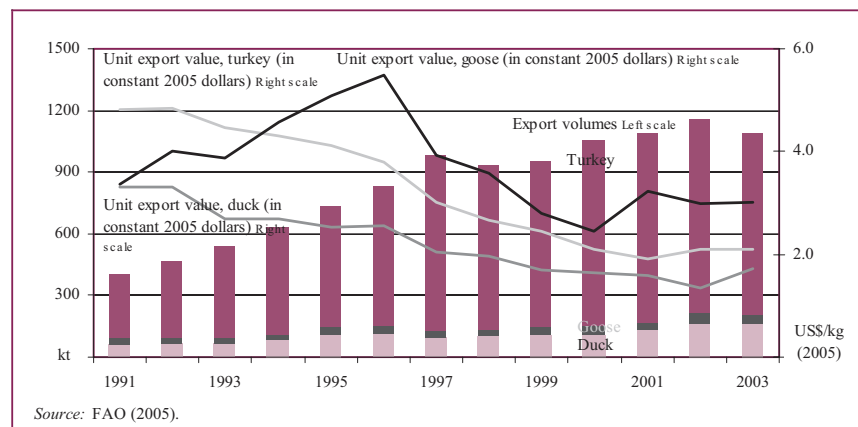


Figure I: World exports and unit export returns of game bird meat

In the three years to 2004, slightly more than half of the value of the Australian game bird industry came from turkey production, with the duck sector contributing another 43 per cent (Table 10).

Other game bird production only contributed 6 per cent of the total value of the industry.

For confidentiality reasons, no detailed breakdown is available from the Australian Bureau of Statistics for the 'other game birds' category in Table 10. Leech et al. (2003) reported estimates of game birds processed in 2001-02; these are shown in Table 11.

The Australian game bird industry seems to be highly concentrated. Leech et al (2003) say that large vertically integrated meat-chicken companies produce more than three-quarters of Australia's turkeys; two companies produce virtually all of Australia's ducks; and a single company produces 75 per cent of Australia's quails.

Around 10 per cent of Australia's game bird meat is exported and this is mainly turkey meat (Figure J). Unit export returns in constant (2005) dollars for turkey meat have trended downwards over time. The increase since 1996 in unit export returns for other game bird meat reflects a greater proportion of higher value game birds, particularly quail, in the total.

While there has been substantial growth in Australian exports of game bird meat since 1990, the small size of the Australian industry makes it difficult to compete on price with the major world producers (Leech et al. 2003).

**Table 10: Game birds: supply, disposal and value in Australia**

	Unit	2001	2002	2003	2004 p
<b>Production</b>					
Ducks and drakes					
- slaughterings	'000	3 896	3 984	4 440	4 493
- production *	tonnes	8 542	8 834	10 068	9 506
- gross value	\$'000	24 718	36 843	36 492	34 269
Turkeys					
- slaughterings	'000	2 997	3 503	4 194	3 050
- production *	tonnes	18 445	19 792	20 193	17 940
- gross value	\$'000	35 571	44 199	51 081	43 013
Other game birds					
- slaughterings	'000	4 919	5 635	5 199	6 247
- production *	tonnes	7 668	8 469	7 576	8 579
- gross value	\$'000	4 872	4 645	4 980	6 641
<b>Exports</b>					
Turkey					
- volume	t	3 104	4 952	4 381	3 636
- value	\$'000	3 792	4 402	3 156	3 527
- unit value	\$/kg	1.22	0.89	0.72	0.97
Other game birds					
- volume	tonnes	429.8	128.8	251.8	258.5
- value	\$'000	2 692	1 102	782	968
- unit value	\$/kg	6.26	8.55	3.11	3.75
<b>All game birds</b>					
Gross value of production	\$'000	65 160	85 687	92 553	83 923
Total export value	\$'000	6 484	5 504	3 938	4 495

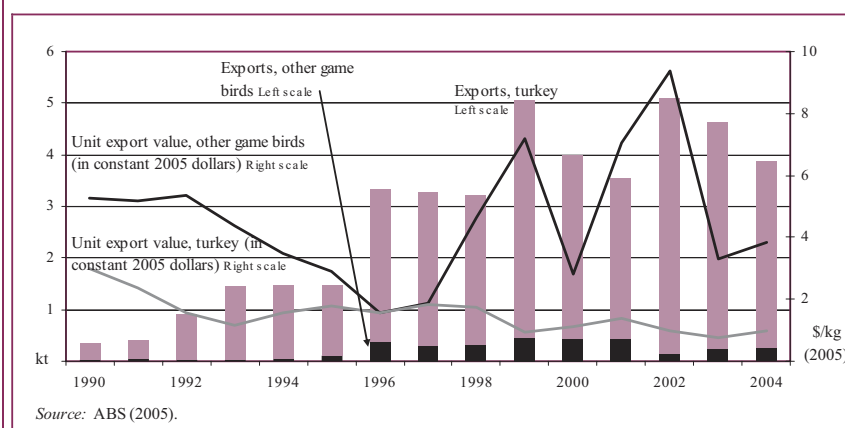
\* Dressed weight.

Source: ABS (2005 and unpublished data); ABARE.

**Table 11: Game birds (other than ducks and turkeys) processed in Australia, 2001-02**

Species	No. processed ('000)	Average dressed weight (kg/bird)	Meat, (dressed weight) (t)
Quail	6 500	0.24	1 560
Squab	680	1.90	1 292
Pheasant	60	0.35	21
Guinea fowl	40	1.10	44
Partridge	18	1.05	19
Goose	5	4.00	20
Total	7 303		2 956

Source: Adapted from Leech, Shannon, Kent, Runge and Warfield (2003).



**Figure J: Exports and unit export returns, game bird meat, Australia**

# Game Pigs

The game pig industry in Australia is based on harvesting the feral pig populations that have become established since European settlement. Game pigs are usually shot in the wild; very small numbers are trapped and slaughtered at abattoirs.

It is estimated that there are now between 13 million and 23 million feral pigs spread across all of the sparsely populated areas of Australia except the arid inland (Department of the Environment and Heritage 2004). Populations are most dense in wetlands and seasonally inundated floodplains.

Feral pigs cause considerable environmental damage in Australia through destroying vegetation, competing with native wildlife for food sources, and wallowing and rooting practices that lead to soil erosion. Australian game pig production has been considerably diminished in recent years by prolonged drought in the Eastern States of Australia (Table 12).

There is only a very small domestic demand for game pig meat (Forsyth and Parkes 2004). The main export markets for game pig



Feral pigs in field chiller

meat are in the European Union, particularly Germany, France and the Netherlands.

ABS (2005) statistics for pig meat exports to the European Union (25 countries) are difficult to interpret, showing a fall to very low levels from January 2002 onwards that is inconsistent with wild pig numbers killed in Australia.

Trade statistics from the European Commission (2005) that have a 'non-domestic' (wild) swine category appear to be more accurate. Imports of Australian game pig peaked in 1999 but have declined in recent years due to a drought-induced shortage of

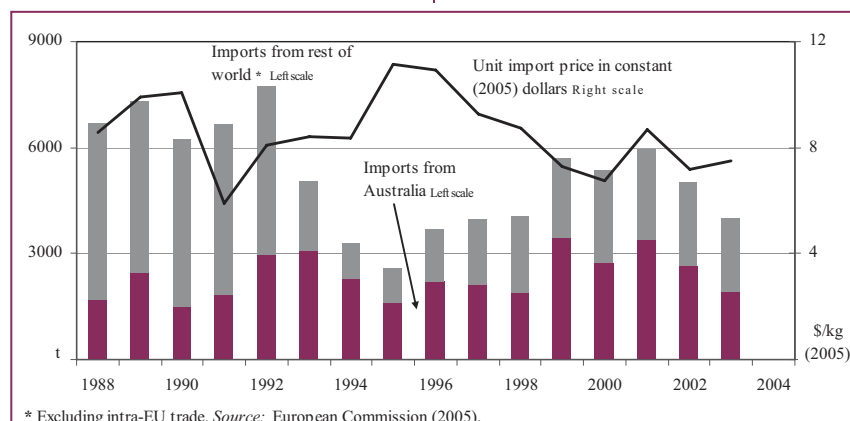
supply in Australia (Figure K). The main competitor to Australia in the European game pig market is the United States. Together Australia and the United States accounted for 96 per cent of the total volume of European Union game pig imports in the three years to 2004.

Unit import prices for the European Union market have fluctuated around \$9 a kilogram (shipped weight) in constant (2005) dollars terms. This implies that the average export return for game pig meat is around twice that for farmed pig meat from Australia (Figure K).

**Table 12: Game pigs: supply, disposal and value in Australia**

	Unit	2001	2002	2003	2004
<b>Production</b>					
Kill	'000	287.7	183.5	139.3	166.3
Volume	tonnes	3 596	2 294	1 567	1 975
Gross value	\$'000	15 690	10 687	7 455	8 905
<b>Exports</b>					
Volume	tonnes	3 572	2 274	1 547	1 955
Value	\$'000	24 574	15 371	9 064	11 356
Unit value	\$/kg	6.88	6.76	5.86	5.81

Sources: ABS (2005); Levies Revenue Service ABARE



**Figure K: European imports of game pig meat**

# Goats

Goats are hardy, versatile, domesticated animals producing meat, milk, fibre (cashmere and mohair) and skins. They adapt to a wide range of climatic conditions and are easily integrated into wheat and sheep farms or grazing enterprises in most agricultural areas (Meat and Livestock Australia 2002).

There are a number of goat-based industries in Australia with different degrees of specialisation in these products. These can be broadly categorised as meat goats, cashmere goats, angora goats and dairy goats.

## Meat goats

Annual world production of goat meat was an estimated 4 million tonnes in 2003. The key producing countries are China (40 per cent of total world production in 2003), India (11 per cent), Pakistan (8 per cent), Nigeria (3 per cent) and Bangladesh (3 per cent). Middle East countries accounted for a further 9 per cent of the total.

Considerably less than 1 per cent of world goat meat production enters world trade. In 2003, a record 28 000 tonnes of goat meat was exported worldwide, worth US\$78 million or an average US\$2.75 a kilogram. Australia provided nearly half of the total export volume in 2003, despite producing only 0.3 per cent of the world's goat meat. The other major exporters in 2003 were China (14 per cent of world export volume), France (8 per cent), Pakistan (8 per cent) and New Zealand (4 per



Well grown boer goat kid ideal for capretto

cent). The main importers in 2003 were the United States (27 per cent of the total world volume), China (17 per cent), United Arab Emirates (10 per cent), Hong Kong, China (10 per cent) and Italy (4 per cent).

## Australian meat goat industry

It appears that more than 80 per cent of Australia's goat meat production and live goat exports arise from the capture of feral goats, with the bulk of the remainder coming from culls from domesticated goat herds of specialist fibre producers. The commercial harvest of feral goats occurs mainly in parts of the rangelands of Australia where the main agricultural product is wool. According to Forsyth and Parkes (2004), this means that lower wool prices lead to higher harvests of feral goats (and vice versa).

Statistics on the supply and disposal of goat meat in Australia are provided in (Table 13). The Australian goat meat industry

is export oriented, with a small domestic market largely based on particular ethnic groups. In recent years, higher export returns and lower wool prices have resulted in a rise in Australian goat meat production and, hence, in exports (live and processed) after a period of decline in the 1990s (Figure L and Figure M). The total value of Australia's exports of live goats and goat meat and hides in 2003-04 was \$51 million, of which goat meat comprised around 83 per cent. In the three years to 2003-04, the largest export markets for Australian goat meat were the United States (40 per cent of total volume), Chinese Taipei (33 per cent), Canada (7 per cent) and Saudi Arabia (3 per cent). Queensland provided 37 per cent of these exports and Western Australia 28 per cent.

Over the same period, the major export destinations for live goats were Malaysia (44 per cent of total volume), Saudi Arabia (28 per cent), Singapore (8 per cent) and Jordan (6 per cent). Western Australia provided 47 per cent of these.

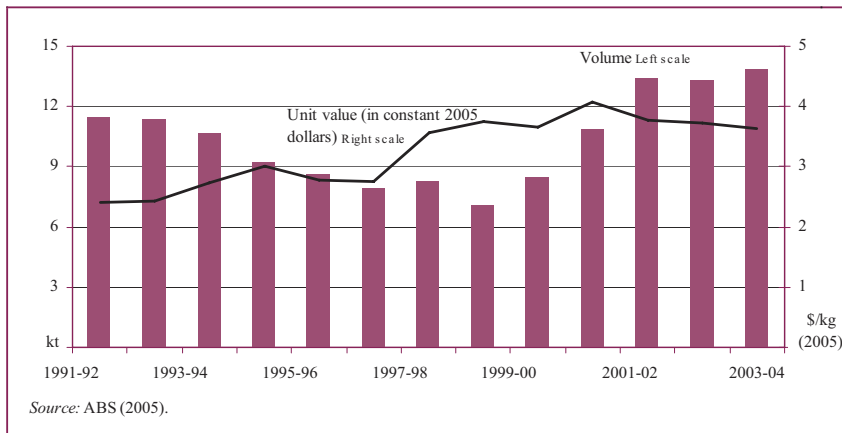


Figure L: Trends in Australian exports of goat meat

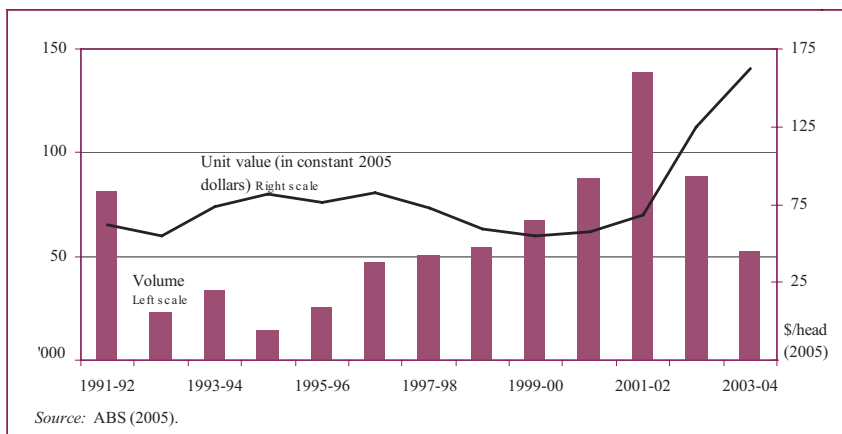


Figure M: Trends in Australian exports of live goats

Table 13: Goat meat and skins: supply, disposal and value in Australia

	Unit	1999-00	2000-01	2001-02	2002-03	2003-04
<b>Production</b>						
Meat	'000	784	1 040	1 346	1 070	1 056
Gross value	tonnes	9 798	12 998	16 829	13 381	13 200
Exports	\$'000	27 600	42 346	52 253	42 271	41 980
<b>Live goats</b>						
- volume	'000	67.4	87.7	138.8	88.7	52.8
- value	\$'000	3 251	4 625	8 901	10 696	8 589
- unit value	\$/head	48.23	52.73	64.14	120.63	162.76
<b>Meat</b>						
- volume	tonnes	8 481	10 870	13 375	13 359	13 914
- value	\$'000	26 578	39 356	46 079	46 938	49 168
- unit value	\$/kg	3.13	3.62	3.45	3.51	3.53
<b>Hides</b>						
- volume	tonnes	449.2	874.4	na	na	na
- value	\$'000	962	2778	2514	3030	1367
- unit value	\$/kg	2.14	3.18	na	na	na
<b>Leather</b>						
- volume	tonnes	26.2	16.2	na	na	na
- value	\$'000	414	425	387	71	107
- unit value	\$/kg	15.82	26.27	na	na	na
<b>Imports</b>						
<b>Meat</b>						
- volume	tonnes	na	5.1	18.9	17.7	0
- value	\$'000	na	15.3	74.1	58.9	0
- unit value	\$/kg	na	3.03	3.93	3.34	0
<b>All meat goat</b>						
Gross value of production	\$'000	30 885	46 978	61 081	53 012	50 569
Value of exports	\$'000	31 205	47 184	57 881	60 734	59 231

Sources: Australian Bureau of Statistics (2005); Australian Livestock Reporting Service; Levies Revenue Service; ABARE.

### Further information about meat goats

- *National Over the Hooks Goat Report* ([www.mla.com.au/uploads/templates/otherpdf/OTHgoatReport.pdf](http://www.mla.com.au/uploads/templates/otherpdf/OTHgoatReport.pdf)), weekly information on goat meat price and goat slaughterings in Australia, provided by the National Livestock Reporting Service.
- Livecorp website ([www.livecorp.com.au](http://www.livecorp.com.au)), statistics on live goat exports, by state.

### Cashmere goats

Cashmere goats produce down — the cashmere fibre — under long coarser hair. Cashmere needs special processing; the raw fibre must be dehaired to separate the fine soft cashmere from coarse and worthless hair.

Cashmere is mainly produced in cold and arid regions of central Asia. World production of raw (unseparated) cashmere was an estimated 18 000 tonnes in 2001, of which China produced 11 000 tonnes and Mongolia 4000 tonnes. The other main producers are Iran, Pakistan and Afghanistan but world exports are dominated by China and Mongolia. Of estimated world trade in raw fibre of 8854 tonnes in 2003, China accounted for 5412 tonnes (worth US\$213 million), Iran 640 tonnes (US\$11 million), Afghanistan 605 tonnes (US\$8 million) and Mongolia 320 tonnes (US\$17 million) (United Nations Statistics Division 2005).

In constant (2005) US dollar terms, Chinese export prices for cashmere moved broadly in the range US\$50–100 a kilogram and





Cashmere goats

were obviously strongly influenced by the level of Chinese exports (Figure N). Much higher Chinese production pushed world cashmere prices to low levels in 2003 but prices have improved somewhat since then.

The major markets for finished cashmere textiles are the United States, Europe and Japan. China is rapidly developing its cashmere manufacturing sector and is now the main exporter of cashmere textiles. In 2002, the value of Chinese exports of cashmere garments totalled US\$156 million (United Nations Statistics Division 2005). (Another US\$143 million of cashmere garments was

exported from Hong Kong, China in 2002.) As a consequence, less raw cashmere is being traded.

According to McGregor (2002), the Australian cashmere industry began in the 1970s, expanded during the 1980s with support from international processors, but has struggled during the 1990s following disruptions in its traditional markets. A factor that has contributed to this slowdown is that knowledge of cashmere processing is kept secret by international processors (ibid). In response to this constraint, a dehairing facility was opened in 2001 in Geelong in Victoria.

Some key industry participants in Australia are:

- Australian Cashmere Growers Association
- Australian Cashmere Marketing Corporation, an industry-owned organisation that operates the cashmere selling system in Australia. It handles around 90 per cent of the Australian cashmere clip.

In 2001 in Australia, there were around 150 farms shearing 33 thousand cashmere goats (Peter McInnes, RIRDC, personal communication, 6 December 2002). Ten of these farms produced around three quarters of this total.

Estimated production of cashmere fibre in Australia in 2003 was 8.1 tonnes (hair in), around 45 per cent of which was classified as fine white, 35 per cent as medium white, 10 per cent as light-dark and 21 per cent as coloured (Carolyn Gould, Australian Cashmere Growers Association, personal communication, 28 January 2004). With some growers choosing not to shear until prices improved, estimated production (hair in) declined to 6.5 tonnes in 2004 with an estimated gross value of \$125 000 (Table 14).

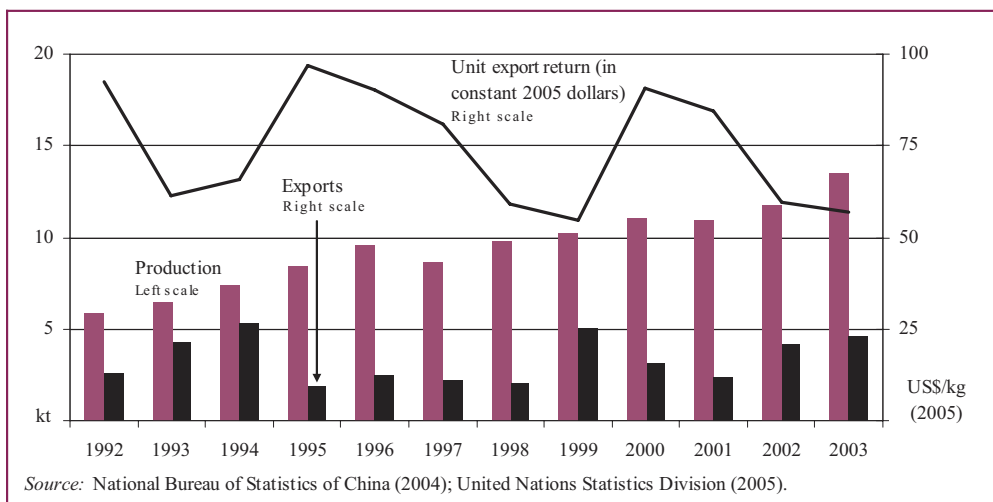


Figure N: Chinese cashmere production and exports

Highest prices are paid for fine white cashmere although other colours are also accepted in markets. Australian cashmere has unique characteristics, such as superior length, fineness, and freedom from dirt and vegetable matter. Recent sales data for cashmere in Australia are shown in Table 15.

**Table 14: Cashmere: supply, disposal and value in Australia**

	Unit	2000	2001	2002	2003	2004
<b>Production</b>						
Fibre, hair-in	tonnes	11.3	11.0	10.1	8.1	6.5
– dehaired	tonnes	3.4	3.6	3.0	2.8	2.3
Gross value of fibre production	\$'000	501	328	202	275	125
Unit gross value of fibre production	\$/kg cashmere	149.14	90.21	67.22	96.90	55.00
<b>Exports*</b>						
Volume	tonnes	na	na	3.8	0.5	3.8
Value	\$'000	na	na	301	57	189
Unit value	\$/kg	na	na	79.08	114.00	49.10
<b>Imports*</b>						
Volume	tonnes	na	na	0.0	61.1	91.8
Value	\$'000	na	na	0	16	40
Unit value	\$/kg	na	na	0.00	0.26	0.44

\* Not carded or combed; no trade was recorded in the carded and combed categories.

Sources: ABS (2005); Australian Cashmere Marketing Corporation; ABARE.

**Table 15: Receivals and prices for cashmere down, Australian Cashmere Marketing Corporation, pools 2002 to 2004**

	Pool 1/2002		Pool 1/2003		Pool 1/2004	
	Receivals* kg	Price \$/kg	Receivals* kg	Price \$/kg	Receivals* kg	Price# \$/kg
White, <16 micron	624	88.02	356	94.96	176	67.00
White, <16.7 micron	218	78.39	332	88.16	208	58.00
White, 16.7–18.5 micron	962	72.46	901	78.86	429	50.00
Light-dark, <16.7 micron	110	71.52	0		0	na
Light-dark, 16.7–18.5 micron	122	63.26	140	71.43	65	46.00
Coloured, <16.7 micron	316	70.14	91	71.43	32	46.00
Coloured, 16.7–18.5 micron	168	50.51	220	64.94	182	42.00
White cashgora, ~20 micron	192	31.63	101	na	32	25.00
Dark cashgora			15	na	3	25.00
White, short and low yielding			15	na	6	37.50
White, vegetable matter and cotts					40	25.00

\*Dehaired down. # Approximate prices because the pool was sold on a clean down basis, before processing. na Not available.

Source: Carolyn Gould, Australian Cashmere Marketing Corporation, personal communication, 9 June 2005.

### Further information about cashmere

- The Schneider Group website ([www.gsneider.com](http://www.gsneider.com)) provides market reports, latest market indicator prices (China, Mongolia and Iran), monthly Chinese cashmere exports.
- UN Commodity Trade Statistics Database (UN Comtrade) ([unstats.un.org/unsd/comtrade](http://unstats.un.org/unsd/comtrade)) provides trade data, by country, for raw cashmere, and for cashmere garments.

The United Kingdom is virtually the only destination for raw Australian cashmere exports. Some local processors also purchase cashmere to produce knitwear for local consumption and export.

There were significant Australian imports of cashmere recorded in 2003 and 2004 (Table 13), mostly from India but also from the United Kingdom and Thailand. However, the very low prices for the cashmere from India suggest that these data are not reliable.

According to Chaffey and McGregor (2004), capturing the cashmere that exists on the backs of feral goats currently being harvested across Australia, if feasible, could produce a further 3–8 tonnes a year.

## Mohair

Mohair is a wool-like fibre produced as fleece from angora goats. Mohair becomes coarser as a goat gets older. 'Kid' mohair starts at an average fibre diameter of 23 microns and is typically used in knitwear. 'Young goat' (intermediate diameter) mohair is used in suiting material while 'Adult goat' mohair — the coarsest ranging up to 36 micron — is typically used in coats and rugs.

Based on data in Mohair South Africa (2004), world mohair production rose in the late 1980s but has since declined to 6600 tonnes in 2003 (Figure O). The decline mainly reflects factors like increased competition from manufactured fibres and the removal of subsidies on mohair production in the United States. It can be seen from Figure O that the world mohair market is increasingly dominated by South Africa. In 2003, South African production represented 60 per cent

of the world total; United States 14 per cent; Argentina 5 per cent; and Australian and Turkey each 4 per cent.

In 2003, South Africa exported 4.9 thousand tonnes of mohair of which 21 per cent went to China, 18 per cent to Chinese Taipei, 14 per cent to France, 11 per cent to the United Kingdom, 10 per cent to India, and 10 per cent to Italy (Mohair South Africa 2004).



Mohair goat

## Australian mohair industry

Australian mohair production peaked at around 1200 tonnes in 1989 but has declined substantially since then (Mohair South Africa 2004). In 2001, there were an estimated 60 000 angora goats farmed in Australia on around 500 holdings (Peter McInnes, personal communication, 6 December 2002). Mohair production was estimated to be 253 tonnes in 2004, worth nearly \$2 million (Table 16).

**Table 16: Mohair: supply, disposal and value in Australia**

	Unit	2001	2002	2003	2004
<b>Production</b>					
Fibre	tonnes	261.4	337.5	300.4	252.9
Gross value, fibre	\$'000	2 295	2 717	2 382	1 992
Unit gross value of fibre production*	\$/kg	8.78	8.05	7.93	7.88
<b>Exports, fine animal hair#</b>					
Volume	tonnes	na	149.3	140.3	116.1
Value	\$'000	na	1 569	1 485	1 268
Unit value	\$/kg	na	10.51	10.59	10.92

\* Average prices from sales through National Mohair Pool and Australian Mohair Marketing Organisation. # Excludes cashmere.

Sources: ABS (2005); Levies Revenue Service; ABARE.

Mohair in Australia is generally sold by auction or private treaty through brokers. In past years Australia has processed up to 40 per cent of its mohair into garments and homewares.

Key participants in the Australian mohair industry are:

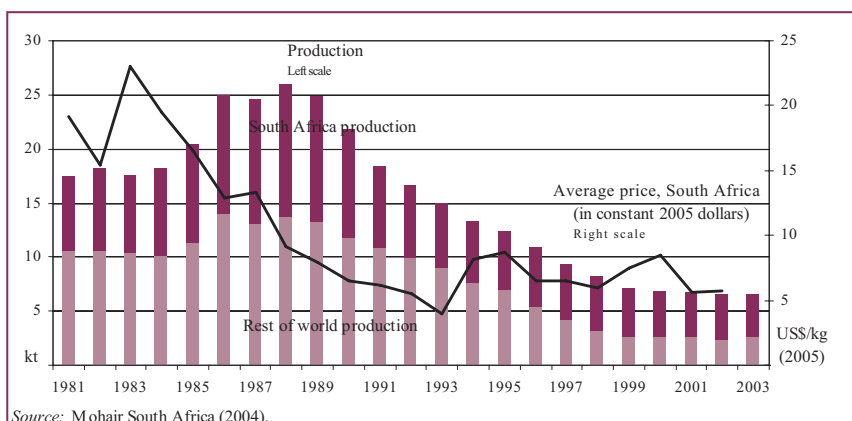
- Mohair Australia Limited, the peak industry organisation for mohair fibre and the angora goat industry in Australia.
- Two major mohair brokers: National Mohair Pool Proprietary Limited (Cudal, New South Wales), and Australian Mohair Marketing Organisation (Narrandera, New South Wales).

Australian mohair is also exported but it is aggregated with other animal fibre in recorded trade statistics. It is likely that the fine

animal hair exports reported in Table 16 are largely made up of mohair. Australia also appears to import mohair; South African exports of mohair to Australia are shown in Mohair South Africa (2004) to be 11.8 tonnes in 2001 and 10.2 tonnes in 2003.

### Further information about mohair

- Mohair South Africa website ([www.mohair.co.za](http://www.mohair.co.za)) provides auction market reports for South Africa and an excellent set of statistic on production consumption and exports of mohair by key producing country.
- Mohair Australia website ([www.mohair.org.au](http://www.mohair.org.au)) provides industry data for Australia, including detailed auction and private treaty sales reports and husbandry hints. Access to the Australian herd book and other information is password protected for members only.



Source: Mohair South Africa (2004).

**Figure O: World mohair production and prices**

## Dairy goats

### Australian dairy milk market

Details of the market for Australian dairy goat products are provided in Stubbs and Abud (2002). Australia has four recognised dairy goat breeds — Saanen, Toggenburg, British Alpine and Anglo Nubian — the most numerous of which is the Saanen.

Australian goat milk is all sold as fresh milk. There are also imports of ultra-heat treated (UHT) and powdered (bulk or tablet) goat milk, mainly from New Zealand. Goat milk is also made into products like yogurt and cheese. The bulk of the cheeses made in Australia from goat milk are of the fresh chevre and feta types. Factor that have probably limited the expansion of the industry in Australia is that producers are geographically dispersed and goat milk production is highly seasonal, making it difficult to provide regular supplies of sufficient volume for processors.

The estimated number of goats milked in Australia in 2003-04 was 10 730 producing 4.8 million litres of milk (Gaille Abud, personal communication, 8 February 2005). About 2.1 million litres of this production went to the whole milk market; 2.6 million litres to the cheese making industry; and 88 000 litres were used in yogurt making. The main producing states of goat milk are Victoria, Tasmania and Queensland.

In recent times, farm gate prices paid for goat milk have ranged from \$0.65 to \$1.00 a litre, and this price has been stable for some years (Stubbs and Abud 2002). The best estimate for the average price for goat milk in 2003-04 is \$0.85 a litre, putting the gross



Dairy Goats milked in herringbone system

value of goat milk production in Australia at \$4.1 million (Table 17).

No data are available on Australian exports of goat milk products but they are small and growing, going mainly to Asia and the United States (Arthur Stubbs and Gaille Abud, personal communication, 27 July 2005).

In 2003-04, Australia imported around \$15.8 million of cheese types that have traditionally been made from goat milk (Table 17). However, feta and kasseri are also traditionally made from sheep

milk and increasing from cows' milk; cheeses made wholly from goat milk were valued at only \$2 million in 2003-04.

### Further information about dairy goats

- Dairy Goat Society of Australia ([home.vicnet.net.au/~dgsa](http://home.vicnet.net.au/~dgsa)).
- Dairy Goat Society of Australia, Victorian Branch ([home.vicnet.net.au/~goats/dgsavictoria/](http://home.vicnet.net.au/~goats/dgsavictoria/))



Dairy Goats grazing

**Table 17: Dairy goat products: supply, disposal and value in Australia**

	Unit	1999-00	2000-01	2001-02	2002-03	2003-04
<b>Production</b>						
Volume	kL	na	na	na	na	4 830
Gross value	\$'000	na	na	na	na	4 106
Unit gross value	\$/L	na	na	na	na	0.85
<b>Imports, cheese</b>						
Wholly from goat milk*						
– Volume	tonnes	26.4	41.7	79.3	134.2	149.7
– Value	\$'000	254	419	960	1 890	1 980
– Unit value	\$/kg	9.62	10.05	12.11	14.09	13.23
Fetta						
– Volume	tonnes	1 250.3	1 317.4	1 790.6	2 036.2	2 318.8
– Value	\$'000	6 739	8 466	9 844	11 525	12 750
– Unit value	\$/kg	5.39	6.43	5.50	5.66	5.50
Kasseri						
– Volume	tonnes	152.2	121.6	138.8	149	122.4
– Value	\$'000	1 219	1 097	1 109	1 417	1 124.1
– Unit value	\$/kg	8.01	9.02	7.99	9.51	9.18

\* Excluding fetta and kasseri. It is not clear how much goat milk is contained in fetta and kasseri.

Sources: ABS (2005); Gaille Abud, personal communication, 8 February 2005; ABARE.

# Kangaroos

The Australian kangaroo industry is based on the harvesting of kangaroos from the wild by shooters. The industry has developed significantly over the past 30 years from being based on pest control to one where greater use is made of the harvested kangaroos, mainly for pet food but also increasingly for human consumption. Kangaroo skins are also an important product of the harvesting.

Kangaroo production operates under a quota system administered by the state and federal governments. Commercial harvesting is currently allowed with only four of the 55 species of kangaroos and wallabies in Australia. The quotas in each state are generally set annually at 10–20 per cent of the estimated population for each of the permitted species. Kangaroo populations vary substantially from year to year depending on seasonal conditions. The state conservation agencies and the Australian Government Department of the Environment and Heritage, have the responsibility for monitoring kangaroo populations and the sustainability of the harvesting process. There is considerable underfill of the quotas (Table 18).

The gross value of production of the kangaroo industry was an estimated \$37.6 million in 2004, down considerably from the previous year due to the effect of severe drought on kangaroo populations (Table 18). This reflects the total amount paid to kangaroo shooters at the meat processing plant gates.

Kangaroo meat exports for human consumption have grown strongly over the past fifteen years (Figure P). This reflects growing demand in Europe where kangaroo meat is considered a game meat. However, the increased supplies seem to have put downward pressure on kangaroo meat prices in constant dollar terms. The major importing countries for kangaroo meat are the Russian Federation (74 per cent of the total volume in the three years to 2004), Papua New Guinea (5 per cent), France (4 per cent) and Germany (4 per cent). Kangaroo meat is mainly used in sausage making in the Russian Federation and is lower in quality and price than the prime cuts trade with countries like France and Germany (Humphries 2005). (Steaks and other prime cuts typically make up only about 15 per cent of the

total dressed weight of a kangaroo, and depending on the cut, command price premiums of \$2–6 a kilogram over the other kangaroo meat.)



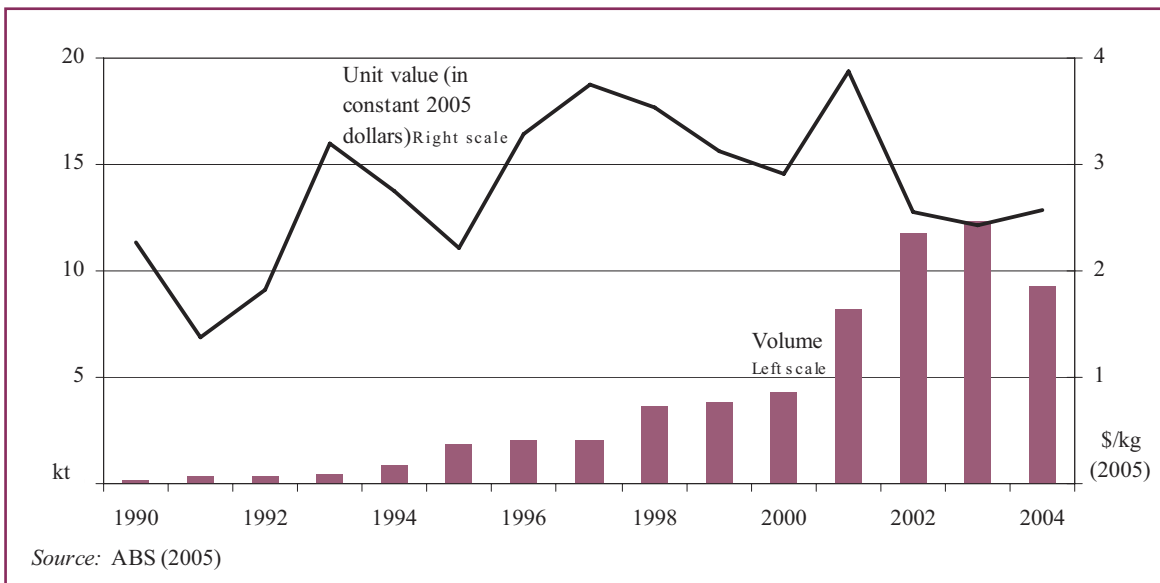
Kangaroos

Kangaroo skins are an important component of the kangaroo industry, with exports totalling \$22 million in 2004. (Because of confidentiality requirements, there are only very limited country details available for these kangaroo skin exports.) The export market for pet food was worth \$330 000 in 2004, with the major markets in recent years being Macau, the United States and Indonesia.

**Table 18: Kangaroo products: supply, disposal and value in Australia**

	Unit	2000	2001	2002	2003	2004
<b>Production</b>						
Harvest quotas	'000	5 516	5 528	6 943	6 552	4 422
Kill	'000	2 746	3 392	3 471	3 276	2 661
Gross value	\$m	30 203	51 773	43 154	44 836	37 579
<b>Meat</b>						
– Human consumption	t	8 133	13 189	16 477	15 033	13 015
– Pet food	t	24 919	27 635	25 299	26 781	19 004
– Total	t	33 052	40 824	41 776	41 814	32 019
<b>Exports</b>						
<b>Meat</b>						
– volume	t	4 320	8 225	11 794	12 317	9 273
– value	\$'000	10 897	28 765	27 953	28 485	23 353
– unit value	\$/kg	2.52	3.50	2.37	2.31	2.52
<b>Pet food</b>						
– volume	t	521	649	525	403	282
– value	\$'000	520	645	572	515	330
– unit value	\$/kg	1.00	0.99	1.09	1.28	1.17
<b>Hides, skins, leather</b>						
– volume	'000	1 652	1 910	2 044	2 322	1 705
– value	\$'000	19 815	23 569	25 196	27 339	22 158
– unit value	\$/hide	11.99	12.34	12.33	11.72	13.00
Total export value	\$'000	31 232	52 979	53 721	56 339	45 841

Sources: ABS (2005); Department of the Environment and Heritage (2005); Levies Revenue Service; ABARE.



**Figure P: Volume and value of Australian kangaroo meat exports**



Kangaroo meat products

### Further information about kangaroos

- Environment Australia ([www.deh.gov.au/biodiversity/trade-use/wild-harvest/kangaroo/index.html](http://www.deh.gov.au/biodiversity/trade-use/wild-harvest/kangaroo/index.html)), information on the kangaroo industry, including quotas and numbers harvested.
- Kangaroo Industry Association of Australia ([www.kangaroo-industry.asn.au](http://www.kangaroo-industry.asn.au))



Part of a mob, Canberra, ACT

# Ostriches

The ostrich is a flightless bird of the ratite family of birds. They are farmed in around 50 countries throughout the world for their meat, skin (leather), oil and feathers.

Ostrich meat is a red meat and is very low in cholesterol and calories and is almost fat free.

Ostrich leather is durable with a distinctive quill pattern and is one of the most expensive leathers in the world.

There is a range of cosmetic products that use ostrich oil as the major active ingredient, including soap, massage oils and hair products.

It is claimed that ostrich oil is a natural moisturiser because of its excellent penetration and emollient properties when applied to the skin (Australian Ostrich Association 2001).

Feathers from ostriches are used extensively in feather dusters (because of their antistatic properties) and in the fashion industry.

Worldwide commercial slaughterings of ostriches were an estimated 560 000 in 2002, of which 350 000 were slaughtered in South Africa (National Department of Agriculture, South Africa 2003).

There are also significant commercial ostrich flocks in China, the United States and Australia. In 2004, world ostrich meat production was around 12 500 tonnes (Stewart 2004).



Ostriches

The Klein Karoo Co-operative Ltd, which had statutory controls over the marketing of South African ostrich products until 1993, controls 60–70 per cent of world trade in ostrich products.

In South Africa, the value of a slaughter bird is broken up as 45 per cent skin, 45 per cent meat and 10 per cent feathers (Stables 2004); ostrich oil or fat apparently has little value yet. Based on data in Statistics South Africa (2005), the average price for ostriches sold in South Africa in 2002 was equivalent to US\$136 or \$A252 a bird.

The bulk of South African ostrich meat exports go to the European Union. However, an outbreak of avian influenza in South Africa in August 2004 resulted in a ban being imposed by the European

Union on imports of South African ostrich meat and eggs until at least June 2005.

In 2002, 564 tonnes of ostrich feathers were sold by ostrich growers in South Africa (Statistics South Africa 2005) at an average price per kilogram equivalent to US\$11.09 or \$A20.38. According to Stables (2004), other world producers have yet to fully explore income from ostrich feathers, probably because feather production is a very labour intensive process.

The average price received in South Africa for ostrich skins in 2002 was equivalent to US\$45 or \$A83 (Statistics South Africa 2005).

## Australian ostrich industry

In 2004, the gross value of ostrich production in Australia was an estimated \$2.6 million, with ostrich meat production of around 350 tonnes, most of which was exported (Table 19). Ostrich skin production in 2004 was also mainly exported.

In the three years to 2004, exports of Australian ostrich meat and edible offal averaged \$3.8 million a year (Table 19).

The main export markets were the United States (43 per cent of total volume), France (15 per

cent), Switzerland (7 per cent), Singapore (6 per cent), Germany (6 per cent) and the Netherlands (6 per cent).

Over the same period, the value of ostrich skin exports averaged \$1.6 million a year.

Nearly 60 per cent of the volume of ostrich skin trade which was accounted for by the Republic of Korea. South African (23 per cent of total volume) and Italy (14 per cent) were the other important markets for ostrich skins.

There were also exports of live ostriches to Japan and Vietnam in this period, with especially large live shipments in 2004.

### Further information about ostriches

- South African Ostrich Business Chamber ([www.saobc.co.za](http://www.saobc.co.za)), information about the South African ostrich industry.
- World Ostrich Association ([www.world-ostrich.org](http://www.world-ostrich.org)), range of information on the world ostrich industry including details of industry standards for ostrich products.

**Table 19: Ostrich products: supply, disposal and value in Australia**

	Unit	2001	2002	2003	2004
<b>Production</b>					
Slaughterings	no.	31 083	23 028	21 429	12 500
Meat production	tonnes	870	645	600	350
Gross value	\$'000	6 217	3 750	2 728	2 508
<b>Exports</b>					
Live ostriches					
– volume	no.	na	60	400	2194
– value	\$'000	na	5	35	130
– unit value	\$/head	na	80.00	87.23	59.23
Meat and edible offal					
– volume	tonnes	na	632	612	374
– value	\$'000	na	4 388	3 559	3 357
– unit value	\$/kg	na	6.94	5.81	8.97
Hides and leather					
– volume	no.	na	69 214	53 774	29 614
– value	\$'000	na	2 060	1 819	833
– unit value	\$/skin	na	29.77	33.83	28.14
<b>All ostrich</b>					
Gross value of production	\$'000	6 217	3 754	2 762	2 637
Total export value	\$'000	na	6 454	5 413	4 320

Sources: ABS (2005); Levies Revenue Service; Michael Hastings, Ostrich Farmers Association, personal communication, 1 February 2005; ABARE



Male ostrich courting a female ostrich



# Possums

An industry based on the harvesting from the wild of brushtail possums (*Trichosurus vulpecular (Kerr)*) has been operating in Tasmania since the early days of European settlement. Possum harvesting is currently not allowed in any other states or territories of Australia.

There is also limited harvesting of brushtail possums for commercial purposes in New Zealand where the brushtail possum was introduced from Australia in the 1930s and its possum population has now grown to pest proportions.

In Tasmania, harvesting for commercial purposes under permit is a component of the government arrangements for the control of the size of the brushtail possum population that also include a bounty paid on skins and carcasses. There is only one processor. Control measures are necessary because the establishment of crops, orchards and vineyards has seen the brushtail possum increase greatly in numbers (Tasmanian Parks and Wildlife Service 1996).

A management plan with quotas and monitoring arrangements is currently operated in Tasmania to ensure that the brushtail possum population does not become an endangered species through over exploitation (see Tasmanian

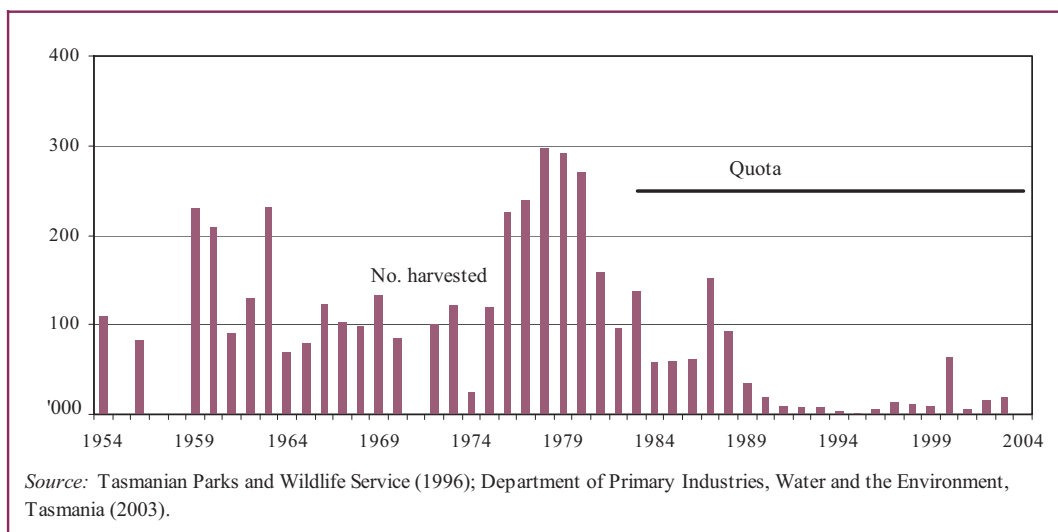


Brush tail possum. Photo: John Kelly, Lenah Game Meats

Parks and Wildlife Service 1999). A quota was first set in 1983 at 250 000 possums a year. The quota includes possums harvested under commercial permits and shot or poisoned under crop protection permits. Prior to the quota, the season was simply closed for commercial harvest when populations were assessed to be under threat of over exploitation.

Initially, the Tasmanian possum industry was largely based on fur production. At its post war in peak in 1979, the industry harvested around 300 000 thousand possums but the industry nearly disappeared in the mid 1990s after the collapse of the world market for animal furs (Figure Q).

The industry was re-established in 1995 based on meat production. Its main outlet is the Chinese market where possum is a close substitute in appearance and taste for a local delicacy, the civet cat (*Paguma larvata*). However, the civet cat was identified as a carrier of the Severe Acute Respiratory Syndrome (SARS) virus with the outbreak of this disease in China in late 2002. In 2004, the Chinese government banned the consumption of civet cat. This has also severely affected demand for possum meat in the Chinese market and the Tasmanian commercial possum harvest has again fallen to low levels in recent years after reaching 64 640 possums in 2000.



Source: Tasmanian Parks and Wildlife Service (1996); Department of Primary Industries, Water and the Environment, Tasmania (2003).

Figure Q: Brush tail possums commercially harvested in Tasmania

At its peak in 2000, the value of brush tail possum production for commercial purposes was around \$400 000 but has fallen to only an estimated \$87 000 in 2004 (Table 20). Small quantities of possum skins are also produced with most exported.

**Table 20: Brush tail possum products: supply, disposal and value in Tasmania**

	Unit	2001	2002	2003	2004
<b>Production</b>					
Harvest	no.	4 896	16 318	19 742	12 000
Meat	tonnes	10	33	39	24
Gross value	\$'000	58	119	144	87
<b>Exports</b>					
Meat					
- volume	tonnes	9	32	38	23
- value	\$'000	62	127	153	93
- unit value	\$/kg	6.50	4.00	4.00	4.00

*Sources:* Greg Hocking, Department of Primary Industries, Water and Environment, Tasmania, personal communication, 16 May 2005; ABARE



Possum stew. Photo: John Kelly, Lenah Game Meats

# Rabbits, farmed

Based on FAO (2005) data, world rabbit meat production for human consumption has been growing at a fairly steady 1.9 per cent a year since 1980 and totalled 1.1 million tonnes of rabbit meat in 2004 (Figure R). A little than half of this production comes from intensive rabbit farms, the remainder by traditional extensive means. By-products of meat production are pelts and offal and off cuts that are used for pet food. Typically around 5 per cent of world rabbit meat production enters world trade and the value of this trade averaged US\$138 million over the three years to 2003 in constant (2005) dollar terms. There has been a strong down trend with rabbit meat prices in constant (2005) US dollars terms since the mid-1990s though there has been a sharp upturn in prices since 2001.

China produces nearly 40 per cent of world rabbit meat and provides around a quarter of world exports. The Netherlands takes two-thirds of China's rabbit exports, with other key destinations being Germany, Japan, Switzerland and the United States. The bulk of the remainder of production and trade occurs in European countries, particularly Italy, Spain and France.

## Australian farmed rabbit industry

The collapse of the wild rabbit industry that occurred in response to the release in 1996 of rabbit calicivirus disease into the Australian environment created the opportunity for the



Crusader rabbits for farming

establishment of a farmed rabbit industry in Australia. This led to a lifting in most Australian states of regulations that had previously not allowed the farming of rabbits. (Rabbit farming had been permitted in Western Australia since the late 1980s but is still banned in Queensland and the Northern Territory).

Farmed rabbit meat differs considerably from the wild rabbit product, being almost white in colour compared to the darkish wild rabbit meat. In February 2004, a survey of a number of markets in Australian (Melbourne, Sydney and Canberra) indicated that wild rabbit carcasses sold for

around 40 per cent of the price per kilogram of farmed rabbit ones.

By 1998-99, there were an estimated 115 commercial scale farms (loosely defined as having more than ten breeding does) (Foster 1999). With an estimated production for human consumption of 106 tonnes dressed weight (84 000 rabbits) in 1998-99, the farmed rabbit industry in Australia was still only 2-3 per cent of the size of the wild rabbit industry in the first half of the 1990s when annual domestic consumption averaged was around 1900 tonnes a year (Foster and Telford 1996).

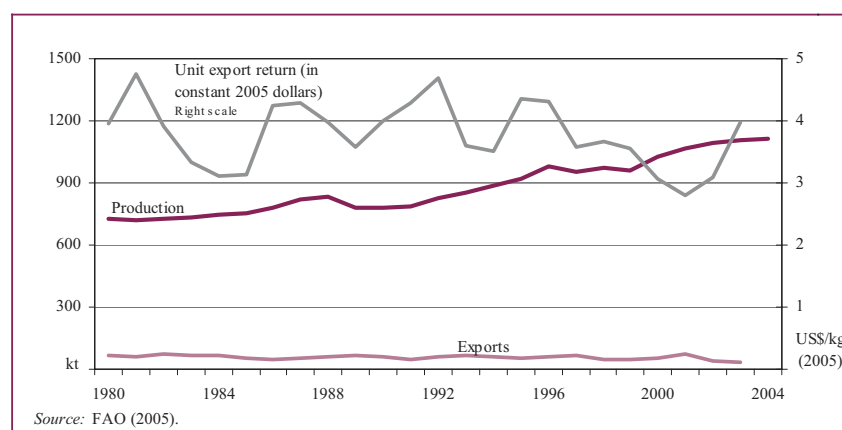


Figure R: World production and trade in rabbit meat

Around three-quarters of Australia's farmed rabbit production occurs in New South Wales where the industry is located mainly in the central and north west regions. The longer established farmed rabbit industry in Western Australia has experienced some difficulty in making inroads into the domestic market because of high production costs; at one stage there were seven rabbit farms in that state but only one operates now. Rabbit farming industries have also been established in Victoria and South Australia, with a Tasmanian industry just starting up.

Based on throughput at abattoirs, Australian production of rabbit meat is estimated to have been 250 tonnes in 2003-04, an increase of 236 per cent since 1998-99 (Table 21). The estimated gross value of the industry in 2003-04 was nearly \$2.2 million. A recent estimate by Gordon and Garrett (2004), based on a survey of rabbit producers, puts production in 2003 somewhat lower at 157 tonnes. The Gordon and Garrett survey indicates that Australian rabbit farmers intend to almost double rabbit meat production by 2008.

It appears that greater use is being made in recent years of the skins and of meat offcuts for pet food. In the earliest years of the farmed rabbit industry in Australia, the fattiness of fur skins from farmed rabbits posed problems in using them in felt making processes, the main use of these skins (Foster 1999). Australia has been importing fairly large quantities of rabbit fur skins for felt making since the collapse of the wild rabbit industry (Table 21). (No rabbit meat is imported). Rabbit skins from Australian farms are now sold to local felt and hat making companies for around \$0.60 a skin, after the development of mechanical processes to markedly reduce the fattiness of the skins.

Exports of rabbit meat from Australia had reached as high as 1081 tonnes in 1991-92 when the Australian rabbit industry had been based on the harvesting of wild rabbits (Figure S). However, exports declined to nothing in the period following the release of calicivirus. In recent years, small quantities of rabbit meat and skins have been exported from Australia (Table 21).

### Further information about farmed rabbits

- Crusader Meat Rabbit Project ([www.csiro.au/index.asp?type=faq&cid=Meat%20rabbits](http://www.csiro.au/index.asp?type=faq&cid=Meat%20rabbits)), information on the rabbit meat industry, and the research under way to support this industry at CSIRO Livestock Industries.
- Commonwealth Scientific and Industrial Organisation (CSIRO) ([www.csiro.au/index.asp?type=faq&cid=Meat%20Rabbit%20Farming&stylesheet=divisionFAQ](http://www.csiro.au/index.asp?type=faq&cid=Meat%20Rabbit%20Farming&stylesheet=divisionFAQ)), technical details relating to meat rabbit farming in Australia.

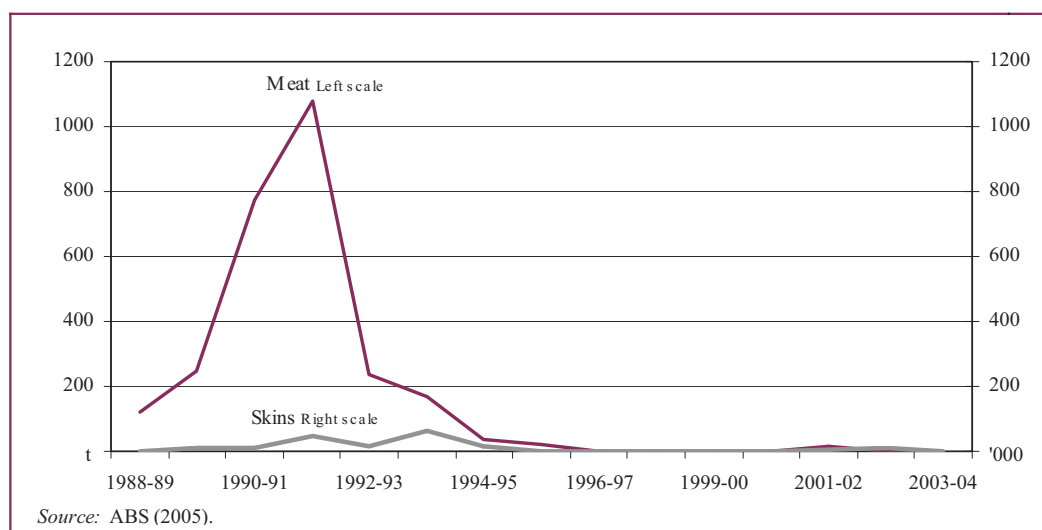


Figure S: Australian exports of rabbit meat and skins

**Table 21: Farmed rabbit products: supply, disposal and value in Australia**

	Unit	1998-99	1999-00	2000-01	2001-02	2002-03	2003-04
<b>Farm</b>							
Number of farms *	no.	115	na	na	na	185	na
Average size (breeding does) *	no.	57	na	na	na	100	na
Sales to processors	no.	84	na	na	na	163	171
Farm gate price	\$/head	7.42	na	na	na	12.10	12.80
Average carcass weight	kg **	1.26	na	na	na	1.28	1.28
Gross value of production	\$'000	623	na	na	na	1 971	2 194
<b>Wholesale</b>							
Meat for human consumption							
– Quantity	tonnes **	106	na	na	na	237	250
– Value	\$'000	793	na	na	na	2 050	2 252
– Unit value	\$/kg	7.5	na	na	na	8.64	9.01
Meat for pet food							
– Quantity	tonnes	35	na	na	na	100	105
– Value	\$'000	43	na	na	na	173	190
– Unit value	\$/kg	1.24	na	na	na	1.73	1.80
Pelts							
– Quantity	'000	na	na	na	na	81	86
– Value	\$'000	28	na	na	na	49	51
– Unit value	\$/skin	na	na	na	na	0.60	0.60
<b>Exports</b>							
Meat							
– Volume	tonnes	0.3	0.9	0.1	15.9	0.0	0.1
– Value	\$'000	6.1	1.5	3.4	105.1	0.2	1.3
– Unit value	\$/kg	22.53	1.57	28.07	6.62	12.67	16.38
Skins, fur skins							
– Volume	'000	0.0	0.0	0.1	5.2	10.4	0.3
– Value	\$'000	0.0	0.5	1.3	162.4	41.8	3.0
– Unit value	\$/skin	0	15.29	25.08	30.97	4.01	9.97
Total export value	\$'000	6	2	5	268	42	4
<b>Imports</b>							
Skins, fur skins <b>c</b>							
– Volume	'000	308.4	1316.1	89.7	151.5	0.3	0.8
– Value	\$'000	217.2	1860.6	195.6	193.7	8.0	27.3
– Unit value	\$/skin	0.70	1.41	2.18	1.28	31.05	34.96

\* End of year. \*\* Dressed weight. The dress out proportion with rabbits is assumed to be 52 per cent. **c** Includes raw and tanned fur skins. (-) negligible. na Not available.

Source: ABS (2005); Foster (1999); Gordon and Garrett (2004); ABARE.

# Emerging plant industries

Essentially the emerging plant-based industries are largely horticultural ones rather than broadacre cropping industries. The estimated value in Australia in 2003-04 of the emerging plant-based industries examined in this report is \$469 million. To put this figure into context, the composition of the value of Australian horticultural production in 2002-03 is shown in Figure T. More statistical information on the production and exports of Australia's cropping industry are provided in Appendix A.

A number of the emerging plant industries in Australia are based on the use of Australian native plants, for example Australian wildflowers like kangaroo paws and waxflowers, or Australian native food like macadamias or bush tomatoes.

As mentioned earlier with emerging animal industries, the emerging plant industries are benefiting from income growth that is leading to demand for products that are more distinctive or healthier. This demand means that emerging industries like the coffee industry can produce for premium-paying niche markets that demand distinctive products, despite having high production costs relative to other coffee producing countries. Growing demand for emerging industry products, like natural pyrethrum and essential oils, reflects consumer demands for natural products that are perceived to be healthier than artificial ones.

As with emerging animal

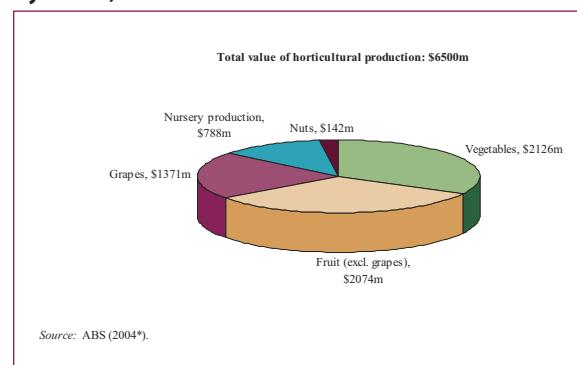
industries, production of some 'new' crops is based on farmers wanting to diversify their production away from more traditional agricultural products. In Queensland, for example, growth in tropical fruit production appears to be related to some farmers moving way from tobacco and sugar production. There is also an important 'lifestyle' element to some industries with hobby farms being important sources of products like essential oils and olives.

Some emerging plant industries are responses to changes in the ethnic composition of Australia that is leading to increasing demand for Asian vegetables and Asian tropical and subtropical fruits like lychees, durians and rambutans. Income and population growth in Asia means that there is also export demand for these products that are familiar to Asian consumers.

The impetus for the emergence of virtually all the plant industries dealt with in this report has been innovation in some form. For example, the pyrethrum industry in Tasmania has emerged very quickly as a major player in the world pyrethrum market through a range of production, processing and marketing innovations.

Many emerging plant industries face strong competition from imports. For example, the

**Figure T: Value of the Australian horticultural industry, by sector, 2002-03**



emerging Australian tropical fruits industry competes with imports from Thailand, a very large producer of tropical fruits and one that has a considerable cost advantage over Australian producers through having much lower labour costs. For seasonal products such as tropical fruits, the Australian industry niche appears to lie with being able to supply fresh product outside the production periods of the main world exporters.

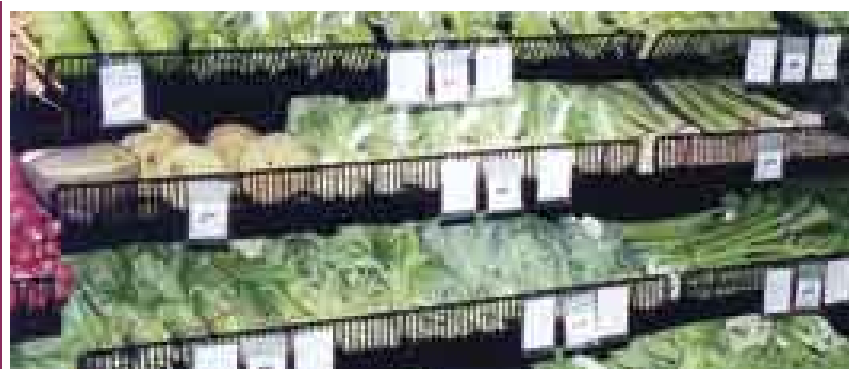
There are environmental benefits associated with many emerging plant industries. For example, the oil mallee and sandalwood industries have benefits in regard to controlling salinity, preserving biodiversity and reducing greenhouse gases.

There are some new and emerging plant industries that are not dealt with in this compendium, including the herb and plant fibre (such as hemp and flax) industries. These are small industries at this stage. The range of new crop industries in Australia is described in great detail in a RIRDC publication (Salvin, Bourke and Byrne 2004).

# Asian vegetables

The Institute of Horticultural Development, Victoria identified 73 types of Asian vegetables grown in Australia (Table 22).

Many of these vegetables have other common names and there is still confusion among consumers about names.



Asian vegetables on supermarket shelves

**Table 22: Asian vegetable types**

Amaranth, green leaved	Coriander	Lemon grass	Tapioca
Asian basil	Curry leaves	Lizard's tail	Taro
Bitter melon	Drumstick	Long coriander	Taro shoots
Bitter melon leaves	Eggplant	Lotus root	Thai eggplant
Bok choy	Foo yip	Mint	Turmeric
Buffalo spinach	Galangal	Mustard green	Vietnamese lettuce
Cang cua*	Garland chrysanthemum	Okra	Water chestnut
Celtuce	Garlic	Pea shoots	Water convolvulus
Ceylon spinach	Garlic chives	Pennywort	Water parsley
Chilli leaves	– Flowering garlic chives	Perilla	Watercress
Chinese boxthorn	Ginger	Pumpkin leaves	White radish
Chinese broccoli	Green radish	Ridged luffa	Wingbean
Chinese cabbage	Guava bean	Shallots	Winter melon
Chinese celery	Hairy melon	Snakebean	
Chinese chard	Hot mint	Snowpea	
– baby Chinese chard	Japanese pumpkin	Spearmint	
– Shanghai Chinese chard	Jicama	Sponge luffa	
Chinese flowering cabbage	Jute/jew mallow	Spring onion	
– baby	Kinh gioi*	Sweet potato	
White flowering cabbage	La lot*	Sweet potato leaves	

\*Vietnamese name.

Source: Institute of Horticultural Development, Victoria (1997)

Production of Asian vegetables grew strongly in Australian throughout the 1990s. According to Lim (1998), this reflected:

- a good range of growing seasons and potential for consistent supply
- counter-seasonal to northern hemisphere markets
- domestic demand from a multicultural society
- proximity to Asia
- clean green image.

By 2000-01, the estimated wholesale value of the total Australian market for Asian vegetables in was \$136 million (Hassall and Associates 2003), up from an estimated \$60 million in 1993-94 (Lee 1995). The estimated number of growers in 2000-01 was 1675.

Based on data available to 2000-01, Hassall and Associates (2003) concluded that 16 per cent of

Australian Asian vegetables were exported but that the volume of exports had not grown significantly since the mid-1990s. They cited increased competition in the export market from China and, more recently, Vietnam as the reasons for this lack of growth.

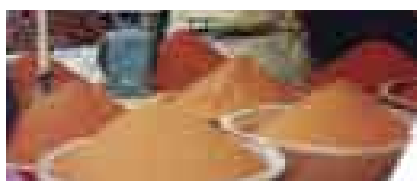
With vegetable trade competition from China intensifying in the 2000s, the value of Australian exports of fresh and processed

vegetables to the main Asian markets has declined steadily from a peak in around 2000 (Figure U).

Because of the diffuse nature of the Asian vegetable industry in Australia it is very difficult to source comprehensive data. The remainder of this chapter is a compilation of the reliable data that are publicly available. Two important Asian vegetables for which virtually no statistics other than prices were available are bok choy (*Brassica rapa var. Chinensis*), a type of Chinese cabbage, and Chinese broccoli (*Brassica oleracea var. alboglabra*). A more complete statistical snapshot would require a survey of industry participants which was beyond the resources available to this project.

The data compiled suggest the value of this industry is probably not larger than the estimate of \$136 million for 2000-01 and, given the evidence of contraction in Australian exports, could be somewhat lower. In the Northern Territory, the only state or territory for which reliable production data for Asian vegetables are available, the total value of production has declined from a peak of \$7.8 million in 2000, to \$6.8 million in 2004 (DBIRD 2005b).

Prices for selected Asian vegetables in the Sydney market are shown in (Table 23). The Perth market is the only capital city market in Australia for which there reliable recent throughput data for the main Asian vegetables (Table 24). These data suggest that Chinese cabbage and Japanese pumpkin are the main Asian vegetables consumed in Australia.



Chillies at Asian markets

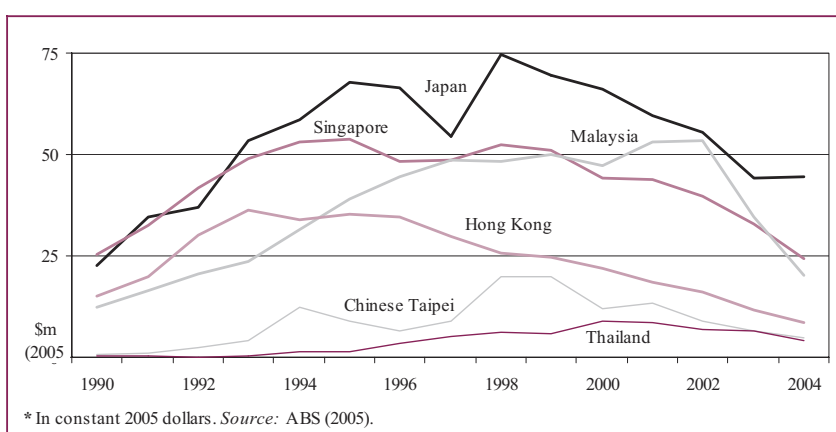


Figure U: Value of Australian fresh and processed vegetables exports to selected Asian countries\*

Table 23: Average prices for selected Asian vegetables, Sydney market

Type and variety	Unit	2001	2002	2003	2004
Bamboo shoots	\$/kg	5.25	5.92	4.89	5.20
Bitter melon	\$/kg	2.70	2.51	2.03	2.25
Chinese cabbage, wombok					
– wombok	\$/carton	9.70	14.41	12.70	13.40
Chinese melon					
– hairy	\$/kg	1.42	1.37	1.30	1.47
– long	\$/kg	1.88	1.55	1.38	1.48
Chinese vegetable					
– bok choy	\$/bunch	0.50	0.57	0.56	0.50
– choisum	\$/bunch	0.50	0.56	0.65	0.60
– drumstick	\$/kg	7.37	4.95	5.50	5.40
– gai choy	\$/bunch	0.50	0.56	0.69	0.68
– gai lum	\$/bunch	na	na	0.84	0.73
– ing choy	\$/bunch	na	0.61	0.78	na
– ong choy	\$/bunch	na	0.62	0.78	na
Gourd	kg	na	2.08	2.00	na
Luffa					
– angled	\$/kg	2.08	2.09	2.04	1.90
– round	\$/kg	1.95	1.71	1.76	na
Okra	\$/kg	4.30	4.55	4.69	4.15
Pumpkin, Japanese	\$/kg	1.11	0.47	0.44	0.65
Snake beans	\$/kg	3.52	3.72	3.31	3.93
Taro	\$/kg	3.41	3.89	3.21	2.80
Winged beans	\$/kg	9.92	10.30	10.96	10.50
Winter melon	\$/kg	0.84	0.60	0.92	na
Yambean	\$/kg	1.71	2.38	3.31	4.45

Source: Sydney Market Reporting Service.

Table 24: Throughput of selected Asian vegetables, Market City, Perth

	2000-01	2001-02	2002-03	2003-04
	tonnes	tonnes	tonnes	tonnes
Bok choy	28.60	35.80	63.40	53.60
Chinese broccoli	0.10	0.00	6.40	0.70
Chinese cabbage	712.70	684.70	709.20	808.20
Chinese radish	38.90	37.60	42.60	45.90
Choy sum	51.90	46.80	72.20	41.10
Japanese pumpkin	3681.80	2778.00	1759.20	1642.50
Kohl rabi	0.00	0.00	0.50	4.40
Okra	9.50	13.00	27.50	12.90
Pakchoy	78.90	90.90	108.70	93.00
Snake beans	0.20	0.20	3.50	1.80

Source: Perth Market Authority (2005).



## Chinese cabbage

Chinese cabbage (*Brassica rapa var pekinensis*), also known as wong bok, is the most frequently eaten vegetable in Asia and one of the most commonly consumed Asian vegetables in Australia (Clarke 2004). It is closely related to bok choy and wombok. It is commonly eaten as a freshly cooked vegetable, for example in stir fry dishes, and is often further processed as a brined product or used in pickles such as kim-chi. Suited to temperate regions, it is grown in all Australian states but mainly south east Queensland and Western Australia.

Production of Chinese cabbage in Australia has been oriented toward the export market but there is growing demand in the domestic market, reflecting the influence of the changing ethnic structure of Australia's population (Table 25).



Chinese cabbage cultivar trials, East Gippsland

Australian exports of Chinese cabbage grew strongly in the late 1980s and early 1990s but declined to 2600 tonnes in 2003-04 (Figure V). This reflects markedly increased competition in world markets from China that has led to lower export prices. After growing

strongly in constant (2005) dollar terms throughout most of the 1990s, export prices have declined to around \$1 a kilogram in recent years (Figure V).

The main export markets for Australian Chinese cabbage are Chinese Taipei (39 per cent of the total volume of Australian exports in the three years to 2003-04), Singapore (31 per cent) Hong Kong (11 per cent), China (6 per cent) and Japan (6 per cent).

## Asian melons

Hairy or Fuzzy Melon (*Benincasa hispida var. chien-qua*) is a long light green gourd with a downy, hairy skin, sometime narrowing in the centre and fattening at the end. Hairy melons are a significant part of the diet and livelihood of local communities in south Asia. The Chinese use these gourds for a range of medicinal purposes.

The fruit, leaves and flowers of the bitter melon (*Momordica charantia*) are consumed in many Asia and Indian foods (Gosbee 2004a). Australian bitter melon production occurs mainly in the Northern Territory (see Table 26) but also in northern Western Australia and the Northern Rivers District of New South Wales. Production is consumed on the domestic market; domestic (Sydney) prices for bitter melons in recent years are reported in (Table 23).

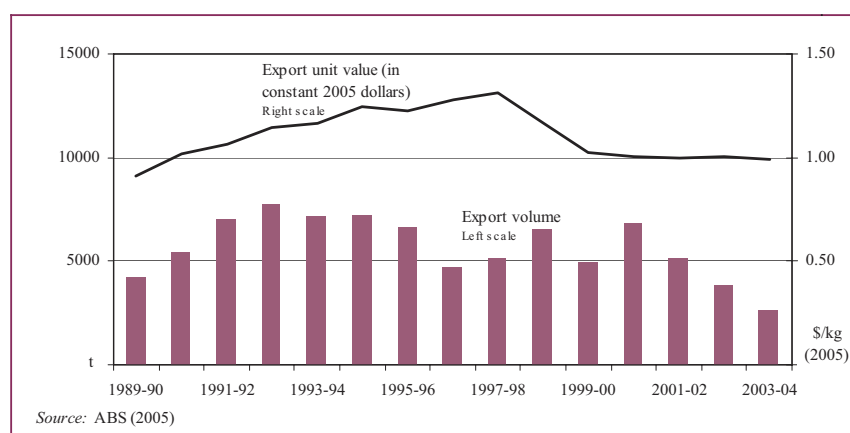


Hairy melon

**Table 25: Chinese cabbage: supply, disposal and value in Australia**

	Unit	1999-00	2000-01	2001-02	2002-03	2003-04
<b>Production</b>						
Production	tonnes	8 561	12 876	11 513	10 476	9 569
Gross value	\$'000	6 258	9 741	8 906	8 459	7 808
<b>Exports</b>						
Volume	tonnes	4 938	6 802	5 182	3 828	2 589
Value	\$'000	4 245	6 064	4 728	3 632	2 408
Unit value	\$/kg	0.86	0.89	0.91	0.95	0.96

Sources: ABS (2005 and unpublished data); ABARE.



**Figure V: Volume and unit value of Australian exports of Chinese cabbage**

**Table 26: Asian melons: supply, disposal and value in the Northern Territory**

	Unit	2001	2002	2003	2004
<b>Bitter melon</b>					
Production	tonnes	707	864	640	640
Gross value	\$'000	1 414	2 159	1 408	1 152
Unit value	\$/kg	2.00	2.50	2.20	1.80
<b>Gourd, long melon</b>					
Production	tonnes	218	285	313	313
Gross value	\$'000	435	570	548	501
Unit value	\$/kg	2.00	2.00	1.75	1.60
<b>Winter melon</b>					
Production	tonnes	125	122	122	na
Gross value	\$'000	188	182	182	na
Unit value	\$/kg	1.50	1.49	1.49	na

Source: DBIRD (2003b); Adam Lourey, Department of Business, Industry and Resource Development, Northern Territory, personal communication, 21 April 2005; ABARE.

## Japanese pumpkin

There are two types of Japanese pumpkin: *Curcubita maxima* (commonly called kabocha) and *Curcubita moschata* (Morgan and Midmore 2003b). It is mainly grown commercially in New South Wales, Victoria, Queensland, Western Australia and Tasmania.

Japanese pumpkin is widely consumed in Australia and is also exported, particularly to Japan. However, because of quarantine restrictions against fruit fly, only pumpkins from Tasmania can be exported to Japan. Over the last decade, annual Australian exports of pumpkins to Japan have fluctuated around 1250 tonnes with an approximate export value (free on board, Australia) of \$1.5 million in constant Australian

(2005) dollars. In volume terms, the Australian share of the total Japanese import market for pumpkins has averaged only around one per cent in the three years to 2004; New Zealand supplied 62 per cent and Mexico 18 per cent.



Kabocha varieties

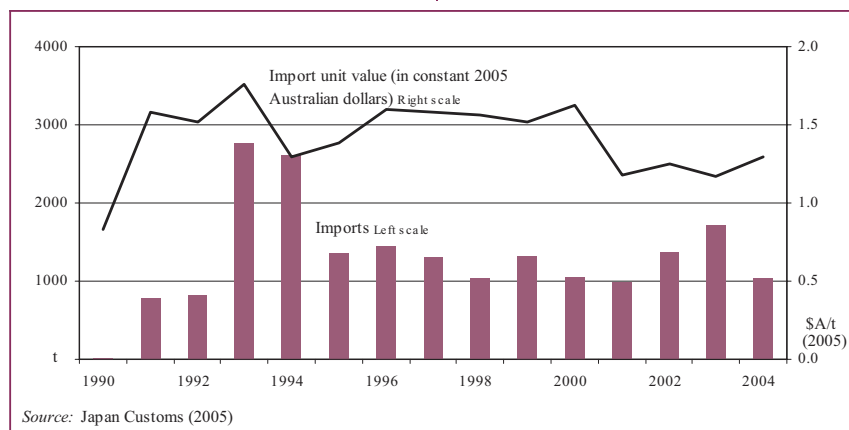


Figure W: Japanese imports of pumpkins from Australia

## Luffa

Luffa is a tropical or subtropical Asian vegetable. Angled luffa (*Luffa acutangula*) is generally used for vegetable production while sponge or common luffa (*Luffa cylindrica L. aegyptiaca*) is used for sponge production. Luffa sponges are produced by allowing the fruit to hang on the vine until the skin hardens and the stems turn yellow. Dried luffa also used as a medicinal tea.

In Australia, luffas are mainly produced in the Northern Territory (around Darwin) in the winter months, and in the other states in the warmer months (Gosbee 2004b).

The volume and value of Northern Territory luffa production is shown in Table 27. Australian production is consumed domestically; domestic (Sydney) prices for luffas are reported in (Table 23).

**Table 27: Luffas: supply, disposal and value in the Northern Territory\***

	Unit	2001	2002	2003	2004
Production	tonnes	72	115	133	132
Gross value	\$'000	130	208	239	212
Unit value	\$/kg	1.81	1.81	1.80	1.61

\*Smooth and angled.

Source: DBIRD (2003b); Adam Lourey, Department of Business, Industry and Resource Development, Northern Territory, personal communication, 21 April 2005; ABARE.

## Snake bean

Snake/yardlong beans (*Vigna unguiculata*) — also known as dau gok in Chinese and dâu que in Vietnamese — are an annual plant producing a pod that is olive green, round, up to 90 centimetres long and very thin. They are grown in frost-free areas of Australia, either as a dwarf bush or climbing plant.

Snake beans are produced mainly in the Northern Territory (see Table 28) but also in northern Western Australia and northern



Snake beans

Queensland. Northern Territory production of snake beans was down sharply in 2004 due to fusarium disease.

Production is sold on the domestic market and there are no imports.

The restricted supplies of snake beans meant higher domestic prices (see Sydney market prices in Table 23).

**Table 28: Snake beans: supply, disposal and value in the Northern Territory**

	Unit	2001	2002	2003	2004
Production	tonnes	483	253	228	114
Gross value	\$'000	1 207	696	512	455
Unit value	\$/kg	2.50	2.75	2.25	3.99

Source: DBIRD (2003b); Adam Lourey, Department of Business, Industry and Resource Development, Northern Territory, personal communication, 21 April 2005; ABARE.

## Taro (large corm)

Taro (*Colocasia esculenta*) is a perennial herbaceous plant grown throughout the humid tropics and parts of the subtropics, mainly for its starchy underground tuber. The leaves and stems are also edible. There are large and small corm forms of taro; the small corm form known as Japanese taro is not dealt with in this compendium.

Taro is an important food crop in less developed countries, particularly in Africa and the South Pacific islands. Total world production in 2004 was an estimated 9.9 million tonnes (FAO 2005) and has been growing at nearly 6 per cent a year since 1990. There was a particularly strong



Taro corms on packing wheel.

world production increase in the late 1990s in response to higher prices for taro. The main taro producers are Nigeria (36 per cent share in the three years to 2004), Ghana (18 per cent), China (16 per cent), Cameroon (10 per cent), Cote d'Ivoire (4 per cent) and Papua New Guinea (3 per cent).

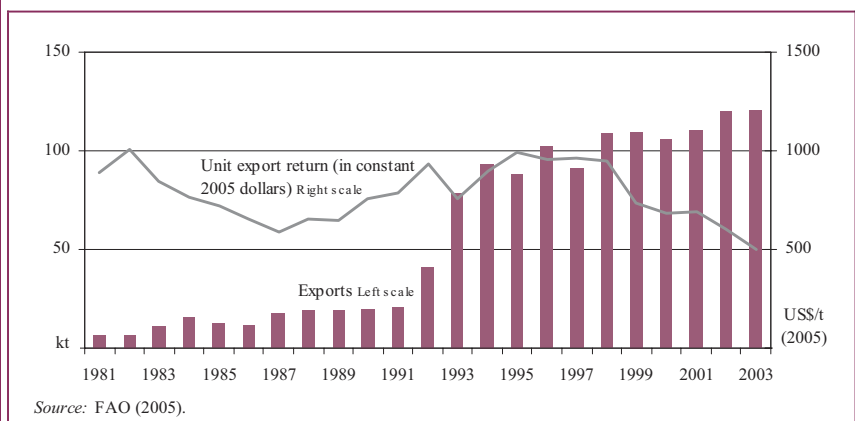
Only around one per cent of world production enters world trade. Trade grew strongly in the 1990s, boosted by higher prices (Figure X). However, the increased export supplies have put considerable downward pressure on world taro prices in more recent years.

China dominates the world export trade, with a share of 89 per cent in the three years to 2003 (FAO 2005). The other main exporters are Fiji (5 per cent), United States

(3 per cent), Thailand (1 per cent) and Tonga (1 per cent). There is probably a considerable trade in taro that does not get recorded in official statistics, particularly between countries in Africa.

## Australian taro industry

Taro has been produced in Australia for many years but production has grown strongly over the last decade in response to domestic demand from migrants from Asian and Pacific Islander origins. The main producing regions in Australia are on the wet tropical coast of north Queensland, with other lesser producing areas in the Northern Territory, central and southern Queensland, and northern New South Wales (Daniells, Petinaud and Salleras (2004).



Source: FAO (2005).  
**Figure X: World taro exports and unit export prices**

According to Daniells, Petiniaud and Salleras (2004), there are around 150 taro growers in Australia producing around 1000 tonnes a year, with a gross value of \$3.5 million. This production is consumed on the domestic market. Domestic (Sydney) prices for taro are shown Table 23.

Australia also imports around 3000 tonnes of taro a year, mainly from Fiji (Daniells, Petiniaud and Salleras 2004). In 2000, Australia imported 2031 tonnes of taro (called dalo in Fiji) from Fiji (Vinning 2003)

## Wasabi

Wasabi (*Wasabia japonica* syn. *Eutrema japonica*) is a spicy vegetable used in Japanese cuisine. More recently it has found widespread appeal in western cuisine due to its unique flavour. Wasabi can be kept fresh for around two weeks after harvesting.

Wasabi is a cool climate crop, tolerating air temperatures ranging

from mild frosts to 30 degrees Celcius (Sparrow 2004). This often means that it must be grown in shaded conditions provided by trees or shade cloth. Wasabi can be grown in soil or in clean running streams with gravel beds.

Hydroponic production has not yet been successful (Sultana and Savage nd). Water grown wasabi commands much higher prices than soil grown wasabi.

The main producers of wasabi are Japan and Chinese Taipei but Sultana and Savage (nd) say that the unique environmental requirements of wasabi growing and shortages of cultivable land limit production in these countries to 880 hectares and 400 hectares, respectively.

Emerging producers include the Republic of Korea, New Zealand, Colombia and Canada (around Vancouver on the Pacific coast).

**Australian wasabi industry**  
Commercial quantities of soil

grown wasabi have been available from Tasmania since 2000, supplying the Sydney, Melbourne and Hobart markets (Sparrow 2004). The first water grown wasabi farm was established in Tasmania in 2004. It is believed that parts of Victoria and highland New South Wales will also be suitable for wasabi production.

Farmgate prices of Tasmanian wasabi are around \$100 a kilogram for premium stems and \$20 a kilogram for smaller stems and leaves (Sparrow 2004).

With annual Australian production of around 250 kilograms from 0.4 hectares, the gross value of the Australian wasabi industry is of the order of \$25 000. However, Australian wasabi yields are currently less than a half those achieved in Japan (Sparrow 2004), so there is considerable scope for increased production through improved cultivation practices alone.

### Further information about Asian vegetables

- Access to Asian Vegetables website ([www.nre.vic.gov.au/trade/asiaveg/index.htm](http://www.nre.vic.gov.au/trade/asiaveg/index.htm)), provides a range of information on the nature of the Asian vegetable market in Australia.
- Hassall and Associates 2003, Asian Vegetable Industry: A Situation Assessment, RIRDC Publication no. 02/168, Canberra ([www.rirdc.gov.au/reports/AFO/02-168.pdf](http://www.rirdc.gov.au/reports/AFO/02-168.pdf)), provides profiles of the Asian vegetable industries in each state and territory, and a long list of industry contacts.
- The 'Asian vegetables' section in RIRDC's The New Crop Industries Handbook, pp. 15–105 ([www.rirdc.gov.au/NewCrops/Contents.html](http://www.rirdc.gov.au/NewCrops/Contents.html)) provides information on Asian brassicas, bitter melon, burdock, Chinese water chestnut, culinary bamboo shoots, long white radish, edamame, Japanese ginger, Japanese taro, kabocha, lotus, luffa, Asian melon, snake bean, taro (large corm) and wasabi.
- Vinning (2005) provides very detailed Australian and international market information for taro, sweet potato and yam.



Bok choy

# Australian native foods

While many native plants have been identified as having market potential (see, for example, Cribb and Cribb 1989; Wallace 2003; and Altech Group et al. 1999), most remain relatively commercially undeveloped. There are significant exceptions, such as the macadamia nut industry estimated to be worth around \$60 million a year, a native food processing firm successfully introducing processed native foods to a large supermarket chain and various retail activities. Since 1998 there has been a dedicated research and development program to address the issues associated with the emerging industry, including evaluation of promising plant varieties (RIRDC 2001a; CSIRO 2003).

The industry is relatively difficult to define. There is a potential for very large number of products and a range of activities, including



Selection of Australian native foods

commercial propagation, intensive and semi intensive cropping, collecting in the wild, processing, value added products and retailing. It has been estimated that there were approximately 800 participants in the native food industry in 2000 and around 85 per cent had income of less than \$10 000 from native food activities (Cherikoff 2000). Most respondents to an industry survey conducted in 2000 (around

90 per cent) were using organic production methods to grow multiple species. Other estimates put industry employment numbers at 500 full time and 500 part time workers (Altech Group et al. 1999, p. 4).

Some of the main products are listed in Table 29; estimated values of production for key native foods are shown in Table 30.

**Table 29: Major Australian native foods**

Common name	Botanical name	Main use
Bush tomato	<i>Solanum centrale</i>	Berry fruit, dried as flavour additive, fresh sales
Lemon aspen	<i>Acronychia acidula</i>	Flavour additive
Lemon myrtle	<i>Backhousia citriodora</i>	Fresh or dried herb, teas, oil
Aniseed myrtle	<i>Backhousia anisata</i>	Leaf for spice
Muntries	<i>Kunzea pomifera</i>	Fruit berries fresh and processed
Native pepper	<i>Tasmania lanceolata</i>	Tree berries dried as black pepper substitute, leaf as spice
Dorrigo pepper	<i>Tasmania stipitata</i>	Green leaf pepper
Quandong	<i>Santalum acuminatum</i>	Fruit used mainly in dried halved form
Warrigal greens	<i>Tetragonia tetragoniodes</i>	Salad leaf vegetable, pesto, sauce
Wattleseed	<i>Acacia spp</i>	Roasted seed used directly and milled to flour
Native currants	<i>Coprosma nitida</i>	Fruit used directly, dried
Riberry	<i>Syzygium luehmannii</i>	Fruit used directly and in processing
Desert lime	<i>Eremocitrus glauca</i>	Fruit used directly, frozen
Kakadu plums	<i>Terminalia ferdinandiana</i>	Fruit used for food and pharmaceutical applications
Davidson plums	<i>Davidsonia pruriens</i>	Fruit used directly
Illawarra plum	<i>Podocarpus elatus</i>	Fruit used directly

There is little information on total production and average price levels in the industry. The primary value of production, excluding macadamias but including value added activity, was estimated at around \$5 million in 1996 (Phelps 1997) and around \$10 million in 2000 (Cherikoff 2000). In a 1999 study (Altech Group et al.), the demand for production and market information on the native food industry was examined. While there was a strong perceived demand for such information within the industry, basic information on prices and volumes was not forthcoming — mainly because the sectors were small and trading was thin. Other key problems in determining value of production include the large number of plants involved (see, for example, Cribb and Cribb 1989; Altech Group et al. 1999), the diverse activities and the ‘cottage industry’ nature of many operations.

While there has been growth in the apparent value of production in the industry from a low base, there are encouraging signs of development. Demand for several products has increased significantly, with strong growth in demand for lemon myrtle as the base for organic tea and the establishment of a range of processed native foods such as bush tomato and native pepper through major retail outlets. Supplies of several native foods such as quandong, riberry, native lime and lemon myrtle, are set to expand with commercial plantings previously undertaken now reaching production. Harvests of some others are currently limited by market requirements.

The industry has a range of challenges for growth. While many products currently rely on novelty value as a key demand driver, a major issue remains establishing

**Table 30: Estimated commercial production and ‘farm’ value of Australian native food**

Common name	1995-96			2003		
	Production tonnes	Farm price \$/kg	Production value \$'000	Production tonnes	Farm price \$/kg	Production value \$'000
Bush tomato	6	25	150	Fresh, 5 Dried, 8	Fresh, 12 Dried, 24	252
Lemon aspen	4	12	48	5*	10	50
Lemon myrtle	7.5	50	375	40	20	800
Muntries	5	12	60	2	14	28
Native pepper	5	45	225	5 Dried leaf, 10	45 35	225 350
Quandong	5	10	50	5	Fresh, 18 Dried, 60	810
Native mint	na	na	na	1	35	35
Wattleseed	9	14	126	9	11	99
Riberry	5	14	70	5	10	50
Wild lime	1	10	10	15.5	12	186
Wild plums	8	14	110	30	14	420
Total			1 224			3 305

\*Production in non-drought year. **na** Not available

Sources: Graham and Hart (1997), various industry sources.

a more robust demand for the products and being able to supply to meet those requirements. This in turn may require a different mix of supply systems because consistency of supply and price considerations are likely to assume greater importance with higher volumes.

Market development opportunities for native food products will vary widely, depending on characteristics and the trade being targeted (for a discussion of some of the issues, see Cherikoff 2000; RIRDC 2001a). For example, a key driver of demand for Kakadu plums has been from the pharmaceutical and cosmetics industry because of its high vitamin C content. Demand for some fresh products, such as bush tomato and native lime, has undoubtedly benefited from the work undertaken in establishing other processed forms. The industry is being actively promoted by marketers, growers, and by RIRDC, which has an active native foods program.

### Further information about Australian native foods

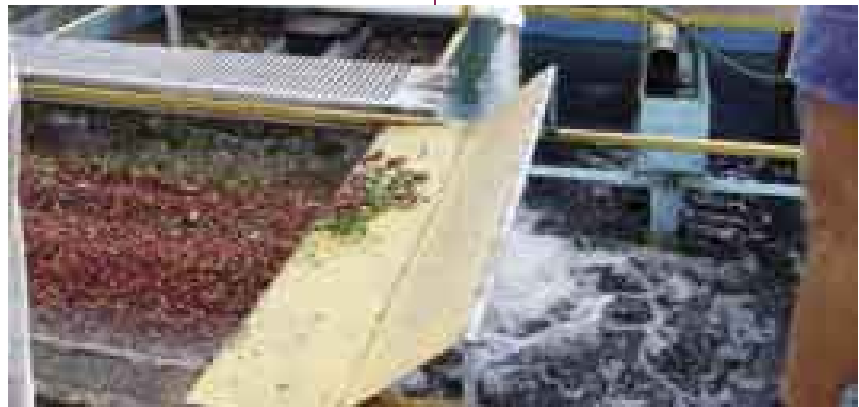
- Altech Group and Total Earth Care 1999, *Improving Access to Bushfood Production and Marketing Information*, RIRDC Publication no. 99/158, Canberra. This publication has a very comprehensive reference and contact list.
- Australian Native Foods website ([www.clw.csiro.au/nativefoods/index.html](http://www.clw.csiro.au/nativefoods/index.html)), jointly supported by RIRDC and CSIRO Land and Water, providing a directory of the Australian native foods industry.
- The ‘Native foods’ section in RIRDC’s *The New Crop Industries Handbook*, pp. 337–84 ([www.rirdc.gov.au/NewCrops/Contents.html](http://www.rirdc.gov.au/NewCrops/Contents.html)).

# Coffee

The two most important types of coffee grown commercially are *Coffea arabica* (arabica coffee), accounting for around 70 per cent of world production, and *Coffea canephora* (robusta coffee) (International Coffee Organisation 2004). Two other types that are grown on a much smaller scale are *Coffea liberica* (liberica coffee) and *Coffea dewevrei* (excelsa coffee). Mild arabicas command price premiums in world markets (Figure Y).

The main world producers of coffee are Brazil (28 per cent of world production in the three years to 2003), Vietnam (10 per cent), Colombia (9 per cent) and Indonesia (7 per cent) (FAO 2005). The emergence of Indonesia as a major producer and exporter over the past decade has contributed to the recent downward trend in world coffee prices.

Green (unprocessed) coffee beans account for more than 90 per cent of world trade in coffee. Brazil accounted for 20 per cent of world trade in green coffee beans in the three years to 2002, with other



Washing coffee cherries

major exporters being Colombia (14 per cent), Vietnam (6 per cent), Guatemala (6 per cent) and Indonesia (4 per cent). In contrast, developed countries dominate the world export trade in roasted coffee, mainly Italy (20 per cent), Germany (17 per cent), Belgium (10 per cent) and the United States (13 per cent).

## Australian coffee industry

The advent of machine harvesting techniques has enabled the re-establishment of the Australian coffee industry through reducing labour costs, a key barrier to its

competitiveness (Drinnan and Peasley 1997). Australia has the advantage of being free from the main diseases and pests that affect many of the coffee producing regions in the world. However, land with suitable climate conditions, particularly freedom from frosts, limits the extent to which coffee can be grown in Australia.

On average, Australia imports coffee in various forms worth more than \$200 million a year (Table 31). It also exports around \$26 million of coffee products but most of the export industry is based on the use of imported coffee beans.

The Australian coffee industry is located in north eastern New South Wales and in Queensland. In 2002, there was around 740 hectares of coffee planted in Australia, producing 495 tonnes of dry green beans (RIRDC 2003). Growers in far north Queensland accounted for about 60 per cent of the total. Australian coffee plantings are projected to grow to 1600 tonnes of dry green beans (RIRDC 2003). The regional distribution of coffee production in Australia — in 2002 and projected for 2007-08 — is shown in Table 31.

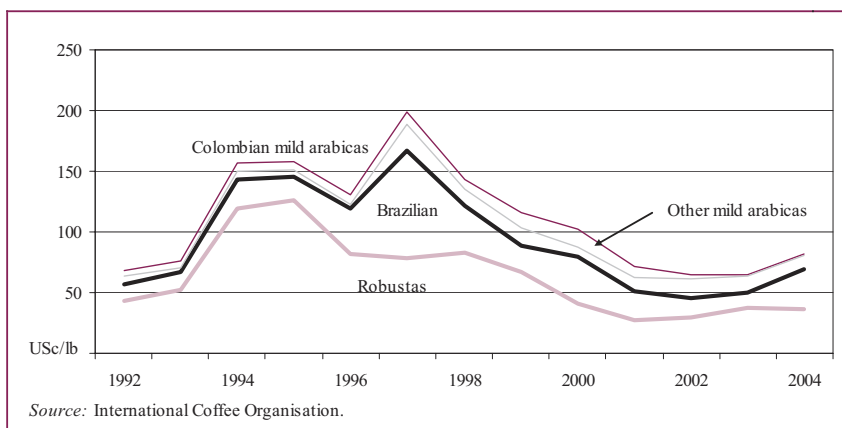


Figure Y: International Coffee Organisation indicator prices for coffee, New York market

**Table 31: Regional production of coffee in Australia: 2002 and projected 2007-08**

Region	2002			2007-08
	Area ha	Growers no.	Production tonnes	Production tonnes
<b>Queensland</b>				
Far north	350	10	300	800
Mackay-Proserpine	20	3	5	50
Yeppoon	100	1	80	200
Caboolture-Nambour	20	10	10	50
<b>New South Wales</b>	250	>120	100	500
<b>Total</b>	740	>144	495	1 600

Source: RIRDC (2003).

**Table 32: Coffee: supply, disposal and value in Australia**

	Unit	1999-00	2000-01	2001-02	2002-03	2003-04
<b>Production</b>						
Area	ha	na	na	740	750	760
Production, dry green beans	tonnes	na	na	495	485	510
Yield	t/ha	na	na	0.67	0.65	0.67
Gross value of production	\$'000	na	na	2833	3083	3280
<b>Exports*</b>						
Coffee, green						
- volume	tonnes	2850	1911	314	305	582
- value	\$'000	22 199	15 555	1 421	1 880	2 623
- unit value	\$/kg	7.79	8.14	4.53	6.16	4.50
Coffee, roasted						
- volume	tonnes	820	918	973	1384	1719
- value	\$'000	4 351	4 540	6 120	9 476	11 847
- unit value	\$/kg	5.30	4.95	6.29	6.84	6.89
Coffee, dry or concentrated						
- volume	tonnes	502	1296	2882	2360	1943
- value	\$'000	5 309	12 193	25 199	22 679	22 836
- unit value	\$/kg	10.58	9.41	8.74	9.61	11.75
<b>Imports</b>						
Coffee, green						
- volume	tonnes	51 843	42 721	37 582	40 628	43 045
- value	\$'000	134 294	90 571	64 978	71 482	68 036
- unit value	\$/kg	2.59	2.12	1.73	1.76	1.58
Coffee, roasted						
- volume	tonnes	2 367	3 650	4 309	3 686	3 350
- value	\$'000	23 077	32 307	34 576	40 830	35 075
- unit value	\$/kg	9.75	8.85	8.02	11.08	10.47
Coffee, dry or concentrated						
- volume	tonnes	35	1 343	8 257	6 242	4 793
- value	\$'000	56 328	82 279	113 697	88 365	65 571
- unit value	\$/kg	1623.86	61.25	13.77	14.16	13.68
<b>All coffee</b>						
Total export value	\$'000	31 859	32 288	32 740	34 035	37 306
Total import value	\$'000	213 700	205 158	213 251	200 677	168 682

\*Includes re-exports. na Not available.

Sources: ABS (2005); James Dinnan, Queensland Department of Primary Industries, personal communication, 16 March 2005; ABARE.

The Australian coffee industry virtually grows only the high quality arabica coffee beans used in the specialty or 'roast and ground' market. According to RIRDC (2003), premium prices of around \$8-9 a kilogram of dry green beans have been consistently paid for Australian produced arabica, compared with the average imported price for arabica of \$3-4 a kilogram. (The import unit returns shown in Table 30 include robusta beans as well as arabica.) Increases in Australian production are likely to result in downward pressure on these premiums (RIRDC 2003).

### Further information about coffee

- AustralAsian Specialty Coffee Association ([www.aasca.com/public/stats.asp](http://www.aasca.com/public/stats.asp)), information on the supply chain and consumption of coffee in Australia.
- International Coffee Organisation ([www.ico.org](http://www.ico.org)), comprehensive market information on coffee.
- Euronext.liffe ([www.liffe.com](http://www.liffe.com)), coffee (robusta) futures prices, London.
- New York Board of Trade ([www.nybot.com](http://www.nybot.com)), coffee (arabica) futures prices.
- The 'Coffee' chapter in RIRDC's The New Crop Industries Handbook, pp. 280-88 ([www.rirdc.gov.au/NewCrops/Contents.html](http://www.rirdc.gov.au/NewCrops/Contents.html)).



# Jojoba

Jojoba (*Simmondsia chinensis*) is an evergreen perennial bush that is native to the hot arid areas of northern Mexico and south western United States. The oil produced from its seed consists almost entirely of liquid wax esters that are suited to use in cosmetics, waxes and high pressure lubricants. Currently, about 80 per cent of jojoba oil production is used in cosmetics (International Jojoba Export Council 2004).

Commercial production of jojoba commenced in 1976. Argentina and the United States are the main producers with other producers being Australia, Chile, Egypt, Israel, Mexico and Peru (Figure Z). World production is expected to increase by 10 per cent a year over the next five years due to increased plantings and maturing plantations.

World trade in jojoba oil increased rapidly throughout the 1980s and 1990s but has dropped back in recent years (Figure AA). Unit export values in constant (2004) dollar terms declined rapidly throughout the 1980s in response to increasing supplies but have



Jojoba seed pods

stabilised at around US\$11 a kilogram over the past decade.

The total value of world exports of jojoba oil was US\$6.8 million in 2003 (FAO 2005). The main exporters of jojoba are the United States (25 per cent of the total volume of trade in the three years to 2003), Israel (17 per cent), Argentina (16 per cent), Germany (15 per cent) and Mexico (12 per cent). The main importers are wealthy countries, particularly Germany, Canada, the United States, France and Japan.

## Australian jojoba industry

There are an estimated 400 hectares planted to jojoba in Australia in 2004, mainly in north west New South Wales and northern Victoria, producing oil with a wholesale value of \$0.5 million at the farm gate.

Despite growing domestic production, Australian imports of jojoba oil have increased sharply in recent years (Table 33).

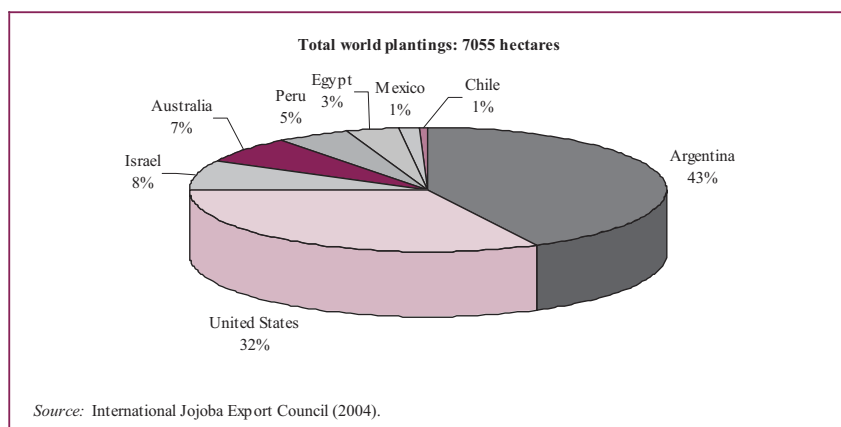


Figure Z: Country shares of world jojoba production



Jojoba harvester. Photo D. Buster

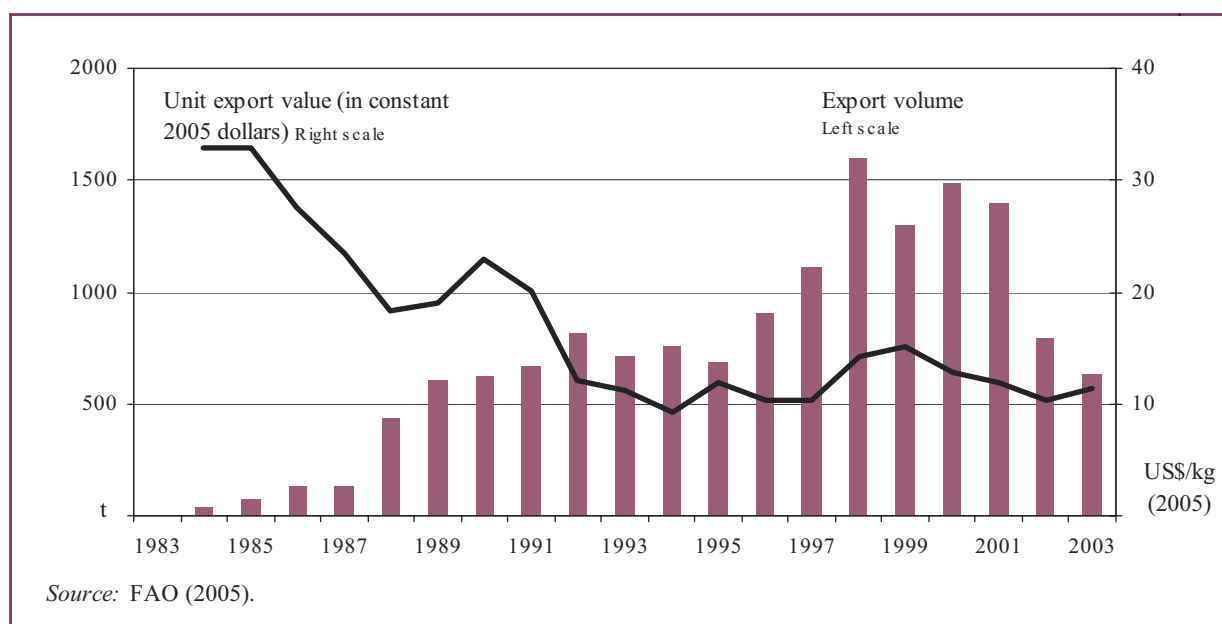


Figure AA: Volume and unit value of world jojoba oil exports

Table 33: Jojoba: supply, disposal and value in Australia

	Unit	2000	2001	2002	2003	2004
<b>Production</b>						
Area	ha	na	na	na	380	400
Seed production	tonnes	na	na	na	43	55
Yield, oil	%	na	na	na	45	42
Oil production	tonnes	na	na	na	19.4	23.1
Gross value	\$'000	na	na	na	513	531
<b>Exports, oil</b>						
Volume	tonnes	2.2	1.4	0.0	0	0
Value	\$'000	42	40	0	0	0
Unit value	\$/kg	19.31	28.13	0.00	0	0
<b>Imports, oil</b>						
Volume	tonnes	11.1	12.5	12.7	15.0	29.4
Value	\$'000	280	296	293	293	275
Unit value	\$/kg	25.16	23.56	23.02	19.47	9.34

Sources: ABS (2005); ABARE; Dan Buster, personal communication, 14 March 2005. na Not available.

### Further information about farmed jojoba

- International Jojoba Export Council website ([www.ijec.net](http://www.ijec.net)), provides information on the nature of the world market for jojoba.
- Jojoba Australia Pty Ltd ([www.jojoba-australia.com.au](http://www.jojoba-australia.com.au)), quality and price information for jojoba products in Australia.
- The 'Jojoba' chapter in RIRDC's The New Crop Industries Handbook, pp. 251–5 ([www.rirdc.gov.au/NewCrops/Contents.html](http://www.rirdc.gov.au/NewCrops/Contents.html)).

# Essential oils

There are many different essential oils that are used in a range of ways including perfumes, cosmetics, therapeutic goods and insecticides.

World trade in essential oils, terpenic byproducts and resinoids was worth US\$1.7 billion in 2003 of which Australia supplied only US\$15 million (United Nations Statistics Division 2005). (Terpenes are the volatile organic compounds that are extracted from essential oils and generally are associated with the characteristic

fragrances of those oils.) The composition of world trade in essential oils in 2003 is outlined in Table 34. In value terms, terpenic byproducts and peppermint, orange and lemon oils are the most traded worldwide (Figure BB).

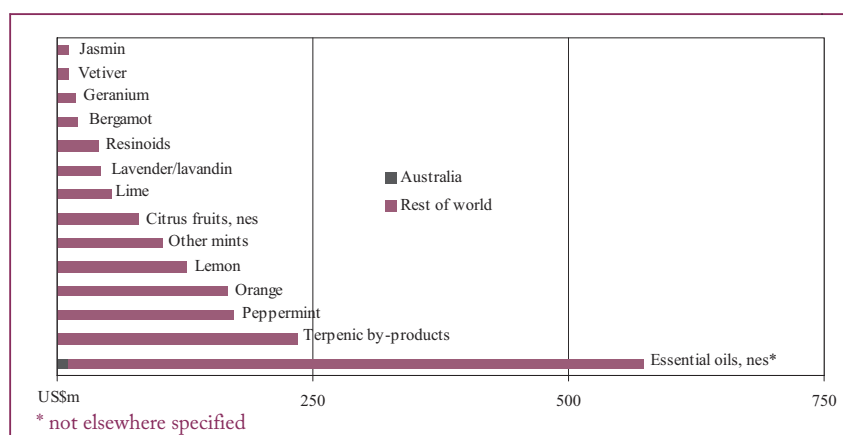


Mechanical harvesting of lavender at Bridestow Estate, Tasmania

**Table 34: Characteristics of the world trade in essential oils, 2003**

Spice	Volume kt	Value	Main exporters (share of total export value in 2003)	Main importers (share of total import value in 2003)
Bergamot	1.0	20.9	Italy (59%), France (12%), Germany (5%), Spain (4%)	France (24%), United States (16%), United Kingdom (8%), Spain (7%)
Citrus fruit, nes	6.0	80.7	United States (35%), Italy (12%), Germany (5%)	Japan (23%), United States (14%), Germany (6%), Switzerland (6%)
Geranium	0.5	17.8	China (30%), Egypt (26%), France (24%), United Kingdom (5%)	France (23%), United Kingdom (14%), India (10%), United States (10%), Spain (9%)
Jasmin	0.4	11.3	France (38%), India (22%), Egypt (19%), Germany (6%)	France (37%), United States (22%), Switzerland (11%)
Lavender/lavandin	2.6	42.3	France (69%), Bulgaria (6%), Spain (4%)	United States (19%), United Kingdom (12%), Germany (11%), Switzerland (10%), Netherlands (6%)
Lemon	11.7	126.2	Argentina (39%), United States (16%), Italy (10%), France (5%)	United States (34%), United Kingdom (12%), Japan (8%), France (6%)
Lime	3.4	53.3	Mexico (47%), United States (16%), Peru (11%), United Kingdom (8%)	United Kingdom (17%), United States (14%), Ireland (6%)
Orange	44.3	166.9	Brazil (46%), United States (20%), Germany (6%), United Kingdom (5%)	United States (31%), Germany (7%), Japan (7%), United Kingdom (6%)
Other mints	9.3	102.6	United States (37%), India (26%), China (11%)	China (21%), United States (16%), United Kingdom (8%), Brazil (7%)
Pepper-mint	11.6	173.2	United States (49%), Thailand (16%), Hong Kong (10%), India (8%)	Hong Kong (18%), United Kingdom (13%), Thailand (10%), United States (6%)
Vetiver	0.3	11.5	Haiti (59%), Indonesia (17%), France (9%)	France (25%), Switzerland (25%), Spain (13%), United States (13%)
Other essential oils	42.2	573.0	France (19%), China (12%), Indonesia (9%), United States (8%)	United States (20%), France (15%), United Kingdom (8%), Switzerland (7%)
Terpenic by-products	57.0	235.1	United States (19%), India (18%), Ireland (9%), Germany (8%)	France (15%), United States (13%), Germany (6%), Japan (6%)
Resinoids	3.1	41.3	France (32%), India (14%), United States (14%), Spain (9%)	United States (11%), United Kingdom (11 per cent), France (8%), Canada (8%), Netherlands (7%)

Source: Based on data from United Nations Statistics Division (2005).



**Figure BB: Composition of world trade in essential oils, 2003**

Australia is both an importer and exporter of essential oils (Table 35).

**Table 35: Australian exports and imports of essential oils\***

Essential oil	Volume			Value			Unit value		
	2001-02 tonnes	2002-03 tonnes	2003-04 tonnes	2001-02 \$'000	2002-03 \$'000	2003-04 \$'000	2001-02 \$/kg	2002-03 \$/kg	2003-04 \$/kg
<b>Exports</b>									
Bergamot	1.5	4.6	1.6	59	204	51	39.77	44.75	31.21
Orange	19.5	12.3	15.4	312	105	111	15.96	8.59	7.21
Lemon	1.4	17.1	7.9	33	252	109	23.92	14.68	13.68
Lime	0.2	0.1	0.1	6	8	9	37.91	54.01	64.57
Other citrus	475.8	139.7	224.9	3010	3250	5312	6.32	23.27	23.62
Geranium	0.6	0.5	1.1	20	41	48	31.97	88.00	42.70
Jasmin	0.0	0.1	0.4	0	10	12		203.62	27.87
Lavender	3.7	8.6	5.6	225	435	368	60.75	50.60	65.91
Peppermint	22.8	19.6	5.7	384	457	291	16.86	23.33	51.00
Other mints	0.6	0.8	0.6	52	52	37	93.15	67.09	59.20
Vetiver	2.1	0.0	0.8	37	1	11	17.22	29.22	14.29
Eucalyptus	79.6	99.6	163.7	2596	1822	3040	32.64	18.29	18.57
Other	468.1	556.0	499.2	10308	15939	13716	22.02	28.67	27.48
Concentrates	na	na	na	3564	3788	3731	na	na	na
<b>Total exports</b>	<b>1075.8</b>	<b>858.9</b>	<b>927.1</b>	<b>20606</b>	<b>26365</b>	<b>26846</b>	<b>19.15</b>	<b>30.70</b>	<b>28.96</b>
<b>Imports</b>									
Bergamot	3.7	3.7	2.2	91	147	131	24.68	40.09	58.56
Orange	411.5	536.1	562.6	1608	2338	2376	3.91	4.36	4.22
Lemon	65.4	61.9	65.1	1556	1200	1152	23.79	19.37	17.68
Lime	18.3	33.2	37.3	912	1008	1026	49.90	30.32	27.53
Other citrus	37.4	24.9	33.4	850	990	543	22.73	39.83	16.25
Geranium	1.8	2.6	2.5	138	260	242	77.68	99.63	97.27
Jasmin	1.8	0.2	0.2	63	85	86	34.65	423.16	442.12
Lavender	35.5	43.2	41.6	1961	2170	1786	55.25	50.24	42.90
Peppermint	40.6	42.6	44.7	1635	1608	1533	40.24	37.76	34.31
Other mints	19.1	18.4	24.3	973	767	859	51.03	41.61	35.36
Vetiver	0.2	0.1	0.1	15	13	10	91.06	90.54	85.33
Other	576.8	874.9	784.7	10537	12813	11391	18.27	14.64	14.52
Concentrates	na	na	na	2156	2192	1562	na	na	na
<b>Total imports</b>	<b>1212.0</b>	<b>1641.9</b>	<b>1598.7</b>	<b>22493</b>	<b>25591</b>	<b>22696</b>	<b>18.56</b>	<b>15.59</b>	<b>14.20</b>

\*Includes re-exports and re-imports. na Not available

Source: ABS (2005).

In this chapter, information is provided on the most important essential oils in terms of value in Australia: eucalyptus, lavender and tea tree oils.

### Further information about essential oils

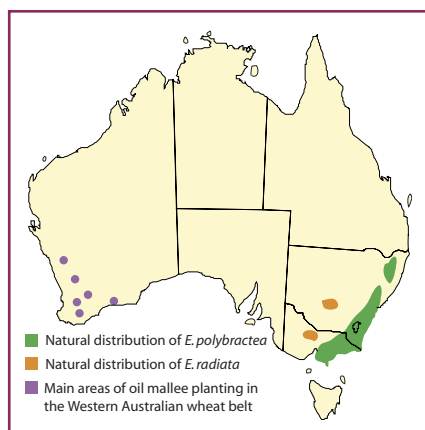
- International Federation of Essential Oils and Aroma Trades (IFEAT) ([www.ifeat.org](http://www.ifeat.org)), information on the world essential oils industry, particularly through the proceedings of the annual IFEAT conference.
- RIRDC 2001b, 'R&D Plan for Essential Oils and Plant Extracts 2002–2006' ([www.rirdc.gov.au/pub/essentoi.html#\\_Toc516383513](http://www.rirdc.gov.au/pub/essentoi.html#_Toc516383513)), profiles Australia's essential oils industry.
- The 'Essential oils' section in RIRDC's The New Crop Industries Handbook, pp. 105–64 ([www.rirdc.gov.au/NewCrops/Contents.html](http://www.rirdc.gov.au/NewCrops/Contents.html)). Includes sections on boronia, chamomile, eucalyptus, fennel, lavender, mint, parsley, sandalwood and tea tree oils.



Harvested boronia flowers

## Eucalyptus

Eucalyptus oil is extracted by steam distillation from the leaves of a number of types eucalypt trees including blue mallee gums (*Eucalyptus polybractea*), narrow leafed peppermint gum (*Eucalyptus radiata* var. *Australiana*), and Tasmanian blue gum (*Eucalyptus globulus*). In recent decades countries such as Spain, Portugal, India and China, have taken over a eucalyptus oil market that once only Australia supplied (Abbott 2004). China is now the world's largest eucalyptus oil producer, accounting for around half of world output. Most of these countries are using the Tasmanian blue gum as the source of their oil.



The main component of eucalyptus oil is 1,8-Cineole, making up to 95 per cent per cent of the oil content with mallee types, and 60–70 per cent with blue gum types (Barton 1998).

The main uses of eucalyptus oil are as a medicine, usually to be externally applied or inhaled. For example, it may be used to treat muscle soreness, arthritis and coughs and cold. It is also used in confectionary, as a disinfectant or fragrance, and in industrial processes, particularly as a solvent. Barton (1998) identifies a number potential industrial uses of eucalyptus oil, particularly

the replacement of a popular petrochemical based solvent that is currently being phased out internationally, due to its ozone depleting properties. Barton acknowledges that large scale penetration in these markets would require prices around half those currently prevailing for eucalyptus oil, but says that this could be possible with large scale production technologies.

Apart from their oil producing qualities, eucalypts of this type are also grown to combat salinity, preserve wildlife diversity, and to contain greenhouse gases through carbon sequestration.

World consumption of crude eucalyptus oil is estimated to be about 3000 tonnes a year, with an ex distillery value of around US\$15 million (Abbott 2004; Davis and Bartle 2004).

### Australian eucalyptus oil industry

Australian eucalyptus oil production is currently around 125 tonnes a year (Table 36), considerably less than the 1000 tonnes a year that was produced in the 1940s (Abbott 2004).

Two companies dominate the Australian eucalyptus oil market: G. R. Davis Pty Ltd in Sydney, and Felton, Grimwade and Bickford in Melbourne. The main areas harvested in Australia are around Bendigo in Victoria, and West Wyalong in New South Wales.

In a program initiated by a state government department with the aid of Australian Government funds, large numbers of oil-producing eucalypts (mainly blue mallee) have been planted in Western Australia. The broad aim of this program is to address environmental degradation issues, particularly salinity and greenhouse gases, through profitable growing of

mallee trees. Apart from eucalyptus oil, the intended outputs from the trees are activated carbon, charcoal and fuel for electricity generation. Another contributor to profitability could be trading in carbon credits. Based on the 25 million trees already planted, Bartle and Shea (2002) estimate that the potential oil yield of these as yet virtually untapped Western Australian plantings is around 1000 tonnes a year, equivalent to a third of world consumption. However, increases of production of this magnitude are likely to have a substantial downward impact on world prices. The program target is plantings of 500 million mallee trees by 2025. Potential annual output from these plantings would be 35 000 tonnes of eucalyptus oil, 140 000 tonnes of activated carbon, and 75 megawatts of electricity (Oil Mallee Project 2004).

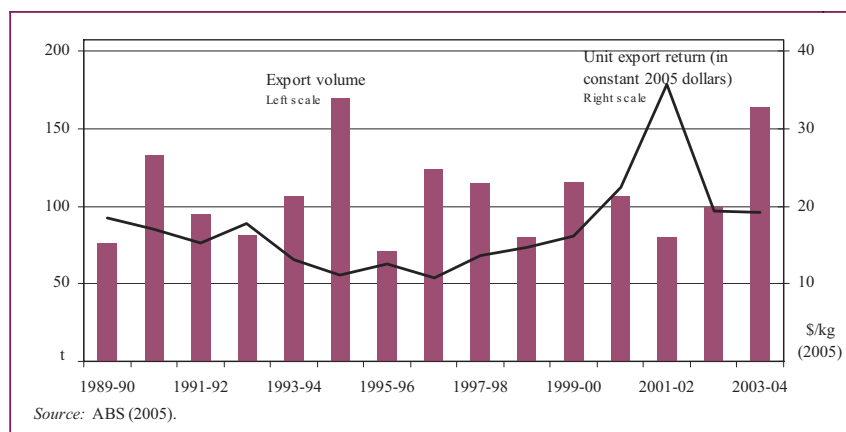
The major part of Australian production is exported. Australian eucalyptus oil exports have fluctuated around 100 tonnes a year over the past fifteen years but increased to 164 tonnes in 2003-04 (Figure CC). Much of the increase in exports in 2003-04 is explained by re-processing then re-exporting of eucalyptus oil from southern Africa (Richard Davis, G.R. Davis Pty Ltd, personal communication, 24 March 2005). There has been some tendency for export returns to improve in constant dollar terms since the mid 1990s, boosted in part by the depreciation of the Australian dollar over that period. The major export markets for Australian eucalyptus oil are Thailand (16 per cent of the total volume of Australian eucalyptus oil exports in the three years to 2003-04), the United States (14 per cent), New Zealand (9 per cent), Malaysia (8 per cent) and Japan (7 per cent).

**Table 36: Eucalyptus oil: supply, disposal and value in Australia**

	Unit	1999-00	2000-01	2001-02	2002-03	2003-04
<b>Production</b>						
Volume	tonnes	na	na	na	120	125
Gross value	\$'000	na	na	na	1 976	2 089
<b>Exports*</b>						
Volume	tonnes	115.7	106.9	79.6	99.6	163.7
Value	\$'000	1 571	2 130	2 597	1 822	3 040
Unit value	\$/kg	13.58	19.92	32.62	18.29	18.57

\*Includes re-exports. na Not available.

Sources: ABS (2005); ABARE.



**Figure CC: Volume and unit value of Australian eucalyptus oil exports**

### Further information about eucalyptus oil

- Oil Mallee Project ([www.oilmallee.com.au](http://www.oilmallee.com.au)), wealth of information on the economics of oil mallee growing.
- The 'Eucalyptus oil' chapter in RIRDC's The New Crop Industries Handbook, pp. 124–30 ([www.rirdc.gov.au/NewCrops/Contents.html](http://www.rirdc.gov.au/NewCrops/Contents.html)).

## Lavender

Lavender oil is an essential oil used mainly in the fragrance, perfume and aromatherapy industries. It is derived from plants of the genus *Lavandula* by steam distillation of the flowers. There are several types of lavender oil. The mostly highly

priced product comes from *Lavandula angustifolia*. There is also lavandin, the essential oil of the hybrid lavender plant *Lavandula hybrida* which has a much higher oil yield than true lavender but is generally considered to be of inferior quality because of a distinct camphor scent. Lavender is also used as fresh or dried flowers.

**Table 37: Lavender oil: supply, disposal and value in Australia**

	Unit	1999-00	2000-01	2001-02	2002-03	2003-04
<b>Production, oil</b>						
Volume	tonnes	na	na	1.7	2.0	2.3
Gross value	\$'000	na	na	420	494	661
<b>Exports*</b>						
Volume	tonnes	5.4	2.3	3.7	8.6	5.6
Value	\$'000	181	151	225	435	368
Unit value	\$/kg	33.35	64.88	60.75	50.60	65.91
<b>Imports*</b>						
Volume	tonnes	37.6	34.6	35.5	43.2	41.6
Value	\$'000	1569	1679	1961	2170	1786
Unit value	\$/kg	41.73	48.48	55.25	50.24	42.90

\*Includes re-exports and re-imports. na Not available.

Sources: ABS (2005); McEldowney (2004); ABARE.

In 2003, 2557 tonnes of lavender and lavandin oil were traded worldwide at a total value of \$US42 million (United Nations Statistical Division 2005). The largest exporter is France with a share in the total value of world trade in 2003 of 69 per cent, with the other main exporters being Bulgaria and Spain (Table 34). The main importers are the United States, the United Kingdom, Switzerland and Germany.

## Australian lavender industry

In Australia, the industry consists of around 500 growers. Some operations are quite large but the majority are small, part time operations. Australia's largest grower is the Bridestowe Estate in northern Tasmania. Peterson (2002) puts annual Australian production of lavender oil in 2001-02 at 1.7 tonnes, 1.2 tonnes of which is produced by Bridestowe Estate. A more recent estimate by McEldowney (2004) has Australian lavender production at over two tonnes.

Prices for good quality Australian lavender oil approached \$300 a kilogram in 2004. The estimated gross value of Australian lavender oil production in 2003-04 was \$661 000 (Table 37).

The industry is oriented toward the domestic market. There were Australian lavender and lavandin oil exports of 5.6 tonnes in 2003-04 but these would appear to be largely re-exports of imported product (Table 37). At the same time, there were lavender and lavandin oil imports of 41.6 tonnes worth \$2.2 million.

### Further information about lavender oil

- Australian Lavender Growers Association ([www.talga.org](http://www.talga.org)), information from an industry organisation representing around 500 lavender growers in Australia.
- Australian Lavender Industry ([www.lavenderaustralia.com](http://www.lavenderaustralia.com)), information on the Australian lavender industry.
- The 'Lavender oil' chapter in RIRDC's The New Crop Industries Handbook, pp. 136-40 ([www.rirdc.gov.au/NewCrops/Contents.html](http://www.rirdc.gov.au/NewCrops/Contents.html)).

## Sandalwood

Sandalwood has been a valuable traded commodity for thousands of years. Sandalwood oil is typically extracted from the heartwood or roots of sandalwood trees that are at least thirty to forty years old.

The oil is used in perfumes, cosmetics and therapeutic goods. The wood has a variety of uses including furniture, turned or

carved woodworks, and incense and joss sticks.

There are various forms of sandalwood tree that produce sandalwood oil. The main form is *Santalum album* which is believed to have originated in Indonesia but is also grown in India (the main producer of sandalwood and exporter of sandalwood oil), China, East Timor and the Philippines. The sandalwood tree is parasitic on other trees. There is also an African tree (*Osyris lanceolata*), native to Tanzania, the wood and oil of which is often traded as sandalwood in world markets.

Australia appears to supply around half of world sandalwood exports, with Indonesia, East Timor and India as the other main exporters. The main importers of sandalwood are Chinese Taipei, China and India. The United States and France are the main importers of sandalwood oil. There is also demand from north Asia and the Middle East.

Sandalwood has been over exploited in India and Indonesia. In India, the government has responded by limiting exports of sandalwood and sandalwood oil to an annual quota. The restrictions on supply have meant a continual rise in sandalwood oil prices, as indicated by the United States



Sandalwood oil. Photo: Mount Romance Australia

import price (Figure DD).

### Australian sandalwood industry

The sandalwood industry was established in the 1850s in Western Australia. Virtually all Australia's current sandalwood production comes from the native tree *Santalum spicatum* that is found throughout much of the lower half of Western Australia and parts of South Australia. There are small natural stands of *Santalum album* around Cloncurry in Queensland.

Sandalwood trees were extensively harvested in Western Australia during the clearing of land for agricultural enterprises. Near the height of this clearing process in 1924-25, 6600 tonnes of sandalwood was exported

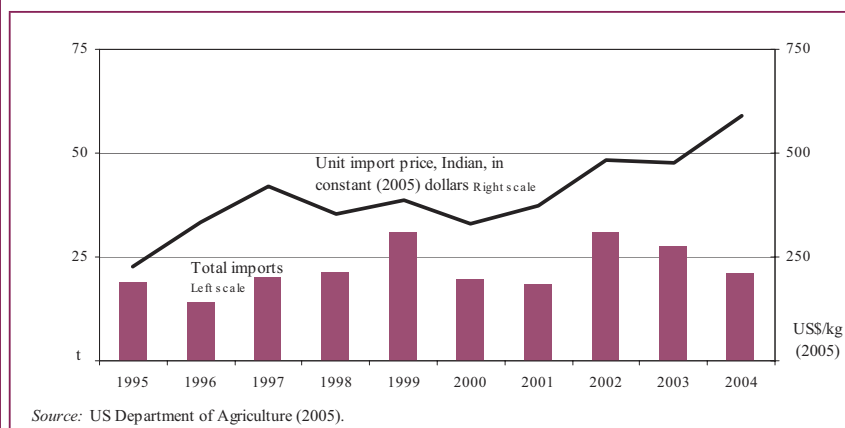


Figure DD: United States imports of sandalwood oil

(Commonwealth Bureau of Census and Statistics 1926).

Under the *Sandalwood Act 1929* in Western Australia, sandalwood is a resource managed on state government owned (Crown) land by a government agency, the Forest Products Commission of Western Australia. Sandalwood is harvested both green and dead (including roots and bark). A maximum sustainable harvest for green sandalwood is set each year; this has been 1500 tonnes a year since 2001-02. Harvesters are contracted by the Commission and are required to plant sandalwood seeds whenever they remove a sandalwood tree.

Processing and marketing of all Crown land sandalwood is conducted by Wescorp International, a private company that was awarded the contract through a public tender process. Recent average prices in US dollars received by Wescorp International from marketing and selling different grades of sandalwood on behalf of the Forest Products Commission are shown in Figure EE. Depending on the grade, prices for sandalwood are 25–47 per cent higher in 2004 than in 1999.

The Commission also has arrangements to encourage Western Australian farmers



Sandalwood plantation (five years) Photo: Forest Products Commission WA

to re-establish sandalwood trees on their farms (see Forest Products Commission 2004b). Apart from providing income sources for farmers and regional communities, the plantings have the environmental benefits of helping to control salinity and waterlogging; sequestering carbon; and enhancing native flora and fauna ecosystems. According to Jones (2004), at least 1000 hectares of private plantations have been planted in Western Australia (including a plantation of *Santalum album* in the Ord River Irrigation Area) and 200 hectares in South Australia, with total plantings increasing at around 500 hectares a year. Because the sandalwood tree is parasitic, it must be planted with others

trees, for example acacia varieties.

The estimated supply and disposal of Australian sandalwood is shown in (Table 38). The sandalwood harvest in Australia in 2003-04 was around 2408 tonnes, of which approximately 700 tonnes is consumed domestically, producing around 12 tonnes a year of sandalwood oil (Jones 2004). Average payments to sandalwood harvesters by the Forest

Products Commission were slightly less than \$4000 a tonne but payments varied according to quality. The estimated gross value of production of sandalwood in Australia in 2003-04 was around \$9.4 million a year.

The estimated value of Australian exports of sandalwood products in 2004 is \$13.3 million (Table 38). In the three years to 2004, more than half of Australian sandalwood exports have gone to Chinese Taipei. Australia supplied 43 per cent of Chinese Taipei's sandalwood imports with Tanzania and Indonesia supplying 20 per cent and 12 per cent, respectively (Taiwan Customs 2005).

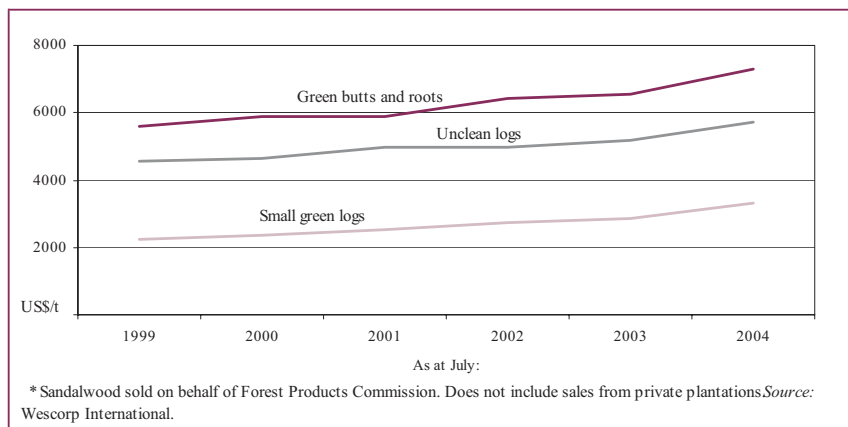


Figure EE: Average prices for different grades of Western Australian sandalwood\*

#### Further information about sandalwood oil

- The 'Sandalwood oil' chapter in RIRDC's *The New Crop Industries Handbook*, pp. 153–57 ([www.rirdc.gov.au/NewCrops/Contents.html](http://www.rirdc.gov.au/NewCrops/Contents.html)).
- Forest Products Commission of Western Australia website ([www.fpc.wa.gov.au](http://www.fpc.wa.gov.au)).



**Table 38: Sandalwood: supply, disposal and value in Australia**

	Unit	2001-02	2002-03	2003-04
<b>Production</b>				
Wood	tonnes	2 496	2 419	2 408
– Green	tonnes	1 554	1 547	1 604
– Dead	tonnes	941	872	646
– Roots	tonnes	0	0	133
– Bark	tonnes	0	0	25
Sandalwood oil	tonnes	9	11	12
Average payments to harvesters*	\$/t	3 513	3 788	3 920
Gross value	\$/000	8 767	9 163	9 441
<b>Exports</b>				
Wood				
– volume	tonnes	2 285	2 135	1 722
– value	\$/000	14 428	14 615	11 184
– unit value	\$/t	6 313	6 845	6 494
Oil				
– volume	tonnes	4	5	12
– value	\$/000	1 185	1 257	2 078
– unit value	\$/kg	320	269	177
Total export value	\$/000	15 613	15 872	13 261

\*Payments by the Forest Products Commission to contractors for harvesting, delivery, regeneration and associated research.

Sources: Jones (2004); Forest Products Commission (2004c); ABARE.

## Tea tree

Tea tree oil is extracted from the leaves of the Australian tea tree (*Melaleuca alternifolia*) by steam distillation. Reflecting its antifungal, anti-inflammatory and antibiotic qualities, the oil is used in a range of cosmetics, pharmaceuticals, toiletries, household products and industrial products (solvents and disinfectants).

The tea tree is native to northern coastal New South Wales and is also grown commercially in Queensland. Many coastal regions of northern Australia are potential growing regions for this tree. However, there is increasing competition from tea tree oil grown in Africa (mainly Zimbabwe) and Asia (mainly China).

### Australian tea tree industry

The average farmgate price in Australia for tea tree oil was around \$17 a kilogram in 2003-

04 (Southwell 2004). This is substantially below the average of around \$50 a kilogram throughout the 1990s.

In 2001, there were around 340 growers in Australia with an average plantation size of 15–25 hectares (Australian Tea Tree Oil Association 2001). Australian tea tree oil production grew strongly throughout the 1990s, peaking at 625 tonnes in 1999–2000, but then stabilised at around 300 tonnes in the early 2000s (Southwell 2004). In 2003–04, however, tea tree oil production is estimated to have been 540 tonnes, worth around \$9.2 million (Table 39).

No specific data are available on Australian exports of tea tree oil

**Table 39: Tea tree oil production in Australia**

	Unit	1999-00	2000-01	2001-02	2002-03	2003-04
<b>Production</b>						
Volume	tonnes	625	390	300	300	540
Farmgate price	\$/kg	40	21	17	17	17
Gross value	\$/000	25 000	8 190	5 100	5 100	9 218

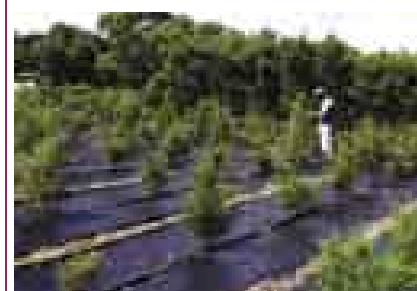
Sources: ABS (2005); Southwell (2004); Ian Southwell, New South Wales Department of Primary Industries, personal communication, March 2005; ABARE.

but the 'Other' category of exports in Table 35 is probably largely made up of tea tree oil exports. Exports in this 'Other' category made up slightly over a half of the total value of Australia's essential oil exports in 2003–04. In volume terms, they have been growing at an average of nearly 17 per cent a year since 1988–89.

The key industry representative body is the Australian Tea Tree Industry Association (ATTIA) ([www.teatree.org.au](http://www.teatree.org.au)), aimed at promoting the interests of Australian tea tree oil producers, exporters and manufacturers. ATTIA facilitates adoption of industry standards, research and development, and generic promotion.

### Further information about tea tree oil

- Australian Tea Tree Oil Association ([www.teatree.org.au](http://www.teatree.org.au)), information on the Australian tea tree oil industry and development strategy.
- The 'Tea tree oil' chapter in RIRDC's The New Crop Industries Handbook, pp. 158–64 ([www.rirdc.gov.au/NewCrops/Contents.html](http://www.rirdc.gov.au/NewCrops/Contents.html)).



RIRDC tea tree oil breeding program

# Macadamia nuts

Macadamia is a high quality nut from a tree that is native to Australia. Macadamia trees grow best in subtropical, frost-free climates. From planting a tree, it takes around ten years to reach maximum nut yields. In Australia, most plantings of macadamia trees are in northern New South Wales and south east Queensland with small areas in South Australia and Western Australia.

Based on US Department of Agriculture (2005) data, the main players in the world macadamia market are Australia, Brazil, Costa Rica, Guatemala, Kenya, South Africa and the United States (Figure FF). Australia is the dominant player, with shares of around 45 per cent of both world production and exports.

According to International Macadamias Ltd (2003), end uses for macadamia nuts have evolved from being mainly used in confectionary to being used in snack packs (45 per cent of total use in 2001), bakery products (34 per cent), confectionary (18 per cent) and ice cream (3 per cent).

The supply and disposal of Australian macadamia nuts is shown in Table 38. Australian production has grown at rate of around 9 per cent a year over the past decade and similar growth is expected over at least the next few years.

In the three years to 2003-04, Australia exported around three-quarters of its macadamia nut production. The most important export markets in terms of value are shown in Figure GG.



Macadamia nuts

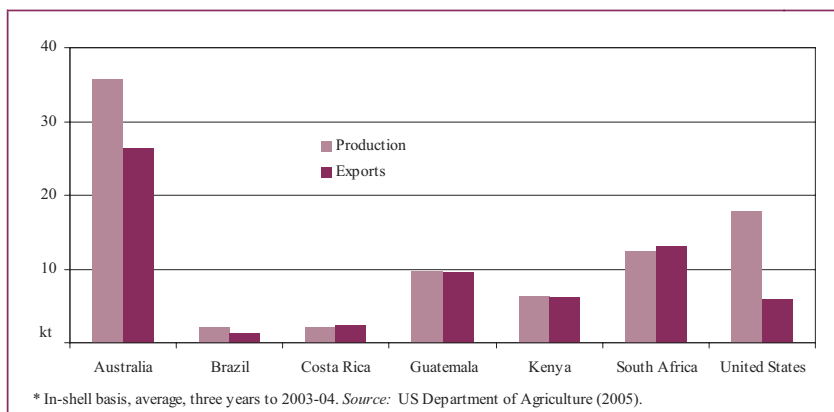


Figure FF: Production and exports of macadamia nuts, by key country\*

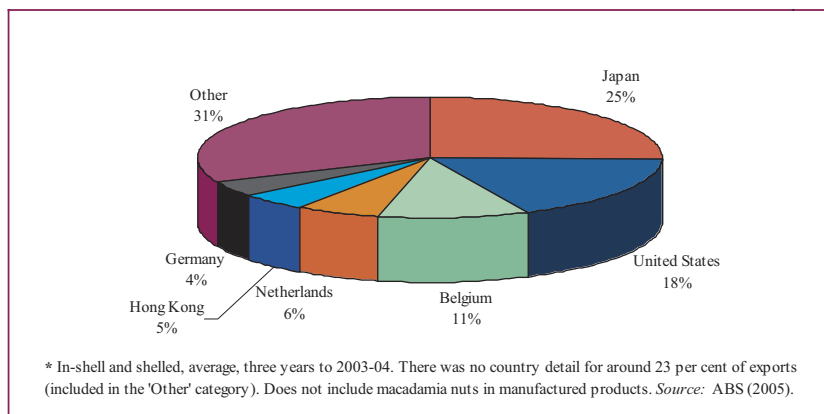


Figure GG: Shares of the value of Australia's macadamia nut exports, by country\*



Macadamia nuts grow on the tree in clusters.

### Further information about macadamia nuts

- US Department of Agriculture's PSD Online database ([www.fas.usda.gov/psd/complete\\_files/default.asp](http://www.fas.usda.gov/psd/complete_files/default.asp)) providing time series data on production, supply and distribution of macadamia nuts (in-shell basis), by key producing country.
- Australian Macadamias Society website ([www.macadamias.org](http://www.macadamias.org)) provides a range of information on the Australian and world macadamia nut markets.

**Table 40: Macadamia nuts: supply, disposal and value in Australia**

	Unit	1999-00	2000-01	2001-02	2002-03	2003-04
<b>Production*</b>						
Production	tonnes	29 500	34 800	30 200	29 700	43 900
Average return to growers	\$/kg	2.12	2.45	2.75	3.20	3.45
Gross value	\$'000	62 540	85 260	83 050	95 040	151 455
<b>Exports</b>						
In shell						
– volume	tonnes	4 427	7 360	8 326	6 415	8 335
– value	\$'000	11 575	20 288	24 687	24 305	34 924
– unit value	\$/t	2 614	2 757	2 965	3 789	4 190
Shelled						
– volume	tonnes	6 073	5 143	6 652	4 925	5 018
– value	\$'000	66 144	57 444	85 653	63 956	71 252
– unit value	\$/t	10 892	11 169	12 876	12 987	14 200
<b>Imports</b>						
In shell						
– volume	tonnes	na	na	1	60	0
– value	\$'000	na	na	5	305	0
– unit value	\$/t	na	na	9 000	5 091	–
Shelled						
– volume	tonnes	na	na	237	1	286
– value	\$'000	na	na	2 588	9	4 034
– unit value	\$/t	na	na	10 937	6 196	14 108
<b>All macadamia</b>						
Total export value	\$'000	77 719	77 732	110 340	88 261	106 176
Total import value	\$'000	na	na	2 592	314	4 034

\*Nut-in-shell price, 10 per cent MC. na Not available.

Sources: Australian Macadamia Society (2005); ABS (2001, 2004ab, 2005); ABARE.

# Olives

The olive industry produces two main products: table olives and olive oil. Based on FAO (2005) data, world production of olives in 2004 was 15.5 million tonnes, down from the record 16.9 million tonnes of the previous year. (Figure HH). The main producers were countries bordering the Mediterranean, including Spain (30 per cent of total world production in 2004), Italy (21 per cent), Greece (15 per cent) and Turkey (12 per cent). The largest producer outside the Mediterranean and Middle East regions was Argentina with a 0.6 per cent share of the world total in 2004.

Around 40 per cent of total world production of olive oil enters world trade, a proportion that has been growing steadily over the past twenty years (Figure HH). The total value of world exports of olives and olive oil was US\$4.1 billion in 2003, 23 per cent of which was attributable to olives (mostly preserved). Shares of the total value of world exports of olive oil in 2003 were Spain 44 per cent, Italy 31 per cent, Greece 9 per cent, and Turkey 5 per cent.



Young olive tree

Italy is also the largest importer of olive oil, with a share in the total value of world trade of 36 per cent in 2003. Italy seems to import lower priced oil (for example, an average US\$2.33 a kilogram in 2003) and exports higher priced oil (US\$3.13 a kilogram in 2002). The other main importers are: the United States (16 per cent), France

(8 per cent), Germany (4 per cent) and the United Kingdom (4 per cent).

The International Olive Oil Council ([www.internationaloliveoil.org](http://www.internationaloliveoil.org)), a United Nations agency that was created in 1959 under the auspices of the United Nations Conference on Trade and Development to administer the International Agreement on Olive Oil and Table Olives, lists internationally accepted classifications for olive oil. First, any oil that is classified as 'virgin olive oil' must be obtained solely from olives using only mechanical or other physical means in conditions, particularly thermal conditions, that do not alter the oil in any way (International Olive Oil Council 2002a). This classification excludes oils obtained by the use of solvents

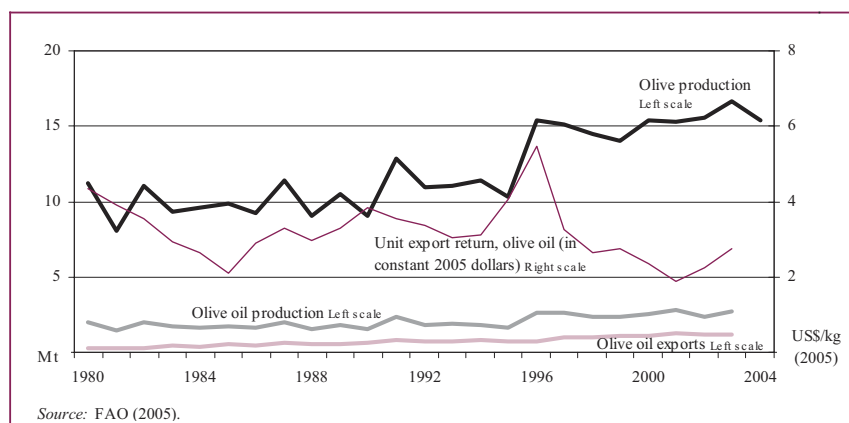


Figure HH: World olive oil production, trade and prices

or re-esterification methods. To be classified as 'extra virgin', the olive oil must also have an oleic acid content that does not exceed 0.8 per cent; 'virgin' 2 per cent; and 'ordinary virgin' 3.3 per cent.

The olive fruit has a bitter component (oleuropein) that means that it is not usually consumed directly from the tree (International Olive Oil Council 2002b). The bitter component is generally removed by soaking the fruit in sodium or potassium hydroxide, brine or by successive rinsing in water. Generally, green olives are olives harvested during the ripening cycle prior to colour change, while black olives are fully ripened ones. Green olives are processed in two principal ways: with fermentation (Spanish type) and without fermentation (Picholine or American type). Sometimes they are stoned (pitted) and stuffed with anchovies, pimento or other edible material. Olives are preserved in a range of substances including salt, brine, acetic acid and vinegar.

## Australian olive industry

Australia is heavily dependent on olive products from foreign countries, with imports worth nearly \$153 million in 2003-04 (Table 41). In volume terms, oil imports having been growing at a rate of 7.1 per cent a year since 1989-90, and olive imports at 4.6 per cent a year (Figure II).

Reflecting interest in olive production in Australia, Australian exports of olive oil have grown sharply in recent years (Figure JJ). It should be noted that the tree numbers for Australia reported in Table 41 considerably understate the actual numbers because the data are only collected from primary producers having an

**Table 41: Olive products: supply, disposal and value in Australia**

Item	Unit	1999-00	2000-01	2001-02	2002-03	2003-04
<b>Olives</b>						
Production*	tonnes	1 397	2 370	na	7 500	13 500
Gross value of production*	\$'000	3 500	5 900	na	18 750	33 750
Unit gross value of production*	\$/kg	2.50	2.50	na	2.50	2.50
<b>Table olive production</b>	tonnes	na	na	na	4000	4500
<b>Olive oil production</b>	tonnes	na	na	na	1300	2300
<b>Exports</b>						
Table olives						
– volume	tonnes	88.2	82.4	107.6	194.6	184.9
– value	\$'000	369	325	330	896	565
– unit value	\$/kg	4.18	3.94	3.06	4.61	3.06
Virgin olive oil						
– volume	tonnes	254.7	277.1	303.3	176.6	286.8
– value	\$'000	868	1 267	1 291	996	1 681
– unit value	\$/kg	3.41	4.57	4.26	5.64	5.86
Other olive oil**						
– volume	tonnes	50.9	77.8	72.5	37.5	99.2
– value	\$'000	248	398	293	242	688
– unit value	\$/kg	4.87	5.11	4.05	6.44	6.93
<b>Imports</b>						
Table olives						
– volume	tonnes	10891	11484	13192	7704	9053
– value	\$'000	27 116	30 991	41 368	20 885	23 308
– unit value	\$/kg	2.49	2.70	3.14	2.71	2.57
Virgin olive oil						
– volume	tonnes	5600	7311	8697	9952	8808
– value	\$'000	25 286	30 676	37 070	44 723	41 521
– unit value	\$/kg	4.52	4.20	4.26	4.49	4.71
Other olive oil						
– volume	tonnes	16 950	23 439	15 995	22 797	20 599
– value	\$'000	69 632	85 530	62 632	94 387	87 747
– unit value	\$/kg	4.11	3.65	3.92	4.14	4.26
<b>Total value</b>						
Exports	\$'000	1 485	1 990	1 914	2 134	2 933
Imports	\$'000	122 034	147 197	141 070	159 995	152 576

\*Year ended 31 March for 1999-2000, year ended 30 June for subsequent years. Based on establishments with an estimated value of agricultural operations of \$5000 or more. \*\* Not chemically modified.

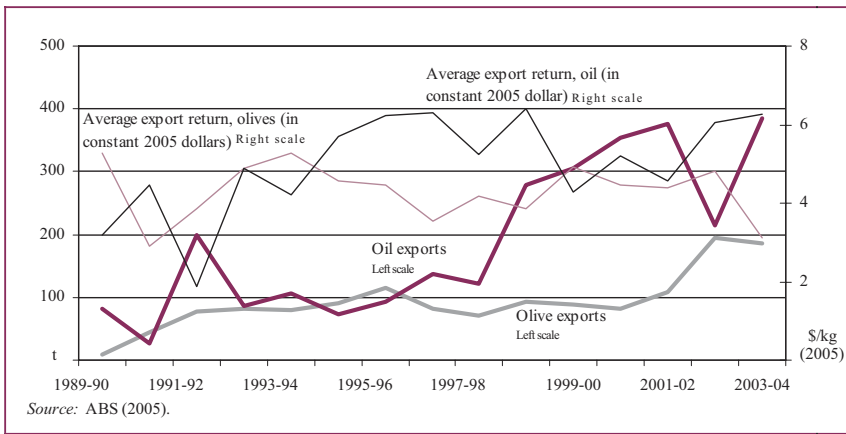
Sources: ABS (2004ab, 2005); Modern Olives (2005); Kailis and Harris (2004); ABARE.

estimated value of agricultural operations greater than \$5000 which means that many small olive producers are excluded.

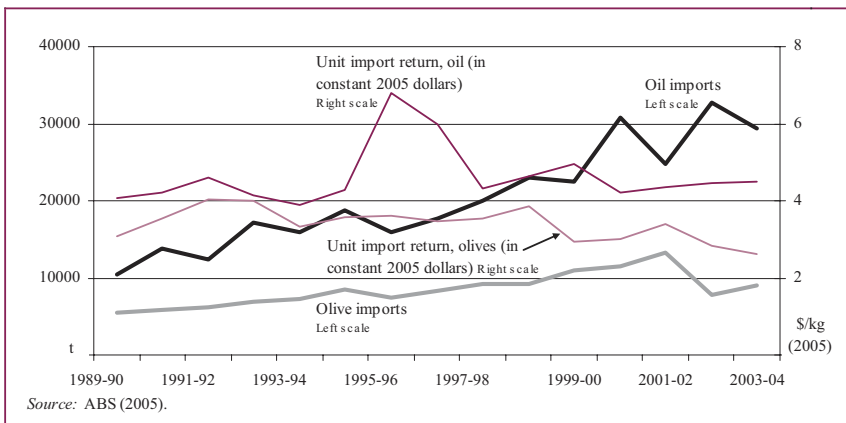
McEvoy and Gomez (1999) report estimates that the number of established olives trees in Australia in 1998 was 1.2 million, with a further 1.8 million on order. Meyers Strategy Group (2001) projected that by 2006 Australia will have the capacity to produce 6750 tonnes of oil from 3 million

producing trees, compared with the estimated 700 tonnes produced in 2001-02.

A recent industry estimate puts Australian olive oil production in 2003 at 1300 tonnes, with production projected to increase to 28 000 tonnes by 2006 (Australian Olive Association Ltd 2003). The value of this production is estimated to be \$6.2 million.



**Figure II: Australian imports of olives and olive oil**



**Figure JJ: Australian exports of olives and olive oil**

### Further information about olives

- Australian Olive Association website ([www.australianolives.com.au](http://www.australianolives.com.au)), information about the Australian industry, including a listing of more than 100 olive processors throughout Australia.
- International Olive Oil Council website ([www.internationaloliveoil.org](http://www.internationaloliveoil.org)), comprehensive information on the agronomics, science and international market for olives and olive products.
- The 'Olive Oil' chapter in RIRDC's The New Crop Industries Handbook, pp. 295–301 ([www.rirdc.gov.au/NewCrops/Contents.html](http://www.rirdc.gov.au/NewCrops/Contents.html)).



Washing olives on a continuous process system.



Australian olive oil

# Pasture seeds

Pasture crops are used extensively throughout the world, primarily to provide feed for animals but also to add nutrients to soils and as 'break crops' to control plant disease cycles in production rotations of crops and livestock.

It is difficult to determine the value of world trade in pasture seeds because in some cases pasture are aggregated in trade statistics with other seeds. For the pasture seeds for which separate details are available (see Table 42) the total value of world trade in 2003 was US\$700 million (United Nations Statistics Division (2005)). In constant US dollar terms, the value of world trade in the selected pasture seeds has declined since the mid 1990s (Figure KK). The export trade in pasture seed is dominated by countries in western Europe and North America (Table 42). Australia is an important player in the world export markets for clover, lucerne and other forage crops seeds.



Clover

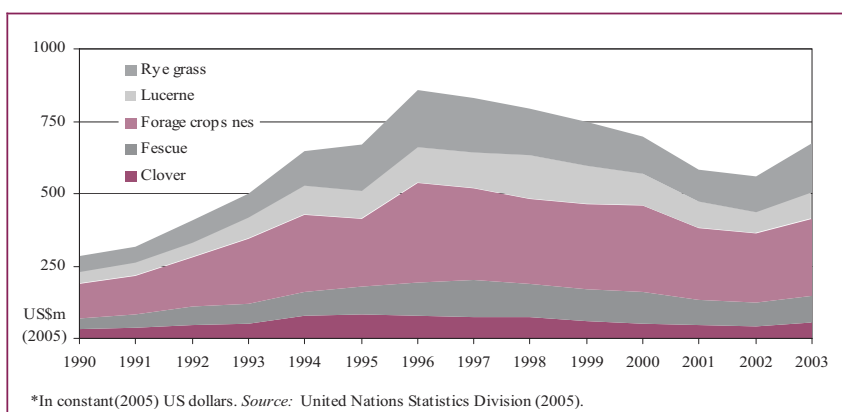


Figure KK: Value of world trade in selected pasture seeds\*

Table 42: Composition of world trade in selected pasture seeds, 2003

Seed	Volume kt	Value US\$m	Main exporters (share of total exports to 2003)	Main importers (share of total imports to 2003)
Clover	32.5	54.3	Canada (15%), Italy (13%), Australia (10%), Egypt (10%), New Zealand (8%), France (7%)	Italy (17%), United States (15%), Germany (10%), Greece (8%)
Fescue	74.3	87.0	Denmark (33%), Canada (28%), United States (13%), Netherlands (10%), Germany (7%)	United States (28%), Germany (13%), France (8%), United Kingdom (6%), China (6%)
Forage crops nes	340.2	250.8	Australia (74%), United States (9%), Germany (2%), Denmark (2%)	Republic of Korea (34%), Spain (14%), Japan (12%), Netherlands (12%), Mexico (7%)
Kentucky blue grass	18.1	42.8	United States (46%), Denmark (29%), Netherlands (12%), Germany (5%)	Canada (19%), Germany (18%), China (12%), Netherlands (11%)
Lucerne	46.0	89.0	Canada (26%), United States (25%), Australia (11%), Spain (10%), Italy (7%), France (6%)	United States (15%), China (12%), Saudi Arabia (11%), Argentina (10%), Italy (8%), Mexico (8%)
Rye grass	129.7	161.8	Netherlands (22%), Denmark (21%), United States (15%), Germany (13%)	Germany (15%), France (11%), Italy (10%), United Kingdom (8%), Netherlands (6%), Australia (5%)
Timothy grass	10.3	13.1	Canada (50%), India (21%), United States (6%), Germany (5%)	United States (55%), Netherlands (8%), Japan (7%), Germany (6%)

Source: Based on data from United Nations Statistics Division (2005).

Over the past twenty years there has been considerable consolidation of the world seed industry with a few large multinational life sciences companies controlling increasing shares of the world seed market. This process of consolidation appears to have been hastened by altered legal forms of intellectual property protection for plant innovations throughout the world, including plant variety rights and the ability to patent genetic modifications.

## Australian pasture seed industry

The pasture seeds industry in Australia is a growing one, with an increasing export orientation. Factors contributing to the growth are Australia's varied climatic and soil conditions; increased awareness by agricultural producers of the role that pasture crops can play in enhancing soils and controlling diseases; enhanced protection of intellectual property rights; Australia's relative freedom from some plant diseases; and research and development that is leading to improved varieties.

There is a production system for certified seed in Australia based on compliance with the OECD Seed Schemes. The scheme aims to promote the use of agricultural seed of consistently high quality through a system of harmonised procedures in 52 participating countries. Under an agreement with the Australian Government, Australian Seeds Authority Limited (a public non-profit company formed in 2002) performs the functions of the National Designated Authority under the OECD Seed Schemes and is the Australian representative to International Seed Testing Association (ISTA).

Certified seed production in

Australia in recent years is provided for key pasture species in Table 43. Lucerne made up nearly half of Australia's certified pasture seed production in the three years to 2002-03 with other important types being clover (15 per cent), subterranean clover (13 per cent), ryegrass (12 per cent) and phalaris (5 per cent).

Many of Australia's large commercial seed producers are subsidiaries of the large multinational life sciences companies. The Australian Seed Federation represents most of the planting seed producers in Australia.

Based on levy collections data from the Levies Revenue Service, production of planting seeds of

clover and subclover is considerably larger than production of certified seed (Table 44). Only information on production of certified seed is available for ryegrass and other pasture seeds; estimates are made of non-certified seed production for these seed types. The estimated value of Australia pasture seed in 2003-04 is \$50 million.

The value (and volume) of Australian exports of pasture seeds has grown strongly since 1989-90 (Figure LL). The main growth areas are lucerne, clover and other pasture seeds (that include phalaris, cocksfoot and kikuyu — no separate breakdowns for these are available later than 1989-90). Australian imports of pasture seeds are mainly ryegrass and small compared to exports (Table 44).

**Table 43: Certified seed production in Australia, selected pasture species\***

Common name	Species	1999-00	2000-01	2001-02	2002-03
		t	t	t	t
Cocksfoot	<i>Dactylis glomerata</i> L.	354.4	45.6	80.8	184.1
Tall fescue	<i>Festuca arundinacea</i> Schreb.	891.4	20.5	95.1	822.6
Italian ryegrass	<i>Lolium multiflorum</i> Lam.	390.2	252.7	762.6	1 333.1
Perennial ryegrass	<i>Lolium perenne</i> L.	458.7	35.3	169.7	597.9
Annual ryegrass	<i>Lolium rigidum</i> Gaudin	360.0	0.0	0.0	81.8
Hybrid ryegrass	<i>Lolium x boucheanum</i> Kunth [ <i>L x hybridum</i> Hausskn.]	0.0	118.4	0.0	351.0
Harbinger medic	<i>Medicago littoralis</i> Rhode ex Loisel.	0.5	15.6	13.2	16.5
Burr medic	<i>Medicago polymorpha</i> L.	44.7	13.6	10.0	9.5
Gama medic	<i>Medicago rugosa</i> Desr.	0.0	0.0	10.0	0.0
Lucerne	<i>Medicago sativa</i> L.	6 920.6	3 967.7	7 160.8	4 364.7
Snail medic	<i>Medicago scutellata</i> (L.) Mill.	115.6	109.8	31.6	14.4
Barrel medic	<i>Medicago truncatula</i> Gaertn.	293.3	71.7	24.3	47.8
French serradella	<i>Ornithopus sativus</i> Brot.	210.0	21.5	39.4	140.2
Kikuyu grass	<i>Pennisetum clandestinum</i> Hochst. Ex Chiov.	53.6	0.0	53.6	41.8
Phalaris	<i>Phalaris aquatica</i> L.	433.9	542.5	654.4	328.4
Field pea	<i>Pisum sativum</i> L. s.l.	81.2	164.9	19.4	25.9
Berseem clover	<i>Trifolium alexandrinum</i> L.	45.7	0.0	28.7	0.0
Balansa clover	<i>Trifolium balansae</i> Boiss.	80.6	233.3	52.6	77.3
Strawberry clover	<i>Trifolium fragiferum</i> L.	75.3	66.9	6.7	3.9
Crimson clover	<i>Trifolium incarnatum</i> L.	46.8	6.9	0.0	44.3
Red clover	<i>Trifolium pratense</i> L.	5.1	13.0	0.0	0.0
White clover	<i>Trifolium repens</i> L.	424.4	451.2	1 731.9	1 656.9
Persian clover	<i>Trifolium resupinatum</i> L.	414.4	126.4	123.6	95.4
Subterranean clover	<i>Trifolium subterraneum</i> L.	1 483.7	460.7	1 981.3	1 568.5
Arrowleaf clover	<i>Trifolium vesiculosum</i> Savi	10.2	4.1	4.1	0.0

\*Under the OECD Seed Schemes.

Source: Australian Seeds Authority Limited (2004).

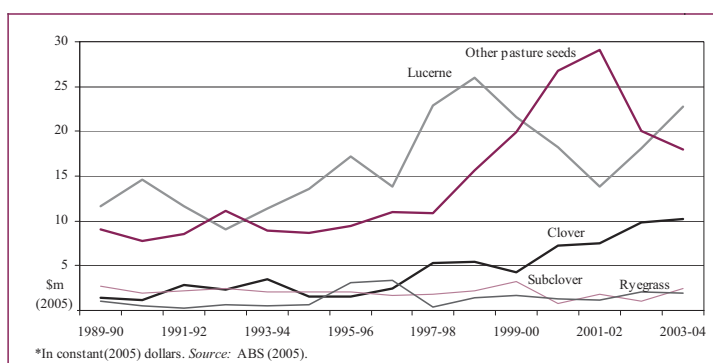


**Table 44: Pasture seeds: supply, disposal and value in Australia**

		2000-01	2001-02	2002-03	2003-04
<b>Production</b>					
<b>Clover</b>					
- volume	tonnes	3 606	978	4 877	2 630
- gross value	\$'000	9 319	2 471	12 672	6 817
<b>Lucerne</b>					
- volume	tonnes	6 325	5 111	7 236	5 396
- gross value	\$'000	20 603	15 310	16 299	14 429
<b>Subclover</b>					
- volume	tonnes	634	1 392	2 663	2 513
- gross value	\$'000	1 186	3 099	6 538	8 102
<b>Ryegrass*</b>					
- volume	tonnes	610	1 398	3 546	5 554
- gross value	\$'000	662	1 547	4 686	7 210
<b>Other pasture seeds*</b>					
- volume	tonnes	2 011	2 064	3 262	7 337
- gross value	\$'000	6 755	8 691	13 382	13 333
<b>Exports</b>					
<b>Clover</b>					
- volume	tonnes	2 137	2 326	3 048	3 329
- value	\$'000	6 497	6 912	9 317	10 154
- unit value	\$/t	3 040	2 972	3 057	3 050
<b>Lucerne</b>					
- volume	t	4 242	3 596	6 430	7 213
- value	\$'000	16 255	12 673	17 038	22 694
- unit value	\$/t	3 832	3 524	2 650	3 146
<b>Subclover</b>					
- volume	tonnes	321	624	318	661
- value	\$'000	707	1 634	920	2 506
- unit value	\$/t	2 200	2 618	2 888	3 793
<b>Ryegrass</b>					
- volume	tonnes	882	827	1 265	1 270
- value	\$'000	1 127	1 076	1 967	1 940
- unit value	\$/t	1 278	1 302	1 555	1 527
<b>Other pasture seeds</b>					
- volume	tonnes	6 356	5 702	4 214	8 898
- value	\$'000	25 114	28 252	20 337	19 022
- unit value	\$/t	3 951	4 955	4 826	2 138
<b>Imports</b>					
<b>Ryegrass</b>					
- volume	tonnes	3 498	4 073	8 990	6 769
- value	\$'000	6 241	7 279	15 972	12 865
- unit value	\$/t	1 784	1 787	1 777	1 901
<b>Clover</b>					
- volume	tonnes	256	204	331	236
- value	\$'000	989	768	1 438	844
- unit value	\$/t	3 864	3 765	4 342	3 583
<b>Other pasture seeds</b>					
- volume	tonnes	970	1 366	2 148	1 605
- value	\$'000	3 107	4 502	7 123	4 928
- unit value	\$/t	3 203	3 295	3 316	3 070
<b>All pasture seeds</b>					
Gross value of production	\$'000	38 525	31 118	53 577	49 893
Export value	\$'000	49 701	50 547	49 579	56 316
Import value	\$'000	10 337	12 550	24 533	18 636

\*Certified seed production only.

Sources: ABS (2005); Levies Revenue Service; Australian Seeds Authority (2004).



**Figure LL: Value of Australian exports of pasture seed\***

### Further information about pasture seeds

- Australian Seed Federation ([www.asf.asn.au](http://www.asf.asn.au))
- International Seed Federation (a non-governmental, non-profit organisation representing the seed industry) website ([www.worldseed.org](http://www.worldseed.org)), provides statistics on the world seed trade.
- OECD Seed Schemes ([www.oecd.org/about/0,2337,en\\_2649\\_33909\\_1\\_1\\_1\\_1\\_1,00.html](http://www.oecd.org/about/0,2337,en_2649_33909_1_1_1_1_1,00.html)), provides information on approved varieties; rules and directions for certification; and statistics on certified seed production in participating countries.



Storing seed bags

# Pulses

World production of pulses has increased sharply in recent years to reach a record 61 million tonnes in 2004 (FAO 2005). The composition of world pulse production in 2004 is shown in Figure NN. The major pulse producer in 2004 was India (with a 24 per cent share of world production), with other major producers being China (9 per cent), Canada (8 per cent), Brazil (5 per cent), Myanmar (5 per cent) and Australia (4 per cent).

India accounts for around a third of world consumption of pulses, with Brazil, China, Mexico, the



Crop of azuki beans close to maturity

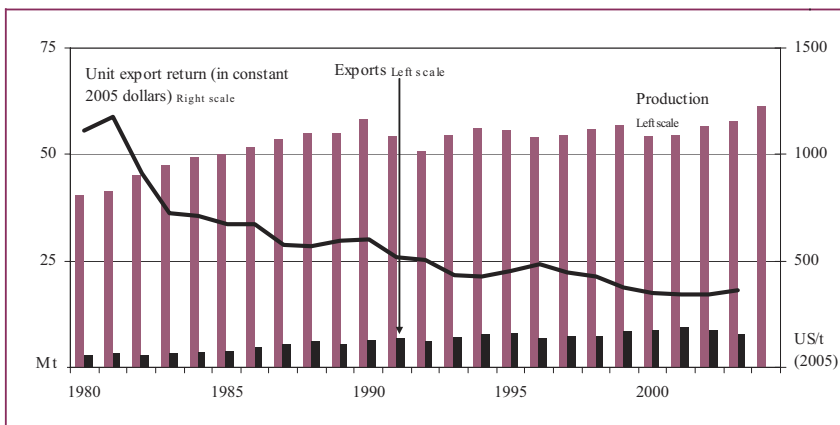


Figure MM: Trends in world pulse production exports and export returns

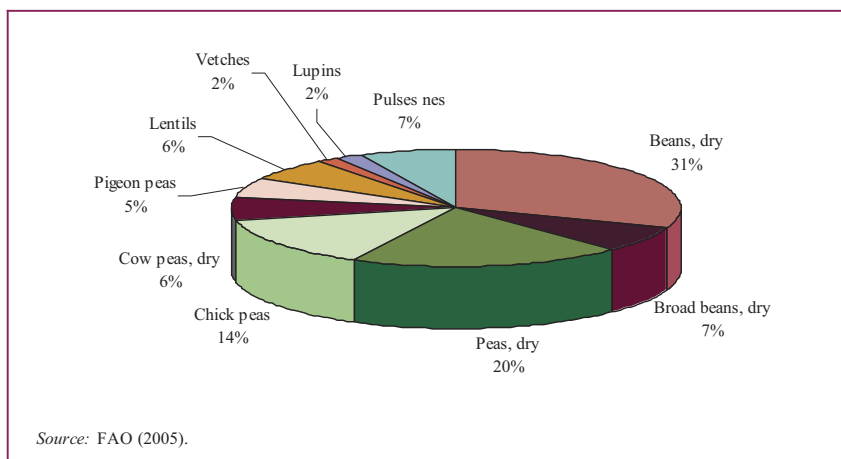


Figure NN: Composition of world pulse production, 2004

United States and Nigeria being the other major consumers.

World trade in pulses has been growing at a rate of more than 5 per cent a year, despite a downward trend in pulse prices in constant dollar terms (Figure MM). The major exporters of pulses in 2003 were Canada (20 per cent of total value of world exports), China (13 per cent), the United States (11 per cent), Turkey (7 per cent) and Australia (5 per cent). The major importers in 2003 were India (18 per cent of total value of world imports), Spain (5 per cent), United States (5 per cent), Italy (5 per cent), Pakistan (4 per cent), Egypt (4 per cent) and Bangladesh (4 per cent).

## Australian pulse industry

Pulse crops have become an important part of the Australian crop rotation. This is largely

because of their usefulness as a break crop and because they enable production diversification. The area planted to pulses in Australia grew rapidly in the 1980s and the early 1990s but has declined sharply since 1998 (Figure OO). The decline reflects a string of poor seasons but also improved relative returns for competing crops.

The main pulse crops grown in Australia are lupins, field peas, chickpeas, faba beans and mung beans (Table 43). Other pulses grown are broad beans, navy beans, azuki beans, vetch and lima beans. The gross value of the Australian pulse industry peaked at nearly \$800 million in 2001-02 but was lower in 2002-03 and 2003-04, largely reflecting poor seasonal conditions.

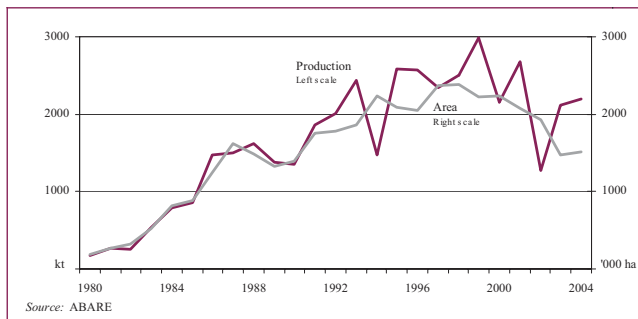


Figure OO: Trends in Australian pulse production

### Further information about pulses

- Pulse Australia ([www.pulseaus.com.au](http://www.pulseaus.com.au)), peak industry body representing all sectors of the pulse industry in Australia. Source of crop information and market statistics.

Table 45: Selected pulses: supply, disposal and value

	Unit	1999-00	2000-01	2001-02	2002-03	2003-04
<b>Azuki beans</b>						
Area	'000 ha	0.4	0.7	0.8	0.8	0.7
Production	kt	0.8	1.5	1.7	1.7	1.6
Exports	kt	0.3	1.0	1.2	1.2	1.1
Value of exports	\$m	0.2	0.9	1.7	1.8	2.2
Imports	kt	1.7	1.8	1.2	1.1	1.3
Value of imports	\$m	1.8	1.9	1.5	1.5	1.3
Gross value of production	\$m	0.5	1.1	1.9	2.0	2.6
<b>Chick peas</b>						
Area	'000 ha	218.0	261.5	195.0	201.0	151.5
Production	kt	229.9	162.4	258.0	136.0	178.0
Exports	kt	217.5	217.8	278.0	88.5	163.8
Value of exports	\$m	100.8	112.6	166.9	52.4	70.6
Imports	kt	0.0	0.1	0.1	0.1	0.1
Value of imports	\$m	0.1	0.2	0.2	0.2	0.1
Gross value of production	\$m	78.1	75.2	130.2	65.0	58.2
<b>Faba beans</b>						
Area	'000 ha	146.8	206.3	180.0	157.0	155.0
Production	kt	226.4	324.9	350.0	108.0	277.0
Exports	kt	189.2	238.3	310.0	74.6	183.2
Value of exports	\$m	74.3	101.2	107.1	32.8	66.8
Gross value of production	\$m	58.4	94.4	122.8	52.1	130.8
<b>Field peas</b>						
Area	'000 ha	320.7	397.0	337.0	380.0	301.4
Production	kt	357.3	456.0	512.0	178.0	407.3
Exports	kt	307.3	387.0	459.1	107.6	209.3
Value of exports	\$m	89.8	111.7	156.9	43.0	55.6
Imports	kt	4.1	3.1	3.0	2.3	3.1
Value of imports	\$m	5.5	5.1	5.2	4.6	5.4
Gross value of production	\$m	106.1	99.7	147.3	61.2	98.9
<b>Lentils</b>						
Area	'000 ha	75.0	117.0	158.0	165.0	131.0
Production	kt	103.0	163.0	266.0	67.0	175.0
Exports	kt	98.2	169.2	294.2	87.8	160.2
Value of exports	\$m	54.4	103.7	164.7	50.1	430.4
Imports	kt	1.4	1.4	1.7	1.8	1.4
Value of imports	\$m	1.4	1.3	1.6	1.6	1.1
Gross value of production	\$m	53.9	62.9	68.5	17.1	43.7
<b>Lupins</b>						
Area	'000 ha	1 347.0	1 180.0	1 139.0	1 024.5	637.7
Production	kt	1 968.0	1 055.0	1 215.0	725.5	953.1
Exports	kt	1 439.3	714.4	414.2	199.4	430.4
Value of exports	\$m	234.9	165.9	108.9	57.2	129.1
Gross value of production	\$m	286.1	216.6	303.8	211.5	214.9
<b>Mung beans</b>						
Area	'000 ha	48.0	87.9	43.0	44.0	44.1
Production	kt	41.3	51.9	43.0	33.6	47.3
Exports	kt	62.3	44.6	50.7	36.3	8.5
Value of exports	\$m	35.6	37.1	42.7	25.7	6.2
Imports	kt	0.2	0.2	0.3	0.4	0.4
Value of imports	\$m	0.3	0.4	0.4	0.5	0.5
Gross value of production	\$m	25.5	27.2	24.9	18.9	26.1
<b>Total pulses</b>						
Area	'000 ha	2 155.9	2 250.4	2 052.8	1 972.3	1 421.4
Production	kt	2 926.7	2 214.8	2 645.7	1 249.8	2 039.2
Exports	kt	2 314.1	1 772.3	1 807.4	595.4	1 156.5
Value of exports	\$m	807.5	908.5	1 051.1	327.6	914.6
Imports	kt	7.5	6.6	6.2	5.7	6.2
Value of imports	\$m	9.1	9.0	8.9	8.3	8.4
Gross value of production	\$m	608.5	577.2	799.4	427.7	575.0

Sources: ABS (2005); ABARE.

## Azuki (Azuki) beans

Azuki beans (*Phaseolus* or *Vigna Angularis*) is a small russet coloured bean with a sweet nutty flavour. In Japan, it is mostly processed into a sweet bean paste called *an*, made up of equal parts of azuki bean, sugar and water. *An* is used in cakes, buns, icecream, drinks and confectionery.

World trade in azuki beans was valued at US\$55.3 in 2003 (United Nations Statistics Division 2005). The main exporters were China (54 per cent share of total value in 2003), Nicaragua (25 per cent) and the United States (10 per cent). The main importers are Japan (31 per cent of total value in 2003), Republic of Korea (19 per cent), El Salvador (16 per cent) and the United States (5 per cent).

A tariff rate quota system operates in Japan to protect domestic azuki (and other bean) production. The quota is 120 000 tonnes a year for four classes of dry legumes: azuki beans, kidney beans, broad beans and peas (for more details, see Severinghaus 2003). A tariff applies to *an* imports but there are no quotas. This has meant that the largest Japanese *an* processors have started joint ventures in China where azuki beans are grown and processed for export to Japan (Severinghaus 2003).

Patent protection applies to some



Good-quality azuki bean seed

preferred Japanese varieties of azuki; Severinghaus (2003) says this means these varieties are restricted from import in Japan.

## Australian azuki industry

In Australia, azuki beans are grown in central and southern Queensland, northern New South Wales and the southern irrigation areas of New South Wales. Annual area planted is estimated to be around 700 hectares, with average production of 1700 tonnes a year. The value of the industry in 2003-04 is estimated to be \$2 million.

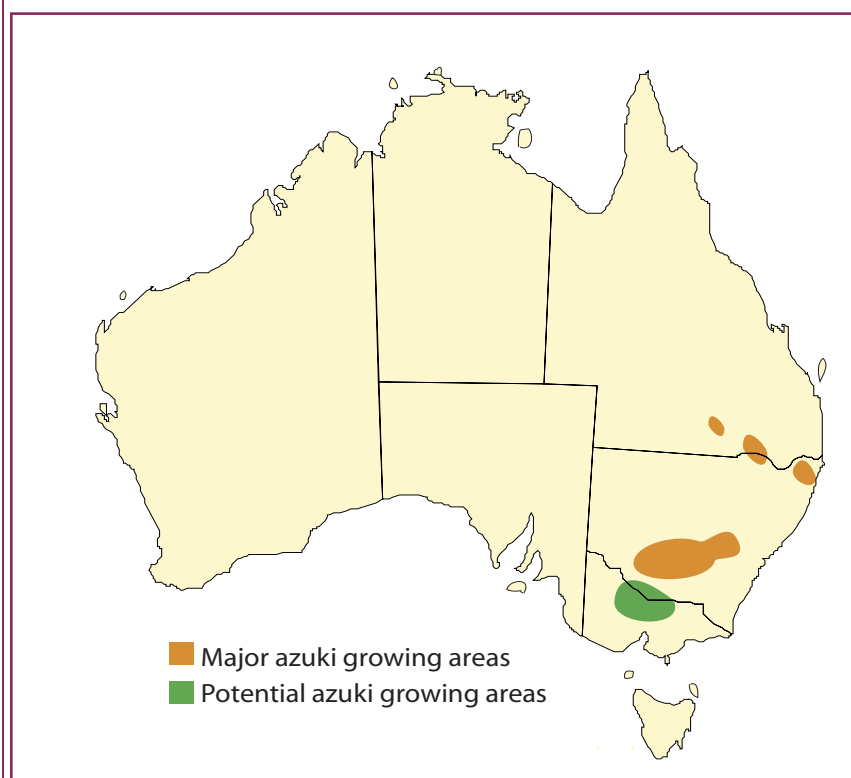
About 75 per cent of production is exported (Table 43). The main export destinations for Australian azuki beans are Japan (49 per cent share of total volume of exports in the three years to 2003-04), Chinese Taipei (24 per cent), Thailand (21 per cent) and the United States (3 per cent). Australia also imports small quantities of azuki beans but the volume is declining as Australian production increases (Table 43).



Flowers and developing azuki bean pods

## Further information about azuki beans

- The New Crop Industries Handbook (Australia) ([www.rirdc.gov.au/NewCrops/Contents.html](http://www.rirdc.gov.au/NewCrops/Contents.html)). Information on azuki (and kintoki) beans in Australia.
- Tokyo Grain Exchange ([www.tge.or.jp](http://www.tge.or.jp)), futures price information for azuki (azuki) beans.



# Pyrethrum

Pyrethrum is an oil that is extracted from the flower head of the pyrethrum daisy (*Tanacetum cinerariaefolium*), a member of the chrysanthemum family. Pyrethrum both repels and kills insects. It has the advantages of low chronic toxicity to humans (Extension Toxicology Network 1994); quick breakdown in the environment; and the development of insect resistance to it is uncommon. There are also synthetic forms of this natural insecticide, usually referred to as pyrethroids. Natural pyrethrum is one of the few insecticides that is permitted for use in organic farming systems.

Based on FAO (2005) data and Australian production estimates, world production of dried pyrethrum flowers in 2003 was 20 500 tonnes, of which Kenya and Australia each supplied 40 per cent. Other key producers are Tanzania and Rwanda. World prices for pyrethrum in constant (2005) dollar terms declined sharply in the period 1995–1998 under the weight of sharply increased export availabilities but had recovered to around the long run average of US\$75 a kilogram by 2003 (Figure PP).

World exports of pyrethrum (pyrethrum, roots containing rotenone, extracts) averaged around US\$24 million in the three years to 2003 (United Nations Statistics Division 2005). Kenya accounted for 46 per cent of this total value, Australia 28 per cent, the United States 8 per cent (largely re-exports) and Tanzania 7 per cent.



A field of pyrethrum in flower in northern Tasmania

The United States was the largest importer of pyrethrum, with a share of 65 per cent of the total value of world imports in the three years to 2003. Other major importers were Germany, Italy, Canada and the Netherlands.

## Australian pyrethrum industry

Pyrethrum production in Australia has grown strongly since 1990. This expansion has been made possible by a number of technological improvements, particularly with planting and harvesting (Botanical Resources

Australia 2001). The Australian pyrethrum industry is located in Tasmania, though there have been attempts at growing the crop in other states since the 1930s.

A single company — Botanical Resources Australia Pty Ltd (BRA) — processes and markets virtually all of Tasmania's pyrethrum. In 2003-04, BRA contracted around 170 farmers to plant 2500 hectares, producing 5000 tonnes of dried pyrethrum flowers. The gross value of this production at the farm gate was \$5.6 million (Table 46). BRA claims to have a 30 per cent share of the world pyrethrum market

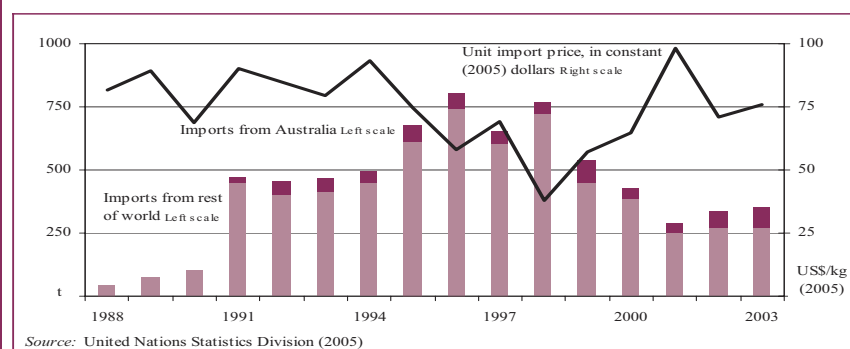


Figure PP: World trade in pyrethrum

and aims to increase this share to 40 per cent by 2006 (Botanical Resources Australia 2001).

Australia exports around 80 tonnes of pyrethrum a year, mostly to the United States (87 per cent of total export volume in the three years to 2003), Italy (9 per cent), the Netherlands (2 per cent) and Japan (1 per cent). Export returns in constant (2005) dollars terms increased have strongly from the mid-1990s (Figure QQ).

### Further information about pyrethrum

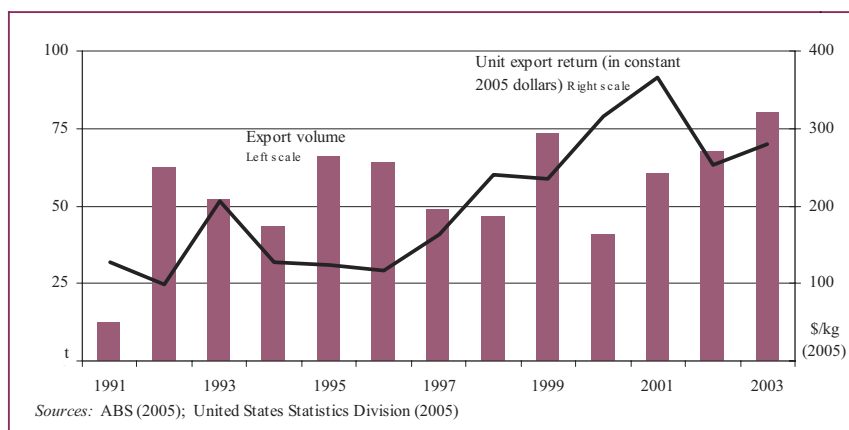
- Botanical Resources Australia Pty Ltd website ([www.botanicalra.com.au](http://www.botanicalra.com.au)), a range of information on the nature of the Australian pyrethrum industry.

**Table 46: Pyrethrum: supply, disposal and value in Australia**

	Unit	2000	2001	2002	2003	2004
<b>Production</b>						
Volume*	tonnes	na	na	6 400	8 000	5 000
Gross value**	\$'000	na	na	7 000	10 000	5 580
Unit gross value**	\$/t	na	na	1094	1 250	1 116
<b>Exports#</b>						
Volume##	tonnes	40.7	60.5	68.0	80.6	65.8
Value	\$'000	11 091	19 971	14 825	20 093	14 532
Unit value	\$/kg	272.35	330.07	218.02	249.32	220.86
<b>Imports</b>						
Volume	tonnes	4.6	4.7	3.8	4.0	6.9
Value	\$'000	925	900	707	706	1 114
Unit value	\$/kg	203.22	192.30	184.88	176.43	161.49

\* Dried flowers. \*\*At the farm gate. #Confidentiality restrictions were put in place by the Australian Bureau of Statistics in September 2002. Export data for 2002, 2003 and 2004 were estimated based on statistical information from importing countries. ##Saps and extracts of pyrethrum. na Not available.

Sources: ABS (2005); United Nations Statistical Division (2005); ABARE.



**Figure QQ: Australian exports of pyrethrum**

# Sesame seed

Sesame (*Sesamum indicum* L.) is an ancient oil crop supplying seeds for confectionery purposes, edible oil, paste (tahini), cake and flour (Bennet 2004). It is adapted to both tropical and temperate conditions.

Based on FAO (2005) data, world production of sesame seed was over 3 million tonnes in 2004 (Figure RR).

The main producers are China (24 per cent of world production in the three years to 2004), India (23 per cent), Myanmar (13 per cent) and Sudan (9 per cent). It is a high value crop, trading at US\$677 a tonne on the world market in 2003.

Like most agricultural commodities, there is a strong downward trend in this price in constant dollars, reflecting the impact of ongoing productivity improvements (Figure RR).

Around a quarter of total world production of sesame seed enters world trade as seed. The main sesame seed exporters are India (23 per cent of total volume of world sesame seed exports in the



Desiccation is a prerequisite to successful harvesting of sesame.

three years to 2003), Sudan (23 per cent), China (15 per cent) and Pakistan (5 per cent). The main importers are Japan (20 per cent), Republic of Korea (10 per cent), Turkey (8 per cent) and China (8 per cent).

## Australian sesame industry

Sesame is grown in Australia in the Northern Territory, Queensland and New South Wales. Australian production reached 620 tonnes in 2000-01 but fell to almost nothing in 2003-04.

The decline reflects drought in eastern Australia and marketing

problems in the Northern Territory. Bennett (2004) anticipates that improvements in cultivars will increase sesame production in Australia.

Australia exports very small quantities of sesame seed and is a substantial importer (Table 47). The total value of Australian imports of the main sesame seed products (seed, oil and tahini) was \$16.4 million in 2003-04, 65 per cent of which was in the form of seed and 27 per cent as oil.

With sesame seed, Australia's main supplying countries were China (40 per cent of the total volume of imports over the three years to 2003-04), India (31 per cent) and Mexico (21 per cent).

The main suppliers of sesame oil were Singapore (30 per cent), China (30 per cent) and Hong Kong (16 per cent), while Lebanon supplied over 65 per cent of the total volume of tahini imports.

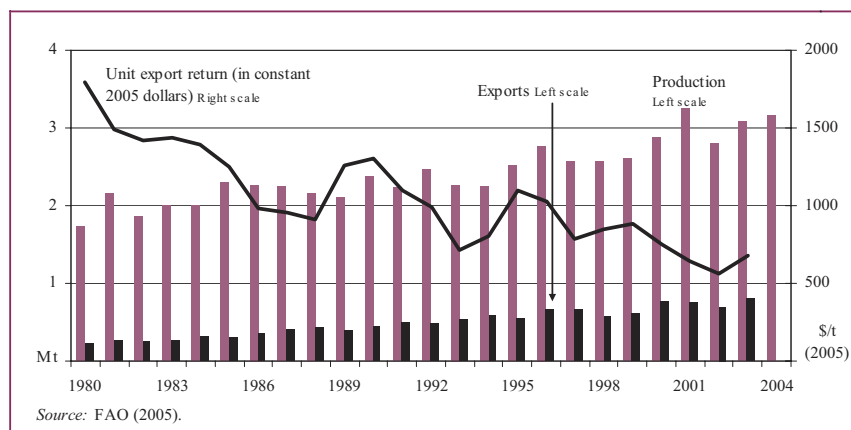


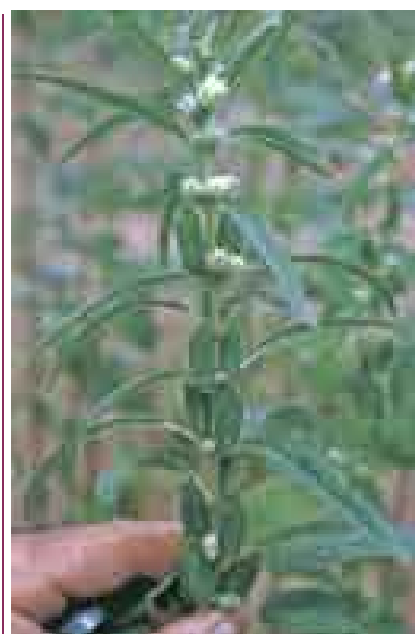
Figure RR: World production and trade of sesame seed

**Table 47: Sesame seed products: supply, disposal and value in Australia**

	Unit	1999-00	2000-01	2001-02	2002-03	2003-04
<b>Production</b>						
Area	ha	553	1790	435	280	36
Yield	t/ha	0.53	0.35	0.40	0.40	0.56
Production	tonnes	292	620	173	111	20
Gross value	\$'000	466	1061	260	147	15
<b>Exports*</b>						
Sesame seed						
– Volume	tonnes	2.4	120.2	21.1	23.4	33.1
– Value	\$'000	16	228	38	56	125
– Unit value	\$/t	6 408	1 897	1 784	2 382	3 782
Sesame oil						
– Volume	tonnes	10.3	11.1	17.6	11.0	6.7
– Value	\$'000	120	54	92	62	42
– Unit value	\$/t	11 590	4 878	5 236	5 647	6 310
<b>Total export value</b>	<b>\$'000</b>	<b>135</b>	<b>282</b>	<b>130</b>	<b>118</b>	<b>167</b>
<b>Imports</b>						
Sesame seed						
– Volume	tonnes	5 600	5 739	6 589	6 105	7 362
– Value	\$'000	9 935	10 908	10 989	9 010	11 297
– Unit value	\$/t	1 774	1 901	1 668	1 476	1 534
Sesame oil						
– Volume	tonnes	1 777	3 235	1 004	1 110	1 359
– Value	\$'000	4 156	4 247	4 514	4 259	3 815
– Unit value	\$/t	2 339	1 313	4 496	3 837	2 807
Tahini						
– Volume	tonnes	406	374	383	422	609
– Value	\$'000	1 125	1 179	1 048	1 005	1 335
– Unit value	\$/t	2 771	3 151	2 738	2 384	2 190
<b>Total import value</b>	<b>\$'000</b>	<b>15 216</b>	<b>16 334</b>	<b>16 552</b>	<b>14 274</b>	<b>16 447</b>

\*Includes re-exports.

Sources: ABS (2005); Bennett (2004); Northern Territory Department of Business, Industry and Resource Development (2002); ABARE.



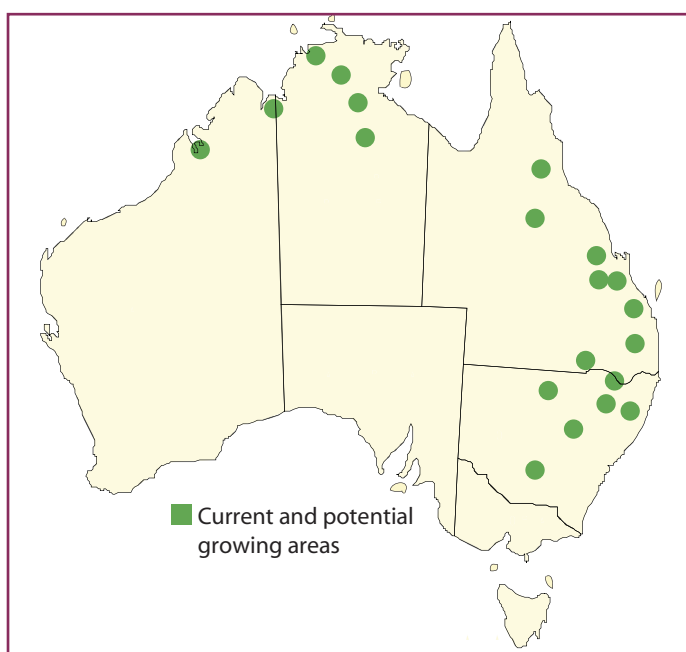
Plant breeding is developing higher yielding cultivars for sesame growing regions of Australia

### Further information about sesame

- The 'Sesame' chapter in RIRDC's The New Crop Industries Handbook, pp. 214–20. ([www.rirdc.gov.au/NewCrops/Contents.html](http://www.rirdc.gov.au/NewCrops/Contents.html)).



Commercial sesame cultivars grown in Australia include Edith, Yori 77, Aussie Gold and Beech's Choice





# Selected culinary spices

There are many different types of spices that are used in cooking. Spices are usually the fruit, seeds, stems, roots, bark or flowers of plants, as distinct from herbs which are usually the leaves of plants. Only a selected range of traditional spices are dealt with here (see Table 46). There are many other common plant products that could be considered in their dried form as spices, such as garlic, poppy seed, mustard seed, celery, liquorice and papaya seeds.

The many different regional cuisines in the world are each characterised by their own distinctive blends of spices. Factors such as migration and increased

incomes are leading to the spread of regional cuisines — for example, Chinese, Indian, Japanese, Thai and Spanish — beyond their traditional borders. Combined with population growth, this is leading to increased demand for virtually all types of culinary spices.

Reflecting this increased demand, the value of world trade in constant US dollars terms of the selected spices has been growing at an average annual rate of 9.7 per cent since 1988. In 2003, around 1.5 million tonnes of these spices were traded worldwide, with a total value of US\$3.1 billion. The structure of the spice trade is summarised in Table 48. The most



Fenugreek plants

important of the spices in terms of value in world trade are vanilla, pepper and spices of the capsicum and pimento genera.

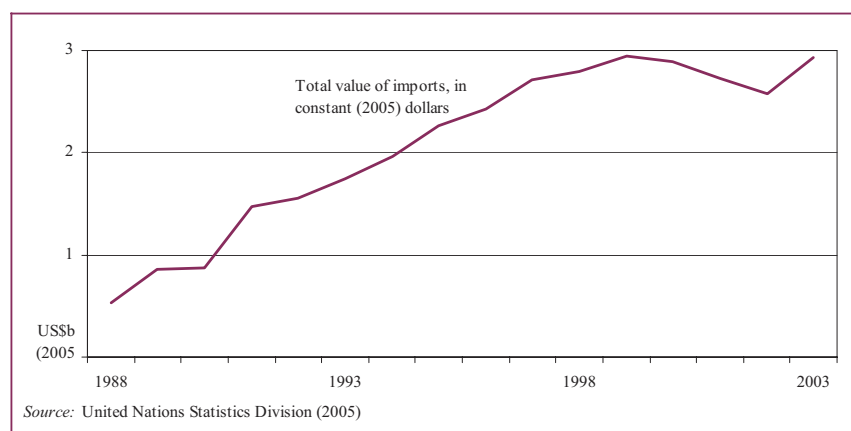


Figure SS: Value of world trade in selected spices

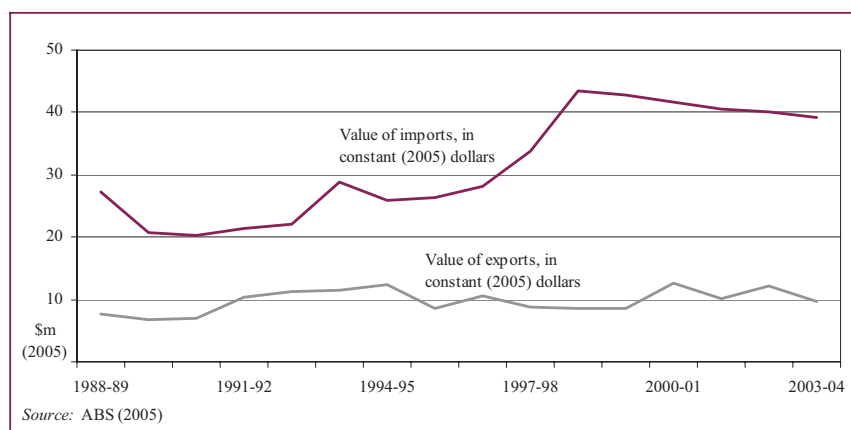


Figure TT: The value of Australian imports and exports of selected spices

## Australian spice industry

Australian exports of the selected spices have fluctuated around \$10 million in constant (2005) dollar terms over past fifteen years. The value of imports grew strongly throughout the 1990s but has levelled off at around \$40 million in recent years (Figure TT).

Coriander seed accounted for 16 per cent of the total value of Australian spice exports in the three years to 2004, while mixed spices and unidentified spices accounted for a further 17 per cent and 31 per cent, respectively (Table 49). It seems that a

large component of Australian export trade in spices other than coriander is based on imports of spices in bulk that are packaged and then re-exported.

On the import side, pepper was the most important spice, accounting for 23 per cent of the total value of imports in the three years to 2004. Other important components of the value of imports were vanilla (14 per cent), capsicum or pimenta spice types (13 per cent), curry (11 per cent) and paprika (6 per cent).



Fenugreek seeds

### Further information about spices

- The 'Herbs and spices' section in RIRDC's The New Crop Industries Handbook, pp. 222–68. ([www.rirdc.gov.au/NewCrops/Contents.html](http://www.rirdc.gov.au/NewCrops/Contents.html)). Contains information on capers, coriander and fenugreek, culinary herbs, ginseng, medicinal herbs and paprika.
- Australian Herb and Spice Industry Association website ([www.ahsia.org.au](http://www.ahsia.org.au)).

**Table 48: Summary of the structure of the world spice trade, 2003**

Spice	Value		Main exporters (share of total exports in 2003)	Main importers (share of total imports in 2003)
	kt	US\$m		
Anise/ badian seed	13.7	27	China (26%), Syria (20%), Turkey (20%), Vietnam (15%)	India (19%), United States (15%), Mexico (6%)
Capsicum/ pimenta	352.9	586	China (25%), India (19%), United States (8%), Mexico (8%), Spain (7%)	United States (24%), Mexico (11%), Malaysia (9%), Sri Lanka (8%), Spain (6%), Thailand (5%)
Caraway seed	13.9	15	Egypt (21%), Canada (15%), Afghanistan (10%), Iran (10%), Netherlands (8%)	United States (23%), Germany (17%), India (11%), Algeria (6%)
Cardamom	28.7	126	Guatemala (64%), Nepal (17%), India (5%)	Saudi Arabia (34%), India (16%), Singapore (9%), Nepal (7%), Pakistan (7%)
Cinnamon	98.3	131	India (36%), China (20%), United States (17%), Sri Lanka (12%)	Mexico (24%), United States (21%), India (10%)
Cloves	49.3	106	Madagascar (42%), Indonesia (29%), Tanzania (9%), Sri Lanka (4%)	Singapore (36%), India (32%)
Coriander seed	70.7	52	Bulgaria (26%), India (24%), Iran (7%), Canada (6%), Morocco (6%)	Sri Lanka (17%), Malaysia (11%), Indonesia (8%), Pakistan (7%), United Kingdom (6%)
Cumin seed	82.5	99	Syria (35%), Turkey (17%), Iran (10%), Afghanistan (18%)	United States (12%), Bangladesh (12%), Pakistan (9%), Singapore (8%), Saudi Arabia (6%), Mexico (4%)
Curry	20.9	48	India (27%), Pakistan (15%), Malaysia (10%), Thailand (8%), Cyprus (8%)	United Kingdom (21%), Saudi Arabia (14%), Singapore (9%), Germany (7%)
Fennel/ juniper berry	20.4	29	Egypt (30%), India (17%), China (9%), Turkey (9%), Bulgaria (6%)	Germany (20%), United States (14%), Malaysia (9%), Sri Lanka (7%)
Ginger	313.8	196	China (58%), Thailand (17%), Nepal (9%)	Japan (35%), India (11%), Pakistan (14%), United States (9%)
Mace	2.7	22	Indonesia (55%), Singapore (9%), Grenada (9%)	Netherlands (26%), Germany (20%), India (14%)
Nutmeg	14.8	94	Indonesia (43%), Grenada (17%), Indonesia (8%), Sri Lanka (7%)	Netherlands (15%), United States (13%), Germany (11%), Belgium (5%), France (5%), Brazil (5%)
Pepper	281.1	636	United States (23%), Mexico (12%), Germany (8%), Netherlands (6%), India (5%), France (4%)	Viet Nam (22%), Indonesia (18%), Brazil (14%), United States (12%), India (8%), Malaysia (7%)
Saffron	1.8	84	United Kingdom (35%), United States (30%), Spain (12%), Iran (5%)	Spain (37%), Mexico (36%), United Kingdom (4%), France (4%)
Turmeric	45.1	45	India (59%), United Arab Emirates (12%), Myanmar (10%)	Iran (15%), Japan (9%), Sri Lanka (9%), Malaysia (6%)
Vanilla	4.6	664	Madagascar (33%), Germany (16%), Iran (11%), United States (7%)	United States (33%), Netherlands (15%), France (10%)
Spices, n.e.s.	76.3	183	India (17%), United States (16%), Turkey (10%), Germany (9%), Pakistan (5%)	United States (18%), Mexico (14%), Belgium (6%), Netherlands (5%)

**Table 49: Australian exports and imports of spices**

Spice	Volume			Value			Unit value		
	2001-02 tonnes	2002-03 tonnes	2003-04 tonnes	2001-02 \$/000	2002-03 \$/000	2003-04 \$/000	2001-02 \$/kg	2002-03 \$/kg	2003-04 \$/kg
<b>Exports</b>									
Anise, badian seeds	2	4	3	24	24	26	11.72	6.21	7.69
Capsicum, pimenta	98	31	56	299	189	318	3.05	6.02	5.64
Caraway seed	1	0	1	3	3	11	2.23	11.73	11.72
Cardamom	1	2	2	48	65	65	32.93	32.59	33.15
Cinnamon	3	6	18	43	126	143	13.25	22.91	8.03
Cloves	0	2	4	20	49	41	57.44	20.94	10.24
Coriander seed	952	813	1 383	1 263	1 299	2 222	1.33	1.60	1.61
Cumin seed	8	25	12	59	127	114	7.64	5.10	9.54
Curry	730	296	60	1 000	600	319	1.37	2.03	5.31
Fennel seed, juniper berry	65	108	23	79	78	20	1.21	0.72	0.90
Ginger	104	263	164	486	826	704	4.68	3.14	4.28
Mace	0	0	0	1	3	1	30.94	38.61	13.59
Mixed spices	561	250	803	1 426	1 465	2 169	2.54	5.86	2.70
Nutmeg	1	5	18	14	85	188	18.42	15.77	10.30
Pepper	97	79	150	597	724	978	6.18	9.19	6.53
Saffron	0	0	0	18	24	44	253.65	100.25	116.16
Turmeric	6	6	12	49	38	42	8.60	6.25	3.59
Vanilla	51	8	11	372	148	668	7.31	19.31	58.90
Spices nes	1 617	842	410	3 409	5 557	1 180	2.11	6.60	2.88
Total exports	4 296	2 740	3 132	9 208	11 430	9 255	2.14	4.17	2.95
<b>Imports</b>									
Anise, badian seed	99	70	75	612	295	226	6.20	4.23	3.01
Capsicum, pimenta	1 130	1 020	1 132	5 937	4 845	4 519	5.25	4.75	3.99
Caraway seed	37	66	62	99	183	125	2.65	2.77	2.03
Cardamom	42	83	84	692	1 172	604	16.30	14.17	7.22
Cinnamon	272	365	588	769	1 083	1 133	2.83	2.97	1.93
Cloves	84	117	92	742	602	281	8.79	5.13	3.04
Coriander seed	157	373	194	255	526	287	1.62	1.41	1.48
Cumin seed	355	410	392	1 782	1 230	883	5.01	3.00	2.25
Curry	688	1 076	975	3 903	5 181	3 327	5.67	4.82	3.41
Fennel seed; juniper berry	64	78	85	198	179	180	3.08	2.30	2.12
Ginger	548	955	734	1 151	1 449	1 451	2.10	1.52	1.98
Mace	7	3	9	70	41	82	10.38	13.77	9.01
Mixed spices	199	190	218	974	855	967	4.91	4.49	4.43
Nutmeg	164	150	216	1 344	1 183	1 321	8.20	7.87	6.11
Paprika	888	819	814	3 149	2 407	2 122	3.55	2.94	2.61
Pepper	2 367	2 095	2 645	9 098	8 307	8 221	3.84	3.96	3.11
Saffron	1	10	9	294	456	412	371.86	44.04	45.63
Turmeric	305	343	342	498	636	579	1.63	1.85	1.70
Vanilla	17	24	32	3 045	3 888	8 197	181.72	160.04	257.52
Spices nes	832	1 137	1 000	3 148	3 831	3 374	3.78	3.37	3.38
Total imports	8 259	9 385	9 697	37 761	38 348	38 291	4.57	4.09	3.95

Source: ABS (2005).

## Coriander seed

The coriander plant (*Coriandrum sativum*) is believed to be of Mediterranean origin but is now widely cultivated throughout the world both for its leaves and seeds. The seed is crushed to provide oil or a powder that is used in curry powder and other spice mixes (Jongebloed 2004).

World trade in coriander seed has grown strongly in recent years with prices steady in recent years at around US\$600 in constant (2005) dollars (Figure UU). The main participants in world trade in coriander seed are summarised in Table 48.

### Australian coriander seed industry

Annual Australian production of coriander seed reached around 5000 tonnes in the early 1990s but has declined to little over 1500 tonnes in 2003-04. This is despite export returns being higher in constant dollar terms in recent years than in the 1990s. Contributing to the loss of interest in growing coriander for seed have been disease problems that have caused large fluctuations in yields (Hooper and Dennis 2002). Western Australia typically accounts for around 60 per cent of Australian coriander production with the other major producing states being South Australia, New South Wales and Victoria. Australia also imports small quantities of coriander seed (Table 50).

Australian exports of coriander seed reached nearly 4000 tonnes in the early 1990s but have declined to less than 1400 tonnes in 2003-04 (Figure VV). The main export markets for Australian coriander seed are China (24 per cent of the total volume in the three years to 2004), Thailand (16 per cent), Vietnam (11 per cent), Hong Kong (10 per cent), India (10 per cent) and Reunion (7 per cent).

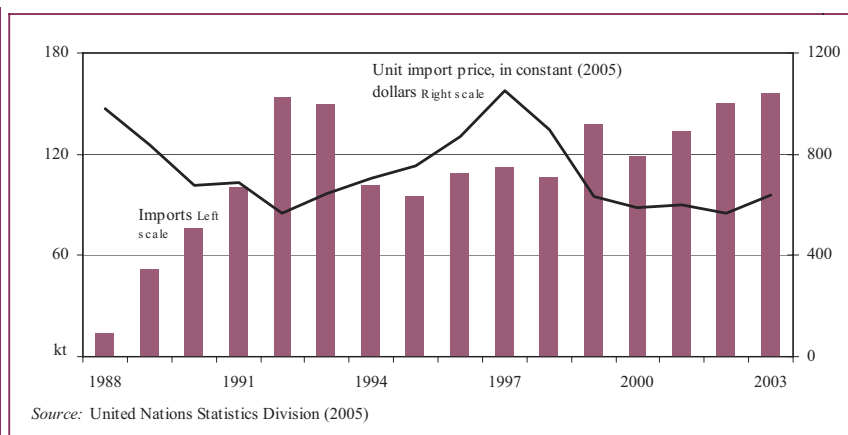


Figure UU: World trade in coriander seed

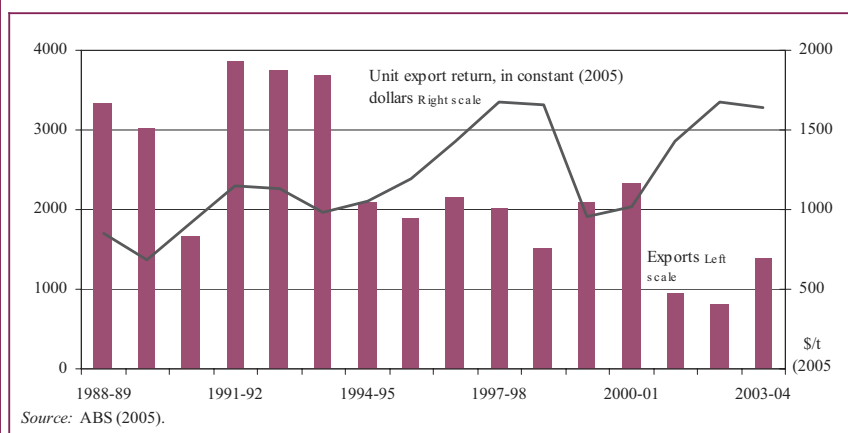


Figure VV: Australian exports of coriander

Table 50: Coriander seed: supply, disposal and value in Australia

	Unit	2000-01	2001-02	2002-03	2003-04
<b>Production</b>					
Volume	tonnes				1 520
Gross value	\$'000				2 219
<b>Exports</b>					
Volume	tonnes	2 328	952	813	1 383
Value	\$'000	2 139	1 263	1 299	2 222
Unit value	\$/t	919	1 326	1 599	1 606
<b>Imports</b>					
Volume	tonnes	114	157	373	194
Value	\$'000	185	255	526	287
Unit value	\$/t	1 632	1 622	1 410	1 481

Sources: ABS (2005); ABARE.

### Further information about coriander seed

- The 'Coriander and fenugreek' chapter in RIRDC's The New Crop Industries Handbook, pp. 229-35. ([www.rirdc.gov.au/NewCrops/Contents.html](http://www.rirdc.gov.au/NewCrops/Contents.html)).

# Exotic tropical and subtropical fruits

The northern regions of Australia are agronomically suited to growing a wide range of exotic tropical and subtropical fruits, many of which originated in Asia and are, therefore, familiar to Asian consumers. More details of the nature of these exotic fruits are available online at [www.australiantropicalfoods.com](http://www.australiantropicalfoods.com).

In this chapter, information on six tropical and subtropical fruits is reported: durian, longan, lychee, papaya, mangosteen and rambutan. Prices received in the Sydney market for these (and other) exotic tropical fruits are shown in Table 51.



Selection of tropical fruits

**Table 51: Average prices of selected exotic tropical fruit, Sydney market**

Fruit type and variety	Unit	2001	2002	2003	2004
		\$/kg	\$/kg	\$/kg	\$/kg
Carambola	SL tray	23.27	17.88	22.00	21.14
Durian	kg	na	na	10.39	12.50
Custard apple	SL tray	12.69	23.29	14.69	22.70
Guava	kg	4.30	3.66	3.86	4.12
Jakfruit	kg	3.10	3.18	3.26	2.93
Lime	9L carton	31.43	16.56	16.31	23.00
Longan	kg	6.61	9.26	7.45	6.59
Lychee					
– B3	9L carton	na	25.64	19.76	23.52
– Bengal	9L carton	na	14.76	17.02	18.78
– Fei Zi Su	9L carton	52.23	48.91	44.17	43.50
– Gee Kee	9L carton	na	24.23	na	na
– Kom	9L carton	na	27.50	na	na
– Kwai May Pink	9L carton	29.94	25.99	28.40	23.52
– No Mai Chee	9L carton	na	41.00	na	na
– Selathiel	9L carton	na	40.69	na	43.60
– Souey Tung	9L carton	39.66	46.14	68.00	na
– Star King	9L carton	na	40.00	34.00	na
– Tai So	9L carton	30.36	33.58	32.40	24.69
– Wai-Chee	9L carton	na	26.13	24.07	21.18
Mangosteen	850g	6.84	12.87	11.44	13.78
Papaya (paw paw)	18L carton	11.35	12.01	13.59	18.86
Pitaya	SL tray	45.61	31.27	33.54	25.21
Pomelo	kg	2.19	2.76	2.58	2.81
Rambutan	850g	7.10	10.75	8.27	8.87
Soursop	kg	5.09	3.50	6.42	4.34

Source: Sydney Market Reporting Service. na Not available.

Thailand is a large producer of these tropical fruits and the main world exporter of many of them (Figure WW). Australia signed a free trade agreement with Thailand in 2004 in which mangosteen, durian, lychee and longan are explicitly specified as market access priority products (See DFAT 2004).

Australia's strict quarantine barriers aimed at preventing the introduction of exotic diseases and pests have worked against imports of some tropical fruits, particularly fresh fruits. While Australia has been importing papaya fruit for a number of years, access has only been possible for fresh durian fruit from Thailand since 1999, for mangosteens from Thailand since July 2004, and for lychee and longan fruit from Thailand and China since April 2004. Rambutan imports have yet to be allowed from any country and no applications have yet been received.

(The ICON database maintained by the Australia Quarantine and Inspection Service provides details on the conditions under which more than 18 000 plant, animal, mineral and human production can be imported into Australia — see [www.aqis.gov.au/icon32/asp/ex\\_querycontent.asp](http://www.aqis.gov.au/icon32/asp/ex_querycontent.asp)).

### Further information about exotic tropical and subtropical fruits

- The 'Fruits and berries' section in RIRDC's The New Crop Industries Handbook, pp. 165–97. ([www.rirdc.gov.au/NewCrops/Contents.html](http://www.rirdc.gov.au/NewCrops/Contents.html)), includes sections on durian, lychee, longan, rambutan and minor tropical fruits (mainly pitaya, pomelo, jakfruit, hog plum and carambola).
- Malaysia Tropical Fruit Information System ([www.myfruits.org](http://www.myfruits.org)). Excellent information about the Malaysian tropical fruit industry, including prices and trade statistics for durian, guava, jackfruit, papaya, rambutan and starfruit.

## Durian

Durian (*Durio zibethinus L.*) is a tree-borne tropical fruit with a complex flavour that some find offensive. Durian is believed to have originated in Borneo and is now extensively cultivated in south east Asia, particularly Malaysia, Thailand, Indonesia and Cambodia.

Durian fruit is mostly eaten fresh but can be frozen, dried or canned.

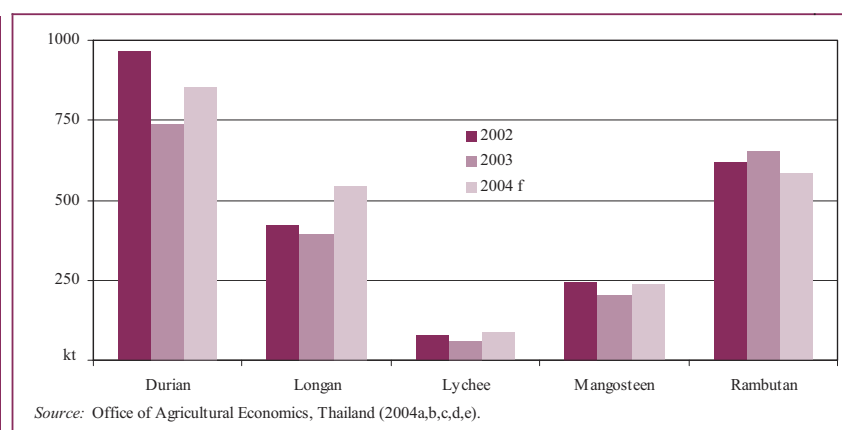


Figure WW: Thai production of selected tropical fruits



Mature durian fruit

Durian fruit has a very short shelf-life. Harvesting before ripe can mean a shelf life of 2–3 weeks with refrigeration but can be as little as 2–3 days if the fruit is damaged.

World trade in fresh durian was 281 000 tonnes in 2003 worth US\$110 million (United Nations Statistical Division 2005). The major importers were Hong Kong, China (64 per cent of total exports in 2003), China (24 per cent) and Singapore (10 per cent).

Thailand, China and Malaysia accounted for all of the recorded fresh exports in 2003 (61 per cent, 29 per cent and 10 per cent, respectively). The bulk of the Thai durian crop is harvested in April to August, with peak production in May.

### Australian durian industry

Commercial growing of durian fruit has only recently commenced in the Northern Territory and north Queensland. Harvest times are November–February in the Northern Territory and January–April in north Queensland. There are 'on' and 'off' years for yields.

According to Diczbalis (2004a), there are 36 durian growers in Australia with around 13000 trees. Current annual Australia production of durian fruit is 20–50 tonnes; production in 2004 was 31 tonnes, with a gross value of \$388 000. Around 70 per cent of durian production occurs in north Queensland, with the Northern Territory accounting for the remainder. Up to a half of total Australian production is sold in the Cairns and Darwin 'tourist markets' (Alan Zappala, Rambutan and Exotic Tropical Growers Association, personal communication, 19 April 2005).

There are small quantities of Australian exports of durian; most Australian production is consumed on the domestic market (Table 52). There are larger quantities of imports, all provided by Thailand. Market access for fresh durian was conceded to this country in 1999 after an import risk assessment. Domestic prices (Sydney market) for durian fruit are shown in Table 51 (data for only two years are available).

**Table 52: Durian fruit: supply, disposal and value in Australia**

	Unit	2000	2001	2002	2003	2004
<b>Production</b>						
Volume	tonnes	na	na	na	35	31
Gross value	\$'000	na	na	na	364	388
<b>Exports*</b>						
Volume	tonnes	na	na	2.2	0.0	3.9
Value	\$'000	na	na	7	0	12
Unit value	\$/kg	na	na	3.36	-	2.98
<b>Imports*</b>						
Volume	tonnes	na	na	41.5	0.0	157.2
Value	\$'000	na	na	89	0	252
Unit value	\$/kg	na	na	2.14	-	1.61

\*Fresh or frozen. na Not available.

Sources: ABS (2005); Diczbalis (2004a); ABARE.

## Longan

Longan (*Dimocarpus longan* or *Euphoria longan*) is a fruit closely related to the lychee. It is suited to production in monsoonal regions and is mainly grown in China, Thailand, Vietnam and Chinese Taipei. Longans are mainly consumed fresh but are also dried and canned.

Thailand is the main exporter of longans. In 2001, total Thai production of longans was 186 800 tonnes of which 138 709 tonnes (valued at US\$91 million) was exported, mainly to China and the United States (Anupunt and Sukhvibul 2005). By 2004, Thai longan production had grown to 544 000 tonnes, suggesting an export availability of around 340 000 tonnes (Office of Agricultural Economics, Thailand 2004b).

Harvesting of longans in Thailand is usually from late June to August but there are techniques, such as soil drenching with potassium chlorate, which can be used to produce off-season fruit.

### Australian longan industry

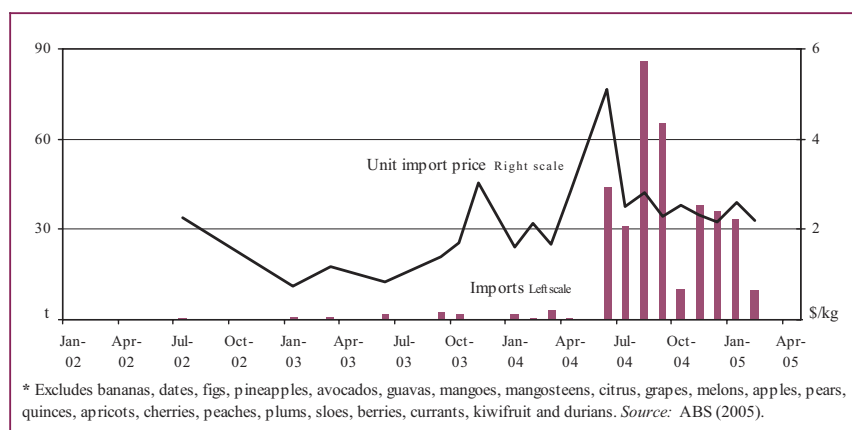
In Australia, longans are grown in the subtropical regions of the eastern coast of Australia as far south as northern New South Wales. The picking season extends from January to April. In 2003, there were an estimated 45 000 longan trees in Australia, with annual production of 300–500 tonnes (Diczbalis 2004b). Production in 2004 was an estimated 600 tonnes (Tibby Dixon, Australian Lychee Growers Association, personal communication, 5 April 2005), with an estimated gross value of \$2.6 million.

Small quantities of longans have been exported from Australia but the harvest is largely disposed on the domestic market.

After an import risk assessment of potential disease risks by Biosecurity Australia, longans (and lychees) from Thailand and China have been allowed access to the Australian domestic market since April 2004. No information is available on imports of longans specifically from ABS (2005) but there is an 'other fresh fruit category' that indicates that imports from Thailand have increased sharply from April 2004; before that imports were almost non-existent (Figure XX). Most of this increase is probably longans. The increased supply appears to have put substantial downward pressure on Australian domestic longan prices in 2004 (Table 51).



Longan crop on the tree



**Figure XX: 'Other fresh fruit' category imports from Thailand**

## Lychee

Lychee (*Litchi chinensis* Sonn.), or lychee nut or litchi, is a tree-borne fruit with sweet, fragrant and juicy fruit and a translucent flesh. The lychee tree is native to southern China, northern Vietnam and Myanmar. It is difficult to grow, requiring frost-free conditions, and does not produce a substantial crop until 6–8 years after planting

(Menzel 2002). The fruits are very susceptible to browning and rotting so they have a relatively short shelf life as fresh fruit. Lychees are also canned whole or made into a range of jellies, jams, preserves and lychee tea.

Lychees are now grown in many subtropical regions of the world. World lychee production is dominated by China with a total output of 1.5 million tonnes in an 'on' year and 0.6 million tonnes in an 'off' year, most of which is consumed domestically (Queensland Department of Primary Industries 2003). Other key producers are India (0.5 million tonnes), Vietnam (0.1 million tonnes), Chinese Taipei, Philippines, Madagascar, Australia and South Africa. Total world trade was around 100 000 tonnes in 1999 (Menzel 2002). Key exporters are China, Madagascar, South Africa and Thailand.

### Australian lychee industry

Lychees have been grown commercially in Australia since the 1970s. The harvest period in Australia is November to February.

There are many different varieties of lychees grown in Australia, with differing agronomic and quality characteristics. Australian domestic prices (Sydney market) for a range of lychee varieties are shown in Table 51.

Annual Australian lychee production was an estimated 6000 tonnes in 2001-02, produced by around 300 growers (Australian Lychee Growers Association 2003). Around 90 per cent of lychee production occurs in Queensland. It is projected that Australian lychee production will reach 12 000 tonnes by 2006-07, valued at \$60 million (Australian Lychee Growers Association 2003).



Lychee cv Fay Zee Siu, ready to harvest

However, Australian production of lychees was only an estimated 2500 tonnes in 2003-04 (Tibby Dixon, Australian Lychee Growers Association, personal communication, 5 April 2005), with a gross value of \$13 million. Production is forecast to be 3500 tonnes in 2004-05 (ibid).

Until recently approximately 20-35 per cent of the Australian crop has been exported, mainly to China (via Hong Kong), Singapore and Europe (QDPI 2003). However, exports have probably been substantially lower than this in recent years due to market access problems with China (via Hong Kong).

The peak lychee industry body is the Australian Lychee Growers Association (ALGA).

### Further information about lychees

- Unlocking Lychee R&D ([www.dpi.qld.gov.au/News/371.html#lychee](http://www.dpi.qld.gov.au/News/371.html#lychee)), newsletter from Queensland Department of Primary Industries reporting on lychee issues.

## Mangosteen

Mangosteen (*Garcinia mangostana* L.) is a tree-borne tropical fruit with a thick reddish-purple rind with a flesh that is segmented like that of an orange. The fruit is usually eaten fresh, but can also be canned, frozen or made into juice, preserves and syrup. The tree is believed to have originated from the Malaysia archipelago.

In 2003, the major mangosteen producing countries were Thailand (204 000 tonnes), Malaysia (15 000 tonnes), the Philippines, Indonesia and the Indian subcontinent.

### Australia mangosteen industry

In Australia, around 10 000-12 000 trees (about 50 hectares) have been planted in the Northern Territory and far north Queensland. The tree takes around nine years to fruit and up to twelve years to provide commercial fruit, but once they are established, they are low maintenance trees. The harvest period in Australia is January to March.

Estimated Australian production of mangosteens in 2004 was 65-70 tonnes, with a farmgate value of around \$0.6 million (Alan Zappala, Rambutan and Exotic Tropical Growers Association, personal communication, 19 April 2005). Small quantities of mangosteen fruit were exported from Australia in the early 2000s but the crop now appears to be entirely sold on the domestic market.

Domestic prices (Sydney market) for mangosteen are shown in Table 51.



Mangosteen



**Table 53: Mangosteen: supply, disposal and value in Australia**

	Unit	2000	2001	2002	2003	2004
<b>Production</b>						
Volume	tonnes					67
Gross value	\$'000					600
<b>Exports, fresh mangosteen and guava</b>						
Volume	tonnes	50.4	45.5	0	–	0
Value	\$'000	588	670	0	–	0
Unit value	\$/kg	na	na	0	–	0

na Not available.

Sources: ABS (2005); Horticulture Australia Limited (2003); ABARE.

## Papaya

Papaya (*Carica papaya L.*), sometimes called paw paw, is a slightly pear-shaped fruit with yellow or golden skin and red, pink or yellow flesh. The papaya is believed to have originated in Central America but is now extensively cultivated throughout the tropical and subtropical regions of the world. The papaya plant lives for around five years but is often replanted more often than this in commercial plantations (Chay-Prove 2003). Papaya is consumed mainly as a fresh fruit but is also canned (usually as pulp), made into jams, or dried and crystallised.

World production and exports of papaya have grown strongly since the early 1990s despite a generally downward trend in prices in constant dollar terms (Figure YY). World production of papayas in 2004 was an estimated 6.5 million tonnes, produced mainly by Brazil

(25 per cent of total production), Mexico (15 per cent), Nigeria (12 per cent), India (11 per cent) and Indonesia (10 per cent).

The main exporters of papayas are Mexico (38 per cent of world exports in the three years to 2003), Malaysia (28 per cent) and Brazil (14 per cent).

### Australian papaya industry

Australia's papayas are grown mainly in the tropical regions

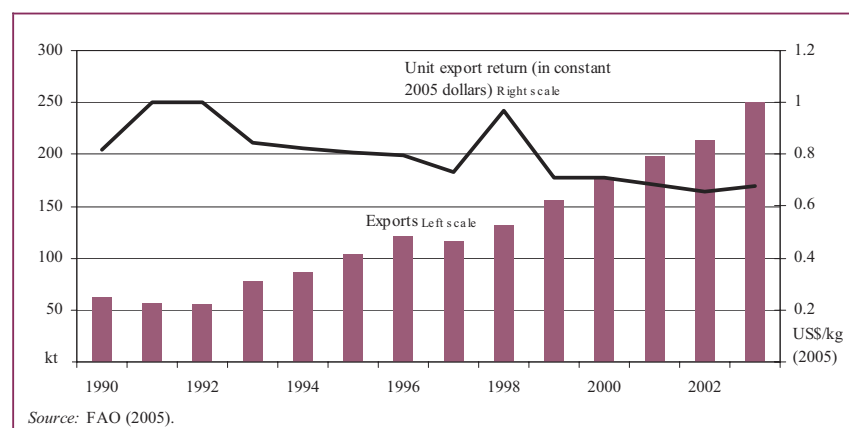
of northern Queensland. Small amounts are also grown in the Northern Territory, southern Queensland, the Kimberly and Carnarvon regions of Western Australia, and northern New South Wales (Primary Business Solutions 2002). Fruit are harvested all year round in Australia but there are production peaks in autumn and spring.

In 2004 Australia produced 9952 tonnes of papaya, with a gross value of \$15.2 million (Table 54). Very small quantities of papaya are imported and even smaller quantities exported; most papaya fruit is consumed in the Australian market as fresh fruit. Prices for fresh papaya in the Sydney market in recent years are shown in Table 51.

**Table 54: Papaya: supply, disposal and value in Australia**

	Unit	2001	2002	2003	2004
<b>Production</b>					
Volume	tonnes	9 622	11 314	8 976	9 952
Area	ha	537	457	623	650
Yield	t/ha	17.9	24.7	14.4	15.3
Gross value	\$'000	7 300	12 500	9 900	15 233
<b>Exports, fresh</b>					
Volume	tonnes	8.4	0.7	0.0	1.4
Value	\$'000	15	1	0	5
Unit value	\$/kg	1.79	2.02	0.00	3.50
<b>Imports, fresh and dried</b>					
Volume	tonnes	22.4	6.9	5.5	18.6
Value	\$'000	26	7	5	37
Unit value	\$/kg	1.18	1.05	0.91	1.97

Source: ABS (2004ab, 2005); ABARE

**Figure YY: World papaya exports and unit returns**

Papaya

## Rambutan

Rambutan (*Nephelium lappaceum*) is a red or yellow tropical fruit that is round to oval in shape, with hairlike protrusions. The rambutan is highly perishable, which makes it difficult to handle and has a very short shelf life. Fruiting may occur twice in one year.

The main producers and exporters are Thailand, Malaysia and Indonesia, with Honduras emerging as a significant exporter in recent years. In 2003, Thailand produced 651 000 tonnes of rambutan (Office of Agricultural Economics, Thailand 2005), Malaysia 49 900 tonnes (Malaysian Tropical Fruit Information System 2005), and Indonesia 310 000 tonnes.

Canned rambutan is an important component of the world rambutan trade. Singapore is the largest importer of rambutan products, with growing demand from other Asian countries, the United States and Europe.

### Australian rambutan industry

The harvest period in Australia is from November to January, with small quantities around June from a secondary fruiting. Around 85 per cent of Australian production takes place in northern Queensland, with the remainder in the Northern Territory. Fruit yields can vary widely from year.

According to Diczbalis (2004c), rambutan production in Australia is currently in the range 500–1000 tonnes a year, from 150 hectares of plantings. Production in 2004–05 was an estimated 600 tonnes (Alan Zappala, Rambutan and Tropical Exotic Growers Association, personal communication, 19 April 2005), with an estimated farmgate value of \$4 million (Table 55).



Rambutan fruit

Industry projections are for annual production to increase to 1700 tonnes a year by 2007, reflecting new plantings and maturing of existing trees.

Australian rambutan growers gained access to the Japanese market in 2000 where the rambutan is considered a luxury item. Most Australian rambutan exports go to this market. In 2002, approximately 90 tonnes of rambutans were exported from Queensland to this market. In recent years, however, Australian exports of

rambutan have fallen because of lower Australian production, the strength of the Australian dollar compared with the Japanese yen, and the prolonged cold winter in Japan (Alan Zappala, Rambutan and Tropical Exotic Growers Association, personal communication, 19 April 2005). No imports of fresh rambutan are allowed into Australia but there may be some canned rambutan imports.

Domestic prices (Sydney market) for rambutan are shown in Table 51.

**Table 55: Rambutan: supply, disposal and value in Australia**

	Unit	2000-01	2001-02	2002-03	2003-04
<b>Production</b>	tonnes	na	na	680	724
Queensland	tonnes	na	na	600	634
Northern Territory	tonnes	67	81	80	90
<b>Gross value of production</b>	\$'000	na	na	4 319	4 885
Queensland	\$'000	na	na	3 600	4 080
Northern Territory	\$'000	499	719	719	805
<b>Exports</b>					
Volume	tonnes	12	90	62	58
Value	\$'000	na	na	720	722
Unit value	\$/kg	na	na	11.62	12.46

na Not available.

Sources: ABS (2005); Diczbalis (2004c); Alan Zappala, Rambutan and Tropical Exotic Growers Association, personal communication, 8 April 2005; ABARE.

# Wildflowers and native plants

World trade in cut flowers (fresh and dried) and foliage was worth around US\$5.5 billion in 2003. The export market is dominated by the Netherlands, with a share of 53 per cent of the total value in 2003. Colombia and Ecuador account for a further 11 per cent and 5 per cent, respectively. The main importers in 2003 were Germany (17 per cent share of total value), United Kingdom (17 per cent), United States (15 per cent), Netherlands (12 per cent), France (9 per cent) and Japan (4 per cent).

The beauty and novelty of many of Australia's native plants and foliage make them a valued component of floral arrangements in many parts of the world. A wide range of Australian native plants are now being grown commercially in countries other than Australia, particularly Israel, Colombia, Kenya, South Africa and Zimbabwe. The most popular plants grown in these countries are waxflower, kangaroo paw, banksia and eucalypt (for foliage).

## Australian wildflower industry

The Australian wildflower and native plant industry was initially based on the harvesting from the wild but most production is now from artificial propagation on commercial farms. Each of the states and territories of Australia have in place arrangements to ensure the wild harvesting of Australian native flora is undertaken in sustainable ways. For example, Western Australia and New South Wales have management plans agreed with the Australian Government

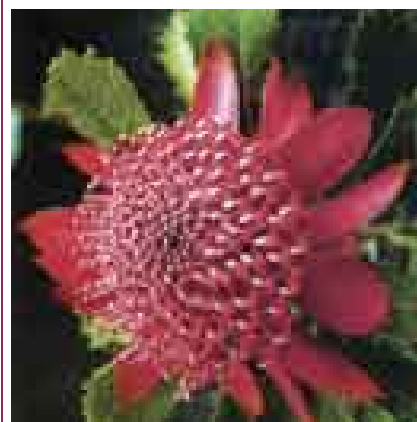
Department of the Environment and Heritage under state and Commonwealth legislation (see CALM 2003; NSW National Parks and Wildlife Service 2002). The arrangements include licensing systems; quotas for specific areas and species; and monitoring of harvested and traded quantities.

There are few statistics on the volume and value of production of flowers and foliage in Australia. Karingal Associates (1997) estimated the total value of the fresh cut flower and foliage domestic market to be \$142 million wholesale and \$285 million retail. Of this total, wildflowers were estimated to make up only 10–15 per cent.

Based on the assumption that around 85 per cent of Australian production of wild flowers, native plants and foliage is exported (Sally Sutton, Flower Export Council of Australia, personal communication, 25 August 2005), the estimated gross value of the Australian wildflower industry in 2003–04 is approximately \$22.5 million. Lower wildflower production in 2002–03 and 2003–04 is partly explained by adverse seasonal conditions.

The value in constant dollar terms of Australia's exports of cut flowers, foliage and live plants (here called 'flower' exports) grew at an average rate of around 7 per cent a year in the period from 1987–88 to its peak of \$46 million in 2001–02.

Exports of wild picked flowers and artificially propagated native flowers and plants made up around 46 per cent of the total value of Australia's flower exports in the three years to



*Telopea speciosissima* (red waratah)

2003–04. Foliage, which includes an unknown amount from native plants, made up a further 17 per cent of the total. It should be noted, however, that Brookes (2001) and Sutton (2002) both concluded that the export statistics used here from the Australian Bureau of Statistics could considerably understate the value of exports to at least some countries. This is because prices received are not known with any certainty until the flowers are sold at auction in the destination country.

Australia imported cut flowers, mosses and foliage worth an average \$34 million a year in the three years to 2003–04. These imports were mostly sourced from the Netherlands (61 per cent of the total value), Singapore (9 per cent) and South Africa (4 per cent).

A list of Australian wildflower and native plants (by species and common name) in order of their importance as an export is shown in Table 56. Some plants from the proteaceae family that are native to Southern Africa, such as proteas, are widely grown in Australia and are usually included in the wildflowers category.

**Table 56: Australian wildflower species**

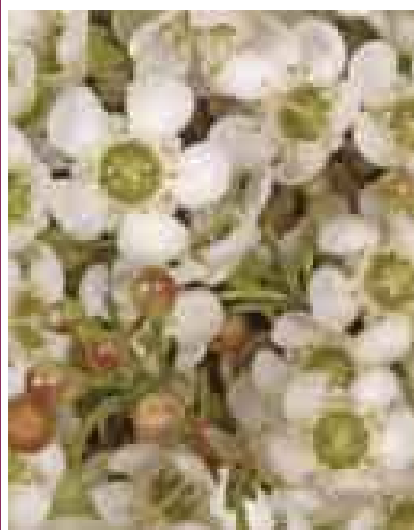
1	<i>Chamelaucium spp.</i> Waxflower	16	<i>Verticordia spp.</i> Feather Flower
2	<i>Anigozanthos spp.</i> Kangaroo Paw	17	DRYANDRA spp. Dryandra
3	<i>Thryptomene spp.</i> Thryptomene	18	<i>Blandfordia spp.</i> Christmas Bells
4	<i>Stirlingia spp.</i> Stirlingia	19	<i>Conospermum spp.</i> Smokebush
5	<i>Protea spp.</i> Protea	20	<i>Cryptandra spp.</i> Cotton Bush
6	<i>Banksia spp.</i> Banksia	21	<i>Ixodia spp.</i> Ixodia
7	<i>Leucadendrum spp.</i> Leucadendron	22	<i>Geleznovia spp.</i> Yellow Bells
8	<i>Caustis spp.</i> Koala Fern Foliage	23	<i>Hypocalymma spp.</i> Myrtle
9	<i>Scholtzia spp.</i> Scholtzia	24	<i>Crowea spp.</i> Crowea
10	<i>Eucalyptus spp.</i> Eucalyptus foliage	25	Grevillea spp. Grevillea
11	<i>Boronia spp.</i> Boronia	26	<i>Podocarpus spp.</i> Emu Bush
12	<i>Leucospermum spp.</i> Leucospermum	27	<i>Agonis spp.</i> Tea Tree
13	<i>Ozothamnus spp.</i> Riceflower	28	<i>Persoonia spp.</i> Persoonia
14	<i>Eriostemon spp.</i> Eriostemon	29	<i>Adenanthos spp.</i> Adenanthos
15	<i>Telopea spp.</i> Waratah	30	<i>Beaufortia spp.</i> Bottlebrush

Source: Australian Flower Export Council (2003).

Waxflower is Australia's most important wildflower export, accounting for over 30 per cent of the value of Australian wildflower, foliage and native plant exports in 2003-04 (Table 57). Australia produces more than 45 different varieties of waxflower. The season for waxflower is generally from June to January. Kangaroo paws are mainly produced in Western Australia and are available from July to January. Foliage is used as a feature and a filler in many floral arrangements. An important component of the foliage market in Australia is eucalypt foliage, including bark, flowers and aromatic leaves.

The value of exports (in constant dollars terms) of wax flower and foliage has grown strongly over the

last ten years (Figure ZZ). At the same time, the value of exports of kangaroo paws and other native species have shown little trend and wild picked flowers (fresh and dried) have declined substantially.



Waxflower Crystal Pearl

The most important export markets for Australian wildflowers, foliage and native plants are Japan (33 per cent of the total value of exports in the three years to 2003-04), the United States (18 per cent), the Netherlands (24 per cent), Germany (7 per cent) and Canada (5 per cent). Western Australia accounted for 34 per cent of the total value of exports in this period, Queensland 24 per cent, New South Wales 22 per cent, and Victoria 20 per cent.

### Further information about wildflowers and native plants

- Australian Flower Export Council ([www.feca.com.au](http://www.feca.com.au)), information about the Australian flower industry.
- Flower Auction Japan ([www.faj.co.jp/english/news/update/update.htm](http://www.faj.co.jp/english/news/update/update.htm)), weekly flower prices and volumes (including Australia natives) in the Ohta Market (located in the southern part of Tokyo).
- Melbourne Market Authority ([www.melbournemarkets.com.au](http://www.melbournemarkets.com.au)), weekly flower prices.
- Wildflowers Australia Network ([www.wildflowersaust.net](http://www.wildflowersaust.net)), information on industry standards, propagation techniques, and species of wildflowers.

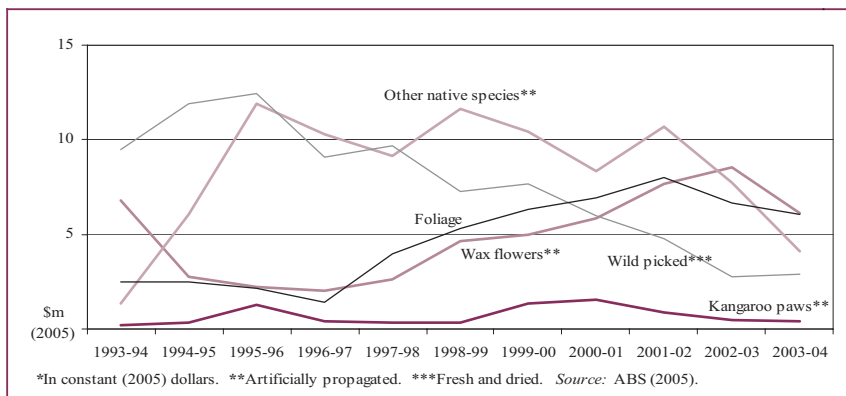


Figure ZZ: Value of exports of wildflowers and native plants, by category\*



*Grevillea baileyana* is widespread in north Queensland rainforests at low to mid altitudes. Propagation is primarily from seed collected from cultivated plants and wild stands. The species is available from a number of native plant nurseries in Queensland.

Table 57: Australian exports of wildflowers, foliage and native plants

	Unit	1999-00	2000-01	2001-02	2002-03	2003-04
<b>Production</b>						
Gross value*	\$'000	30 700	30 400	34 900	29 300	22 500
<b>Kangaroo paws**</b>						
Volume	'000 stems	3 547	2 756	1 187	1 212	1 133
Value	\$'000	1 138	1 417	816	426	401
Unit value	\$/stem	0.32	0.51	0.69	0.35	0.35
<b>Wax flowers**</b>						
Volume	'000 stems	11 720	11 486	10 371	19 549	17 843
Value	\$'000	4 233	5 242	7 129	8 125	5 952
Unit value	\$/stem	0.36	0.46	0.69	0.42	0.33
<b>Other Australian native species*</b>						
Volume	'000 stems	17 826	16 578	20 374	16 991	16 916
Value	\$'000	8 847	7 522	9 895	7 354	4 012
Unit value	\$/stem	0.50	0.45	0.49	0.43	0.24
<b>Wild picked, fresh</b>						
Volume	'000 stems	9 518	12 639	9 922	9 035	7 760
Value	\$'000	2 819	2 576	2 091	931	1 353
Unit value	\$/stem	0.30	0.20	0.21	0.10	0.17
<b>Wild picked, dried or preserved</b>						
Volume	'000 stem	5 862	5 781	4 409	3 715	3 239
Value	\$'000	3 685	2 824	2 327	1 700	1 494
Unit value	\$/stem	0.63	0.49	0.53	0.46	0.46
<b>Foliage</b>						
Volume	na	na	na	na	na	na
Value	\$'000	5 385	6 260	7 416	6 346	5 917
Unit value	na	na	na	na	na	na
<b>Total export value</b>	<b>\$'000</b>	<b>26 107</b>	<b>25 841</b>	<b>29 674</b>	<b>24 882</b>	<b>19 128</b>

\*Derived based on the assumption that 85 per cent of Australian wild flower production is exported. \*\*Artificially propagated. na Not available.

Source: ABS (2005).



*Athertonia diversifolia* is found growing in very wet rainforest (low to high altitude) from Cape Tribulation to the southern Atherton Tableland. Propagation is primarily from seed collected from wild stands. It is available in forestry tubes from Yuruga Nursery in north Queensland and from other native plant nurseries in south-east Queensland.



*Lomatia fraxinifolia* is widespread in north Queensland rainforests at mid- to high-altitude. Propagation is primarily from seed collected from wild stands. It is available in forestry tubes from Yuruga Nursery in north Queensland and from other native plant nurseries in south-east Queensland.

# Appendices

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# Appendix A: Gross value of Australian livestock and crop production

**Table A 1: Gross value of Australian livestock production, by commodity**

	2000-01 \$m	2001-02 \$m	2002-03 \$m	2003-04 \$m
<b>Livestock slaughterings</b>				
Cattle and calves <sup>a</sup>	5 949	6 617	5 849	6 338
Cattle exported live <sup>b</sup>	482	526	562	314
Sheep <sup>c</sup>	368	544	468	455
Lambs <sup>cd</sup>	776	1181	1161	1321
Sheep exported live	258	392	408	266
Pigs	822	968	911	878
Poultry	1 060	1 175	1 281	1 275
<b>Total slaughterings</b>	9 715	11 403	10 640	10 853
<b>Livestock products</b>				
Wool <sup>e</sup>	2 541	2 713	3 318	2 394
Milk <sup>g</sup>	3 053	3 717	2 795	2 808
Other livestock products <sup>h</sup>	462	501	423	461
<b>Total livestock products</b>	6 057	6 931	6 536	5 663

<sup>a</sup> Includes dairy cattle slaughtered.

<sup>b</sup> Excludes animals exported for breeding purposes.

<sup>c</sup> Excludes skin values.

<sup>d</sup> New lamb saleyard indicator weight introduced in July 1995. New weight indicator 18–20 kilograms dressed weight used from 1995-96; 16–18 kilograms dressed weight used before 1995-96.

<sup>e</sup> Shorn, dead and fellmongered wool and wool exported on skins.

<sup>g</sup> Milk intake by factories and valued at farmgate.

<sup>h</sup> Mainly egg production, honey and beeswax.

*Note:* Prices used in these calculations exclude GST.

*Sources:* Australian Bureau of Statistics; ABARE.

**Table A 2: Gross value of crop production, by commodity**

	2000-01	2001-02	2002-03	2003-04
	\$m	\$m	\$m	\$m
<b>Grains and oilseeds</b>				
Wheat	5 130	6 356	2 692	5 596
Barley	1 344	1 725	984	1 615
Oats	138	251	210	228
Triticale	126	168	84	118
Maize	65	90	72	78
Sorghum	279	349	300	334
Rice	350	327	153	162
Lupins	217	304	212	215
Field peas	100	147	61	99
Chickpeas	75	130	65	58
Canola	545	675	389	657
Sunflowerseed	28	27	10	23
Soybeans	18	22	7	27
Other oilseeds <sup>a</sup>	33	23	43	43
Total	8 448	10 596	5 281	9 252
<b>Industrial crops</b>				
Cotton lint and cotton seed <sup>b</sup>	1 862	1 504	817	639
Sugar cane (cut for crushing)	657	989	1 019	848
Wine grapes	925	1 059	849	1 088
Total	3 482	3 589	2 726	2 608
<b>Other crops</b>				
Other crops <sup>nei c</sup>	6 657	6 809	7 042	7 253
<b>Total crops</b>	18 587	20 993	15 049	19 113

<sup>a</sup>Linseed, safflowerseed and peanuts.

<sup>b</sup>Value delivered to gin.

<sup>c</sup>Mainly fruit, vegetables and fodder crops.

<sup>e</sup>ABARE estimate.

<sup>f</sup>ABARE forecast.

<sup>nei</sup>Not elsewhere classified.

*Note:* Prices used in these calculations exclude GST.

*Sources:* Australian Bureau of Statistics; ABARE.



# Appendix B: Levies applicable to emerging industries in Australia

Commodity	Levy arrangements	Purpose
Buffalo	<ul style="list-style-type: none"> <li>\$5.33/head on Australian produced buffaloes that are exported live</li> <li>\$10.33/head on buffaloes slaughtered for human consumption at Australian abattoirs</li> </ul>	Funding for research and development via RIRDC, and the activities carried out by the Brucellosis and Tuberculosis Eradication Council
Deer	<ul style="list-style-type: none"> <li>\$7.75/head payable on live deer produced in and exported from Australia</li> <li>10.5c/kg (hot dressed weight) on deer slaughtered at an abattoir and intended for human consumption</li> <li>3.5 per cent of the sale (or declared) value of deer velvet produced and sold in Australia</li> <li>3.5 per cent of the sale (or declared) value of deer velvet produced in Australia and exported</li> </ul>	Funding for research and development via RIRDC, and residue testing administered by the National Residue Survey
Goats	<ul style="list-style-type: none"> <li>1.5 per cent of the sale value of shorn goat fibre</li> <li>37.7c/head for all transactions where ownership of the goat changes hands</li> <li>3c/head for all wild (game) goats killed for human consumption and processed at a licensed establishment</li> </ul>	Funding for research and development via RIRDC and Meat and Livestock Australia, and residue testing administered by the National Residue Survey
Game pigs	<ul style="list-style-type: none"> <li>25c/head</li> </ul>	Funding residue testing administered by the National Residue Survey
Kangaroo	<ul style="list-style-type: none"> <li>7c/head for all wild (game) kangaroos killed for human consumption by shooting and that are processed at a licensed establishment</li> <li>From 2004, 3c/head for all macropods killed for pet food</li> </ul>	Funding for research and development via RIRDC, and residue testing administered by the National Residue Survey
Lychee	<ul style="list-style-type: none"> <li>8c/kg for fresh lychee</li> <li>1c/kg for processing lychee</li> <li>8c/kg for export lychee</li> </ul>	Funding for research, development and marketing activities of Horticulture Australia Limited
Macadamia	Domestic levy and export charge for macadamia nuts calculated as: <ul style="list-style-type: none"> <li>Dried kernel, 25.21c/kg</li> <li>Nut-in-shell, 8c/kg</li> </ul>	Funding for research, development and promotion by Horticulture Australia Limited, and residue testing administered by the National Residue Survey
Papaya	Domestic levy and export charge for papaya calculated as: <ul style="list-style-type: none"> <li>Fresh, 2c/kg</li> <li>Processing, 0.25c/kg</li> <li>Export, 2c/kg</li> </ul>	Funding for research, development and promotion by Horticulture Australia Limited
Pasture seeds	Levy calculated as: <ul style="list-style-type: none"> <li>Category 1 (medics), \$10/t</li> <li>Category 2 (lucerne), \$15/t</li> <li>Category 3 (clovers), \$15/t</li> <li>Category 4 (subclovers), \$11/t</li> <li>Category 5 (serradella), \$10/t</li> </ul>	Funding for research and development via RIRDC
Pulses	Levy calculated as a percentage of the farmgate value at the rates: <ul style="list-style-type: none"> <li>1.015 per cent for field peas, lupins and chick peas</li> <li>1.000 per cent for mung beans, pidgeon peas, peanuts, navy beans, vetch, cow peas and lentils</li> </ul>	Funding for research and development activities of the Grains Research and Development Corporation, and residue testing administered by the National Residue Survey for field peas, lupins and chick peas
Ratites (emu and ostrich)	Applied to all ratites slaughtered for human consumption in Australia at the rate of: <ul style="list-style-type: none"> <li>\$0.75/head for emus</li> <li>\$1.25/head for ostriches</li> </ul>	Funding for research and development via RIRDC, and residue testing administered by the National Residue Survey

# Appendix C: Contacts for selected Australian emerging industries

<b>Alpaca</b>	
<b>Australian Alpaca Association</b>	PO Box 1076 Mitcham North Vic 3132 Tel:(03) 9873 7700 Fax: (03) 9873 7711 Email: alpaca@alpaca.asn.au Website: www.alpaca.asn.au
<b>Australian Alpaca Fleece Limited</b>	Unit 2/114 Fairbairn Road Sunshine VIC 3020 Tel: (03) 9311 0933 Fax : (03) 9311 0499 Email: info@australionalpacafleece.com.au Website: www.australionalpacafleece.com.au
<b>Buffalo</b>	
<b>The Buffalo Industry Council of the Northern Territory</b>	Neil Ross (Executive Officer) PO Box 36828 Winnellie NT 0821 Tel: (08) 8947 1833 Fax: (08) 8947 1822
<b>Camel</b>	
<b>Central Australian Camel Industry Association</b>	Camels Australia Export PO Box 8760 Alice Springs NT 0871 Tel: (08) 8951 8183 Fax: (08) 8951 8188 Email: info@camelsaust.com.au Website: www.camelsaust.com.au
<b>Cashmere</b>	
<b>Australian Cashmere Growers Association</b>	PO Box 380 Kellyville NSW 2155 Phone: 0500 500 284 Tel/Fax: (02) 9629 2390 email: cashmere@acga.asn.au
<b>Deer</b>	
<b>Deer Industry Association of Australia</b>	DIAA Secretariat Solange Shapiro 191 Hamilton Highway Lismore VIC 3324 Tel: (03) 5596 2323 Fax: (03) 5596 2313 Email: shapiro@tca-online.com.au Website: www.diaa.org
<b>Essential oils</b>	
<b>Australian Lavender Growers Association</b>	The Secretary TALGA Inc PO Box 1296 Richmond North VIC 3121 Email: secretary@talga.com.au Website: www.talga.com
<b>Australian Tea Tree Industry Association</b>	PO Box 20 Tweed Heads NSW 2485 Tel: (02) 6674 2925 Fax: (02) 6674 2475 Email: enquiries@teatree.org.au Website: www.teatree.org.au
<b>The Australian Lavender Industry</b>	PO Box 81 Leichardt NSW 2040 Fax: (02) 4872 1151 Email: admin@lavenderaustralia.com Website: www.lavenderaustralia.com
<b>Essential Oil Producers Association of Australia</b>	22 Canterbury Chase Goonellabah NSW 2480 Tel: (02) 6624 2453 Website: www.eopaa.com.au
<b>Goat</b>	
<b>Meat and Livestock Australia</b>	Locked Bag 99 North Sydney NSW 2059 Tel: (02) 9463 9333 Fax: (02) 9463 9393 Free Phone: 1800 023 100 (Australia only) Website: www.mla.com.au
<b>Dairy Goat Society of Australia</b>	Federal Secretary PO Box 9048 Traralgon VIC 3844 Tel/fax: (03) 5176 0388 Email: ricksim@net-tech.com.au Website: home.vicnet.net.au/~dgsa/
<b>Australian Goat Milk Association</b>	Elizabeth Creek Farms Pty Ltd RMB 2930 Childers VIC 3824 Tel/fax: (03) 5634 7603
<b>Jojoba</b>	
<b>Australian Jojoba Industry Association</b>	Secretary PO Box 1204 Dubbo NSW 2830 Tel/fax (02) 6887 2647
<b>Jojoba Australia Pty Ltd</b>	PO Box 573 Bourke NSW 2840 Tel: (02) 6872 2833 Fax: (02) 6872 1072 Email: info@jojoba-australia.com.au Website: www.jojoba-australia.com.au
<b>Kangaroo</b>	
<b>Kangaroo Industry Association of Australia</b>	Tel: (03) 6326 8639 Fax: 0363 262 70 Email: kiaa@bigpond.net.au Website: www.kangaroo-industry.asn.au

Macadamia nut	
Australian Macadamia Society	Suite 1, 113 Dawson St Lismore NSW 2480 Tel: (02) 6622 4933 Fax: (02) 6622 4932 Email: admin@macadamias.org Website: www.macadamias.org
Mohair	
Australian Mohair Marketing Organisation Limited	Classing Centre Lot 3 River Street Narrandera NSW 2700 Tel: (02) 6959 2988 Fax: (02) 6959 3004 Email: admin@ausmohair.com.au Website: www.ausmohair.com.au
Mohair Australia	Tel: (02) 6959 2069 Email: mohair@mohair.org.au Website: www.mohair.org.au
Olives	
Australia Olive Association	Secretariat PO Box 309 Pendle Hill NSW 2145 Tel: (02) 9863 8735 Fax: (02) 9636 4971 Email: Secretariat@australianolives.com.au Website: www.australianolives.com.au
Ostrich	
Australian Ostrich Association	15 Fitzgerald Crt Mooroolbank VIC 3138 Tel: (03) 9726 5700 Email: truth@iinet.net.au Website: www.aoa.asn.au
Pasture seed	
Australian Seed Federation	PO Box 3572 Manuka ACT 2603 Email: admin@asf.asn.au Tel: (02) 6282 6822 Fax: (02) 6282 6922 Website: www.asf.asn.au
Seed Industry Association of Australia	Seed Industry Association of Australia Ltd Suite 9, 21 Colbee Court Phillip A.C.T. 2606 Email: Tel: (02) 6282 8168 Fax: (02) 6282 9166 Website: www.sia.asn.au
Pulses	
Pulse Australia	Level 3 100 New South Head Road Edgecliffe NSW 2027 Tel: (02) 9327 8588 Fax: (02) 9327 1633 Email: sroberts@pulseaus.com.au Website: www.pulseaus.com.au

Pyrethrum	
Botanical Resources Australia Pty Ltd	PO. Box 852 Sandy Bay TAS 7006 Tel: (03) 6224 4511 Fax: (03) 6224 4473 Email: sales@botanicalra.com.au Website: www.botanicalra.com.au
Rabbits	
Farmed Rabbit Industry Association	The Treasurer Farmed Rabbit Industries of Australia Ltd Kathleen Bowerman 'Sun Downer Station', Monaro Highway Bredbo NSW 2626.
Spices and herbs	
Australian Herb and Spice Industry Association	PO Box 737 Melrose Park SA 5039 Email: webadmin@ahsia.org.au Website: www.ahsia.org.au
Tropical fruit	
Australian Lychee Growers Association	Tel: (07) 4956 6212 Fax: (07) 4956 6482 Email: Website: www.australianlychee.com
Rambutan and Tropical Exotic Growers Association	PO Box 188 Miriwinni QLD 4871 Tel: (07) 40675266 Email: zappala@iig.com.au
Wild flowers and Australian native plants	
Australian Flower Export Council (Flower Export Council of Australia Inc)	PO Box 442 North Melbourne VIC 3051 Tel: (03) 9258 6150 Fax: (03) 9687 7714 Email: exportcouncil@australianflowerers.com.au Website: www.feca.com.au
Wildflowers Australia Network	PO Box 6168 Hawthorn West Vic 3122 Website: www.wildflowersaust.net

# References

- ABARE 2005, 'Statistical tables', *Australian Commodities*, vol. 12, no. 1, Canberra (and previous issues).
- Abbott, P. 2004, 'History of eucalyptus oil', Felton Grimwade and Bickford Pty Ltd, Oakleigh South, Victoria ([www.fgb.com.au/AdditionalInfo/EucOilHistory.htm](http://www.fgb.com.au/AdditionalInfo/EucOilHistory.htm)).
- ABS (Australian Bureau of Statistics) 2001, *Principle Agricultural Commodities Produced, Australia, 2000–01, Preliminary*, cat. No. 7501.0, Canberra.
- ABS 2004a, *Value of Agricultural Commodities Produced, Australia*, cat. no. 7503.0, Canberra (2002–03 and previous issues).
- ABS 2004b, *Agricultural Commodities, Australia 2002–03*, cat. no. 7121.0, Canberra (and previous issues).
- ABS 2005, *International Trade*, electronic data service, cat. no. 5464.0, Canberra.
- Altech Group and Total Earth Care 1999, *Improving Access to Bushfood Production and Marketing Information*, RIRDC Publication no. 99/158, Canberra.
- Anupunt, P. and Sukhvibul, N. 2005. 'Lychee and longan production in Thailand', *Acta Horticulturae*, vol. 665, International Society for Horticultural Science, pp. 53–60 ([www.actahort.org/books/665/665\\_5.htm](http://www.actahort.org/books/665/665_5.htm)).
- Australian Alpaca Association 2002, 'Alpaca History', Mitcham North, Victoria ([www.alpaca.asn.au/info/history.shtml](http://www.alpaca.asn.au/info/history.shtml)).
- Australian Alpaca Association Inc. 2003, *2020 Vision*, Report of the Strategic Development Task Force.
- Australian Alpaca Fleece Ltd 2004a, 'AAFL fleece prices effective 1st October 2004 and effective to September 2005', Sunshine, Victoria ([www.australionalpacafleece.com.au/Images/AAFL%20Fleece%20Prices%201Oct04.pdf](http://www.australionalpacafleece.com.au/Images/AAFL%20Fleece%20Prices%201Oct04.pdf)).
- Australian Alpaca Fleece Ltd 2004b, 'Australian Alpaca Fleece Ltd – history', Sunshine, Victoria ([www.australionalpacafleece.com.au/about.asp](http://www.australionalpacafleece.com.au/about.asp)).
- Australian Buffalo Industry Council 2004, 'Northern Territory buffalo industry' Darwin ([buffaloaustralia.org/pages/nt.html](http://buffaloaustralia.org/pages/nt.html)).
- Australian Flower Export Council 2003, 'Flora for export', North Melbourne ([www.feca.com.au/exports.htm](http://www.feca.com.au/exports.htm)).
- Australian Lychee Growers Association 2003, '2003–2008 Strategic Plan for the Australian Lychee Industry' [www.horticulture.com.au/industry/lychee.asp](http://www.horticulture.com.au/industry/lychee.asp).
- Australian Macadamia Society (2005), 'Statistics', Lismore ([www.macadamias.org](http://www.macadamias.org)).
- Australian Olive Association Ltd 2003, 'Australian olive industry strategic plan, 2003–2008', Pendle Hill, New South Wales ([www.australionalives.com.au/Strategic%20plan/strategy.htm](http://www.australionalives.com.au/Strategic%20plan/strategy.htm)).
- Australian Ostrich Association 2001, 'Ostrich information', Mooroolbank, Victoria ([www.aoa.asn.au/os\\_info.htm](http://www.aoa.asn.au/os_info.htm)).
- Australian Seeds Authority Limited 2004, *Second Annual Report 2003–2004*, Melbourne ([www.grainscouncil.com/ASA/Annual\\_report\\_2003\\_04.pdf](http://www.grainscouncil.com/ASA/Annual_report_2003_04.pdf)).
- Australian Tea Tree Industry Association 2001, *Australian Tea Tree Industry Development Plan, 2001–2010*, Report prepared by Celect Management Pty Ltd and Excel Consulting Group (Qld) Pty Ltd, Tweed Heads, New South Wales ([www.teatree.org.au/images/pdfs/2010%20Strategic%20Plan%20-%20Austrian%20Tea%20Tree%20Industry.pdf](http://www.teatree.org.au/images/pdfs/2010%20Strategic%20Plan%20-%20Austrian%20Tea%20Tree%20Industry.pdf)).
- Bartle, J. and Shea, S., 2002, 'Development of mallee as a large-scale crop for the wheatbelt of WA', *Proceedings of the Australian Forest Growers 2002 National Conference: Private Forestry – Sustainable, Accountable and Profitable*, Albany, Western Australia, pp. 243–50.
- Barton, A. 1998, 'Industrial uses of eucalyptus oil' ([www.oilmallee.com.au/docs/Barton.doc](http://www.oilmallee.com.au/docs/Barton.doc)).
- Bennett, M. 2004, 'Sesame' in S. Salvin, M. Bourke, and T. Byrne (eds), *The New Crop Industries Handbook*, RIRDC Publication no. 04/125, Canberra, pp. 213–20.
- Botanical Resources Australia 2001, 'BRA – the first five years: celebrating the changes', *PYLINES: Newsletter of the Australian Pyrethrum Industry*, August ([www.botanicalra.com.au/HTML/Pyelines\\_8\\_2001.pdf](http://www.botanicalra.com.au/HTML/Pyelines_8_2001.pdf)).
- Brooks, P. 1997, *Flower Export Statistics*, RIRDC Publication no. 01/097, Canberra, July.
- CACIA (Central Australian Camel Industry Association) 2004, 'Camels Australia Export' ([www.camelsaust.com.au](http://www.camelsaust.com.au)).
- CALM (Department of Conservation and Land Management, Western Australia) 2003, *Management of Commercial Harvesting of Protected Flora in Western Australia, 1 July 2003 – 30 June 2008*, Department of the Environment and Heritage, Canberra, June ([www.deh.gov.au/biodiversity/trade-use/sources/management-plans/approved/flora-wa/pubs/wa-flora-management-plan.pdf](http://www.deh.gov.au/biodiversity/trade-use/sources/management-plans/approved/flora-wa/pubs/wa-flora-management-plan.pdf)).
- Caldwell, J. 2004, *World trade in crocodilian skins, 2000–2002*, UNEP World Conservation Monitoring Centre, Cambridge, UK, May.
- Chaffey, S. and McGregor, B. 2004, *Making Cashmere Attractive to Investors*, RIRDC Publication no. 04/097, Canberra ([www.rirdc.gov.au/reports/RNF/04-076.pdf](http://www.rirdc.gov.au/reports/RNF/04-076.pdf)).
- Chay–Prove, P. 2003, 'Growing papaya: before you start', Queensland Department of Primary Industries, Brisbane ([www.dpi.qld.gov.au/horticulture/5326.html](http://www.dpi.qld.gov.au/horticulture/5326.html)).

- Cherikoff, V. 2000, *Marketing the Australian Native Food Industry*, RIRDC Publication no. 00/61, Canberra.
- CITES (Convention on International Trade in Endangered Species) 2005, 'CITES Trade Database, Cambridge', UK ([www.cites.org/eng/resources/trade.shtml](http://www.cites.org/eng/resources/trade.shtml)).
- Clarke, M. 2004, 'Asian brassicas' in S. Salvin, M. Bourke and T. Byrne (eds), *The New Crop Industries Handbook*, RIRDC Publication no. 04/125, Canberra, pp. 16–21 ([www.rircd.gov.au/NewCrops/Contents.html](http://www.rircd.gov.au/NewCrops/Contents.html)).
- Commonwealth Bureau of Census and Statistics 1926, 'Forestry in Australia', *Official Year Book of the Commonwealth of Australia, 1926*, Melbourne ([www.abs.gov.au/Ausstats/abs@.nsf/0/80cbbbb02f11f947ca2569e30020566c?OpenDocument](http://www.abs.gov.au/Ausstats/abs@.nsf/0/80cbbbb02f11f947ca2569e30020566c?OpenDocument)).
- CSIRO (Commonwealth Scientific and Industrial Research Organisation) 2003, 'Native Food Plant Cultivation Newsletter', CSIRO, Canberra, April (and previous issues) ([www.clw.csiro.au/research/farming/crops](http://www.clw.csiro.au/research/farming/crops)).
- Cribb, A. and Cribb, J. 1989, *Useful Wild Plants in Australia*, Collins Australia, Sydney.
- Daniells, Petiniaud, P. and Salleras, P. 2004, 'Taro' in S. Salvin, M. Bourke and T. Byrne (eds), *The New Crop Industries Handbook*, RIRDC Publication no. 04/125, Canberra, pp. 90–7.
- Davis, R. and Bartle, J. 2004, 'Eucalyptus oil' in S. Salvin, M. Bourke, T. Byrne (eds), *The New Crop Industries Handbook*, RIRDC Publication no. 04/125, Canberra, pp. 124–30.
- DBIRD (Department of Business, Industry and Resource Development, Northern Territory) 2001, 'Camels in Australia: Converting feral cost to viable resource', Darwin ([www.nt.gov.au/dbird/dpif/animals/camels.shtml](http://www.nt.gov.au/dbird/dpif/animals/camels.shtml)).
- DBIRD 2002, 'The crocodile industry in the Northern Territory', Darwin ([www.nt.gov.au/dbird/dpif/animals/crocodiles.shtml](http://www.nt.gov.au/dbird/dpif/animals/crocodiles.shtml)).
- DBIRD 2003a, 'Portrait of the NT', Darwin ([www.primaryindustry.nt.gov.au](http://www.primaryindustry.nt.gov.au)).
- DBIRD 2003b, *PrimeStats, 2001–02*, Darwin.
- DBIRD 2005a, *Pastoral Market Update*, December (and previous issues), Darwin ([www.nt.gov.au/dbird/dpif/pubcat/newsletters/pmu.shtml](http://www.nt.gov.au/dbird/dpif/pubcat/newsletters/pmu.shtml)).
- DBIRD 2005b, 'Value of Asian vegetables from 1990 to 2004', Darwin, ([www.primaryindustry.nt.gov.au/pls/portal30/docs/FOLDER/DBIRD\\_PI/HORTICULTURE/PRODUCTION/ASIAN+VEG+GRAPH.PDF](http://www.primaryindustry.nt.gov.au/pls/portal30/docs/FOLDER/DBIRD_PI/HORTICULTURE/PRODUCTION/ASIAN+VEG+GRAPH.PDF)).
- DDM Wholesale 2005, 'Wholesale emu oil products', Oklahoma City ([www.ddmwholesale.com/EmuOilProd.aspx?CatID=65](http://www.ddmwholesale.com/EmuOilProd.aspx?CatID=65)).
- Deer Industry New Zealand 2004, 'Industry info', Wellington ([www.deernz.org/n4.html](http://www.deernz.org/n4.html)).
- Deer Industry New Zealand 2005, *Market Report, January 2005*, Issue no. 79, Wellington ([www.deernz.org/upload/notion/sectionimages/2184\\_914-MR79\\_r3.pdf](http://www.deernz.org/upload/notion/sectionimages/2184_914-MR79_r3.pdf)).
- Department of Agriculture, Western Australian 2002, 'Southern sandalwood in Western Australia', Perth ([agspsrv34.agric.wa.gov.au/environment/trees/tree\\_crops/sandalwood\\_introduction.htm#Markets\\_and\\_Industry\\_Development](http://agspsrv34.agric.wa.gov.au/environment/trees/tree_crops/sandalwood_introduction.htm#Markets_and_Industry_Development)).
- Department of the Environment and Heritage 2004, 'The feral pig (*sus scrofu*)', Canberra ([www.deh.gov.au/biodiversity/invasive/publications/pig/index.html](http://www.deh.gov.au/biodiversity/invasive/publications/pig/index.html)).
- Department of the Environment and Heritage 2005, 'Wild harvest of native species — kangaroos' Canberra ([www.ea.gov.au/biodiversity/trade-use/wild-harvest/kangaroo/quota/2003.html](http://www.ea.gov.au/biodiversity/trade-use/wild-harvest/kangaroo/quota/2003.html)).
- Department of Primary Industries, Water and the Environment, Tasmania 2003, *Harvest Quota Application for the Brushtail Possum in Tasmania: 1 July 2003 to 30 June 2004*, Hobart, December.
- DFAT 2004, *Australia–Thailand Free Trade Agreement*, Canberra ([www.dfat.gov.au/trade/negotiations/aust-thai/aus-thai\\_FTA\\_text.pdf](http://www.dfat.gov.au/trade/negotiations/aust-thai/aus-thai_FTA_text.pdf)).
- Diczbalis, Y. 2004a, 'Durian' in S. Salvin, M. Bourke and T. Byrne (eds), *The New Crop Industries Handbook*, RIRDC Publication no. 04/125, Canberra, pp. 166–73.
- Diczbalis, Y. 2004b, 'Lycches and longans' in S. Salvin, M. Bourke and T. Byrne (eds), *The New Crop Industries Handbook*, RIRDC Publication no. 04/125, Canberra, pp. 190–7.
- Diczbalis, Y. 2004c, 'Rambutan' in S. Salvin, M. Bourke and T. Byrne (eds), *The New Crop Industries Handbook*, RIRDC Publication no. 04/125, Canberra, pp. 190–97.
- Drinnan, J. and Peasley, D. 1997, 'Coffee' in K. Hyde (ed) 1997, *The New Rural Industries*, Rural Industries Research and Development Corporation, Canberra ([www.rircd.gov.au/pub/handbook/contents.html](http://www.rircd.gov.au/pub/handbook/contents.html)).
- European Commission 2005, 'Eurostat database', Brussels ([epp.eurostat.cec.eu.int](http://epp.eurostat.cec.eu.int)).
- Extension Toxicology Network 1994, 'Pesticide information profile', Corvallis, Oregon ([extoxnet.orst.edu/pips/pyrethri.htm](http://extoxnet.orst.edu/pips/pyrethri.htm)).
- FAO (Food and Agriculture Organisation of the United Nations) 2005, 'FAOSTAT Agriculture Data', Rome ([apps.fao.org](http://apps.fao.org)).
- Forest Products Commission of Western Australia 2005a, 'Sandalwood', Perth, Western Australia ([www.fpc.wa.gov.au/content/native\\_forests/arid/sandalwood.asp](http://www.fpc.wa.gov.au/content/native_forests/arid/sandalwood.asp)).
- Forest Products Commission of Western Australia 2005b, *Farming Western Australian Sandalwood*, Perth, Western Australia ([www.fpc.wa.gov.au/pdfs/sandalwood04.pdf](http://www.fpc.wa.gov.au/pdfs/sandalwood04.pdf)).
- Forest Products Commission of Western Australia 2005c, *Annual Report, 2003–04*, Rivervale, Western Australia (and previous editions)
- Forsyth, D. and Parkes, J. 2004, *Maximising the Conservation Benefits of the Commercial Goat Industry in Australia*, Final report for the Department of Environment and Heritage, Canberra.

- Foster, M. 1999, *Australian Farmed Rabbit: Prospects for Industry Development*, RIRDC Publication no. 99/89, Canberra, August.
- Foster, M. and Telford, R. 1996, *Structure of the Australian Rabbit Industry: A Preliminary Analysis*, ABARE report prepared for the Livestock and Pastoral Division, Department of Primary Industries and Energy, Canberra, September.
- Gordon, J. and Garrett, D. 2004, *Rabbit Farming: An Evaluation of the Crusader R&D Program*, RIRDC Publication no. 03/144, Canberra, February.
- Gosbee, M. 2004a, 'Luffas, Asian melons and snake beans' in S. Salvin, M. Bourke and T. Byrne (eds), *The New Crop Industries Handbook*, RIRDC Publication no. 04/125, Canberra, pp. 22–6.
- Gosbee, M. 2004b, 'Bitter melons' in S. Salvin, M. Bourke and T. Byrne (eds), *The New Crop Industries Handbook*, RIRDC Publication no. 04/125, Canberra, pp. 84–9.
- Graham, C. and Hart, D. 1997, *Prospects for the Australian Native Bushfood Industry*, RIRDC Research Publication no. 97/22, Canberra.
- Hooper, P. and Dennis, J. 2002, *Coriander – Overcoming production limitations*, RIRDC publication no. 02/147, Canberra ([www.rirdc.gov.au/reports/NPP/02-147.pdf](http://www.rirdc.gov.au/reports/NPP/02-147.pdf)).
- Horticulture Australia Limited 2004, *National Olive Growers Levy Consultative Draft*, Sydney, April ([www.australianolives.com.au/Strategic%20plan/condraftfinal.pdf](http://www.australianolives.com.au/Strategic%20plan/condraftfinal.pdf)).
- Hassall and Associates 2000, *The New Rural Industries: Financial Analysis, Volume II*, RIRDC Publication no. 00/133, Canberra, September.
- Hassall and Associates 2003, *Asian Vegetable Industry: A Situation Assessment*, RIRDC Publication no. 02/168, Canberra ([www.rirdc.gov.au/reports/AFO/02-168.pdf](http://www.rirdc.gov.au/reports/AFO/02-168.pdf)).
- Humphries, C. 2005, 'Kangaroo meat skips off shelves', *The Moscow Times*, 4 August ([www.themoscowtimes.com/stories/2005/08/04/003.html](http://www.themoscowtimes.com/stories/2005/08/04/003.html)).
- Institute of Horticultural Development, Victoria 1997, 'Asian vegetables thesaurus', Knoxfield, Victoria ([www.nre.vic.gov.au/trade/asiaveg/index.htm](http://www.nre.vic.gov.au/trade/asiaveg/index.htm)).
- International Coffee Organisation 2004, 'About coffee: botanical aspects', London ([www.ico.org/acoff/botan.htm](http://www.ico.org/acoff/botan.htm)).
- International Jojoba Export Council 2004, 'Jojoba facts' ([www.ijec.net/jojoba\\_facts.html](http://www.ijec.net/jojoba_facts.html)).
- International Macadamias Ltd 2003, 'Australian macadamia industry', ([www.macadamia.au.com/aus\\_mac.html](http://www.macadamia.au.com/aus_mac.html)).
- International Olive Oil Council 2002a, 'Olive oil', Madrid ([www.internationaloliveoil.org/oliveworld\\_usingoil.asp](http://www.internationaloliveoil.org/oliveworld_usingoil.asp)).
- International Olive Oil Council 2002b, 'Table olives', Madrid ([www.internationaloliveoil.org/oliveworld\\_tableolive.asp](http://www.internationaloliveoil.org/oliveworld_tableolive.asp)).
- International Seed Federation 2005, 'World seed trade statistics', Madrid ([www.worldseed.org/statistics.htm](http://www.worldseed.org/statistics.htm)).
- Japan Customs 2005, 'Trade statistics of Japan, Tokyo' ([www.customs.go.jp/toukei/info/index\\_e.htm](http://www.customs.go.jp/toukei/info/index_e.htm)).
- Jones, P. 2004, 'Sandalwood oil' in S. Salvin, M. Bourke and T. Byrne (eds), *The New Crop Industries Handbook*, RIRDC Publication no. 04/125, Canberra, pp. 153–57.
- Jongebloed, M. 2004, 'Coriander and fenugreek' in S. Salvin, M. Bourke and T. Byrne (eds), *The New Crop Industries Handbook*, RIRDC Publication no. 04/125, Canberra, pp. 229–35.
- Kailis, S. and Harris, D. 2004, 'Table olives' in S. Salvin, M. Bourke and T. Byrne (eds), *The New Crop Industries Handbook*, RIRDC Publication no. 04/125, Canberra, pp. 320–30.
- Karingal Associates 1997, *The Australia Wildflower Industry: A Review – Second Edition*, RIRDC Publication no. 97/64, Canberra.
- Kent, P. 1994, 'Emu farming', Queensland Department of Primary Industries, Brisbane ([www.dpi.qld.gov.au/poultry/5143.html](http://www.dpi.qld.gov.au/poultry/5143.html)).
- Lee, B. 1995, *Audit of the Australian Vegetable Industry*, RIRDC Report no. 95/13, Canberra.
- Leech, A., Shannon, P., Kent, P., Runge, G. and Warfield, B. 2003, *Opportunities for Exporting Game Birds*, RIRDC Publication no. 03/106, Canberra.
- Levies Revenue Service 2002, *Business Plan 2002–2005 and Report to Clients 2001–02*, Agriculture Fisheries and Forestry – Australia, Canberra.
- Levies Revenue Service 2003, *Report to Stakeholders, 2002–03*, Australian Government Department of Agriculture, Fisheries and Forestry, Canberra.
- Lim, T. 1998, 'Loofahs, gourds, melons and snake beans', in K.W. Hyde (ed.) *The New Rural Industries*, Rural Industries Research and Development Corporation, Canberra, ([www.rirdc.gov.au/pub/handbook/contents.html](http://www.rirdc.gov.au/pub/handbook/contents.html)).
- Love, G. and Langenkamp, D. 2003, *Australian Aquaculture: Industry Profiles for Selected Species*, ABARE eReport 03.8, Canberra.
- Malaysian Tropical Fruit Information System 2005, 'Rambutan: Marketing and Trade — general information' ([www.myfruits.org](http://www.myfruits.org)).
- McEvoy, D. and Gomez, E. 1999, *The Olive Industry: A Marketing Study*, RIRDC Publication no. 99/86, Canberra, August ([www.rirdc.gov.au/reports/NPP/DAQ-210A.rtf](http://www.rirdc.gov.au/reports/NPP/DAQ-210A.rtf)).
- MacNamara, K., Nicholas, P., Murphy, D., Riedel, E., Goulding, B., Horsburg, C., Whiting, T. and Warfield, B. 2003, *Markets for Skins and Leather from the Goat, Emu, Ostrich, Crocodile and Camel Industries*, RIRDC Publication no. 02/142, Canberra ([www.rirdc.gov.au/reports/NAP/02-142.html](http://www.rirdc.gov.au/reports/NAP/02-142.html)).
- Meat and Livestock Australia 2002, 'Goat meat research' North Sydney ([www.mla.com.au/content.cfm?sid=1141](http://www.mla.com.au/content.cfm?sid=1141)).
- Meyers Strategy Group 2001, *Regional Australian Olive Oil Processing Plants*, RIRDC Publication no. 00/187, Canberra, February ([www.rirdc.gov.au/reports/NPP/01-23.pdf](http://www.rirdc.gov.au/reports/NPP/01-23.pdf)).

- Menzel, C. 2002, *The Lychee Crop in Asia and the Pacific*, RAP Publication 2002/16, FAO, Bangkok, June ([www.fao.org/DOCREP/005/AC681E/AC681E00.HTM#Contents](http://www.fao.org/DOCREP/005/AC681E/AC681E00.HTM#Contents)).
- Michael, D. 2000, *Benchmarks for New Animal Products: Emu and Ostrich Production*, RIRDC Publication no. 00/136, Canberra, August.
- Ministry of Agriculture and Forestry, New Zealand 2004, 'The New Zealand deer industry', Wellington ([www.maf.govt.nz/mafnet/rural-nz/overview/nzoverview010.htm](http://www.maf.govt.nz/mafnet/rural-nz/overview/nzoverview010.htm)).
- Modern Olives 2005, 'The Olive Industry: Australian overview', Lara, Victoria ([www.modernolives.com.au/industry\\_australia.html](http://www.modernolives.com.au/industry_australia.html)).
- Mohair South Africa 2004, 'Review 2003', Port Elizabeth, South Africa ([www.mohair.co.za/home/review.asp?cat=samohair&id=19](http://www.mohair.co.za/home/review.asp?cat=samohair&id=19)).
- Morgan, W. and Midmore, D. 2003a, *Chinese Broccoli (Kailaan) in Southern Australia*, RIRDC Publication 02/161, Canberra, January ([www.rirdc.gov.au/reports/AFO/02-161.pdf](http://www.rirdc.gov.au/reports/AFO/02-161.pdf)).
- Morgan, W. and Midmore, D. 2003b, *Kabocha and Japanese Pumpkin in Australia*, RIRDC Publication 02/167, Canberra, August ([www.rirdc.gov.au/reports/AFO/02-167.pdf](http://www.rirdc.gov.au/reports/AFO/02-167.pdf)).
- National Bureau of Statistics of China 2004, *China Statistical Yearbook, 2004*, China Statistical Press, Beijing (and previous issues).
- National Department of Agriculture, South Africa 2003, 'Trends in the agricultural sector, 2003', Pretoria ([www.nda.agric.za/docs/Trends2003/trends.htm](http://www.nda.agric.za/docs/Trends2003/trends.htm)).
- NSW National Parks and Wildlife Service 2002, *Management Plan for Protected and Threatened Plants in the Cut Flower Industry in New South Wales, 2002–2005*, Department of the Environment and Heritage, Canberra ([www.deh.gov.au/biodiversity/trade-use/sources/management-plans/approved/flora-nsw/pubs/cut-flower.pdf](http://www.deh.gov.au/biodiversity/trade-use/sources/management-plans/approved/flora-nsw/pubs/cut-flower.pdf)).
- Northern Territory Department of Business, Industry and Resource Development 2002, *Northern Territory Primary Industry and Fisheries Statistics, 2000–01*, Technical Bulletin no. 306, Darwin.
- Office of Agricultural Economics, Thailand 2004a, 'The estimation of durian production, year 2004', Bangkok ([www.oae.go.th/mis/predict/forecast/Durian47-e.htm](http://www.oae.go.th/mis/predict/forecast/Durian47-e.htm)).
- Office of Agricultural Economics, Thailand 2004b, 'The estimation of longan production, year 2004', Bangkok ([www.oae.go.th/mis/predict/forecast/Longan47-e.htm](http://www.oae.go.th/mis/predict/forecast/Longan47-e.htm)).
- Office of Agricultural Economics, Thailand 2004c, 'The estimation of lychee production, year 2004', Bangkok ([www.oae.go.th/mis/predict/forecast/Lychee47-e.htm](http://www.oae.go.th/mis/predict/forecast/Lychee47-e.htm)).
- Office of Agricultural Economics, Thailand 2004d, 'The estimation of mangosteen production, year 2004', Bangkok ([www.oae.go.th/mis/predict/forecast/Mangosteen47-e.htm](http://www.oae.go.th/mis/predict/forecast/Mangosteen47-e.htm)).
- Office of Agricultural Economics, Thailand 2004e, 'The estimation of rambutan production, year 2004', Bangkok ([www.oae.go.th/mis/predict/forecast/Rambutan47-e.htm](http://www.oae.go.th/mis/predict/forecast/Rambutan47-e.htm)).
- Oil Mallee Project 2004, 'The oil mallee project', Fremantle, Western Australia ([www.oilmallee.com.au](http://www.oilmallee.com.au)).
- O'Malley, P. and Snowden, J. 1999, *Emu Products: Increasing Production and Profitability*, RIRDC Publication no. 99/143, Canberra, December.
- Pearse, E., SriRamaratnam, R. and Dake, C. 1994, 'Dynamics of supply and demand for New Zealand venison and velvet', Ministry of Agriculture and Forestry, New Zealand, Wellington ([www.maf.govt.nz/mafnet/rural-nz/profitability-and-economics/structural-change/market-dynamics-for-venison/](http://www.maf.govt.nz/mafnet/rural-nz/profitability-and-economics/structural-change/market-dynamics-for-venison/)).
- Perth Market Authority 2005, 'Produce information database', Perth ([www.perthmarket.com.au/produceinfoframe.htm](http://www.perthmarket.com.au/produceinfoframe.htm)).
- Peterson, L. 2002, *The Australian Lavender Industry: A Review of Oil Production and Related Products*, RIRDC Publication no. 02/052, Canberra ([www.rirdc.gov.au/reports/EOI/02-052.pdf](http://www.rirdc.gov.au/reports/EOI/02-052.pdf)).
- Phelps, D. 1997, *Feasibility of a Sustainable Bushfood Industry in Western Queensland*, RIRDC Publication no. 97/11, Canberra.
- Porosus Pty Ltd 2004, 'Crocodile farming: harvesting', Darwin ([www.crocfarm.com.au/harvest.asp](http://www.crocfarm.com.au/harvest.asp)).
- Primary Business Solutions Pty Ltd 2002, *2003–2008 Strategic Plan for the Australian Papaya Industry*, Report prepared for the Queensland Fruit and Vegetable Growers, Brisbane, December ([www.horticulture.com.au/docs/industry\\_strategic\\_plans/Papaya.pdf](http://www.horticulture.com.au/docs/industry_strategic_plans/Papaya.pdf)).
- QDPI (Queensland Department of Primary Industries) 2002, 'Broccoli' ([www.dpi.qld.gov.au/business/3204.html#broccoli](http://www.dpi.qld.gov.au/business/3204.html#broccoli)).
- Queensland Department of Primary Industries 2003, 'World production and marketing', *Unlocking Lychee R&D* ([www.dpi.qld.gov.au/News/371.html#lychee](http://www.dpi.qld.gov.au/News/371.html#lychee)).
- RIRDC 2001a, 'R&D Plan for the Native Foods Industry 2001–2006', Canberra ([www.rirdc.gov.au/pub/native](http://www.rirdc.gov.au/pub/native)).
- RIRDC 2001b, 'R&D Plan for Essential Oils and Plant Extracts 2002–2006', Canberra ([www.rirdc.gov.au/pub/essentoi.html#\\_Toc516383513](http://www.rirdc.gov.au/pub/essentoi.html#_Toc516383513)).
- RIRDC 2003, *R&D Plan for the Australian Coffee Industry 2003–2008*, RIRDC Publication no. 03/056, Canberra.
- RIRDC 2004, *Annual Report, 2003–04*, Canberra
- Salvin, S., Bourke, M. and Byrne, T. (eds), *The New Crop Industries Handbook*, RIRDC Publication no. 04/125, Canberra, pp. 213–20.
- Schneider Group 2004, 'Alpaca trends since 1984', Luxembourg ([www.gschnneider.com/brochure/specialfibresalpaca-trend.php](http://www.gschnneider.com/brochure/specialfibresalpaca-trend.php)).
- Severinghaus, J. 2003, 'bean profile: overview', Agricultural Marketing Resource Center, Ames, Iowa ([www.agmrc.org/agmrc/commodity/grainsoilseeds/soy/azukibeanprofile.htm](http://www.agmrc.org/agmrc/commodity/grainsoilseeds/soy/azukibeanprofile.htm)).
- Southwell, M. 2004, 'Tea tree oil' in S. Salvin, M. Bourke and T. Byrne (eds), *The New Crop Industries Handbook*, RIRDC Publication no. 04/125, Canberra, pp. 158–63.

- Sparrow, A. 2004, 'Wasabi' in S. Salvin, M. Bourke and T. Byrne (eds), *The New Crop Industries Handbook*, RIRDC Publication no. 04/125, Canberra, pp. 98–103.
- Stables, A. 2004, 'Dominance of the industry by SA', South African Ostrich Business Chamber, Oudtshoorn, South Africa ([www.saobc.co.za/modules.php?name=News&file=article&sid=22](http://www.saobc.co.za/modules.php?name=News&file=article&sid=22)).
- Statistics South Africa 2005, *Census of Commercial Agriculture 2002: Financial and Production Statistics*, Report no. 11-02-01 (2002), Pretoria.
- Stewart, S. 2004, WOA and world ostrich economics. Presentation to the China Ostrich Conference 2004, Xi'an, World Ostrich Association, Carlisle, United Kingdom ([www.world-ostrich.org/chinacon.htm](http://www.world-ostrich.org/chinacon.htm)).
- Stubbs, A. and Abud, G. 2002, *Dairy Goat Manual*, RIRDC Publication no. 02/025, Canberra, April ([www.rirdc.gov.au/reports/NAP/02-025.pdf](http://www.rirdc.gov.au/reports/NAP/02-025.pdf)).
- Sultana, T. and Savage, G. nd, 'Wasabi or Japanese horseradish', Animal and Food Sciences Division, Food Group, Lincoln University, Canterbury, New Zealand. ([www.foodscience.ac.nz/research\\_topics/wasabi/Wasabi.htm](http://www.foodscience.ac.nz/research_topics/wasabi/Wasabi.htm)).
- Sutton, S. 2002, *Export Flower Industry: A Review of Recorded Statistics*, RIRDC Publication no. 02/130, Canberra.
- Taiwan Customs 2005, 'Taiwan Customs Statistics' (203.66.210.47/stap/main.asp?lang=1).
- Tasmanian Parks and Wildlife Service 1996, 'Management program for brushtail possum (*Trichosurus vulpeca* (Kerr)) in Tasmania – review of background information', Department of the Environment and Heritage, Canberra ([www.deh.gov.au/biodiversity/trade-use/wild-harvest/possum/possm01.html](http://www.deh.gov.au/biodiversity/trade-use/wild-harvest/possum/possm01.html)).
- Tasmanian Parks and Wildlife Service 1999, 'Management program for the Brushtail possum (*Trichosurus vulpecula* (Kerr)) in Tasmania for the period 1 January 2000 to 31 December 2004', Department of the Environment and Heritage, Canberra ([www.deh.gov.au/biodiversity/trade-use/sources/management-plans/approved/possum-tas/](http://www.deh.gov.au/biodiversity/trade-use/sources/management-plans/approved/possum-tas/)).
- Tuckwell, C. 2001, *Australian Velvet Antler and Deer Co Products – Developing Domestic Markets*, Part A, RIRDC Publication no. 01/085, Canberra, July.
- Tuckwell, C. 2004, *Deer Production Handbook and Industry Statistics*, RIRDC Publication no. W04/042, Canberra, February ([www.rirdc.gov.au/reports/DEE/w04-041.pdf](http://www.rirdc.gov.au/reports/DEE/w04-041.pdf)).
- United Nations Statistics Division 2005, 'UN Commodity Trade Statistics Database (UN Comtrade)', New York ([unstats.un.org/unsd/comtrade](http://unstats.un.org/unsd/comtrade)).
- US Department of Agriculture 2005, 'PSD Online', Washington DC ([www.fas.usda.gov/psd/complete\\_files/default.asp](http://www.fas.usda.gov/psd/complete_files/default.asp)).
- Wallace, J. 2003, *Commercial Opportunities from Native Plants in Tasmania's Midlands*, National Heritage Trust, Hobart.
- Warfield, B. and Tume, L. 2000, Marketing Analysis and Plan for the Camel Industry, RIRDC Publication no. 00/9, Canberra.
- Vinning, G. 2003, *Selected Markets for Taro, Sweet Potato and Yam*, RIRDC Publication no. 03/052 ([www.rirdc.gov.au/reports/AFO/03-052.pdf](http://www.rirdc.gov.au/reports/AFO/03-052.pdf)).
- Wondur Holdings 2001, *Benchmarks for New Animal Products: Alpaca, Buffalo and Rabbit Production and Duck Processing*, RIRDC Publication no. 01/113, Canberra, August.
- Wondur Holdings 2002, *Benchmarks for New Animal Products: Crocodile, Squab and Yabby*, RIRDC Publication No. 02/113, Canberra, October.
- Zappala, A. 2002, *Australian Durian Industry Strategic Plan, 2001–2006*, RIRDC Publication no. W02/016, Canberra.



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# Abbreviations

kg	kilogram	2.20462 pounds
t	tonne	1000 kilograms
kL	kilolitre	1000 litres
kt	kilotonne	1000 tonnes
Mt	megatonne	1 000 000 tonnes
A\$	dollar (Australian)	
\$m	million dollars (Australian)	
\$b	billion dollars (Australian)	
US\$	dollar (United States)	
US\$m	million dollars (United States)	
US\$b	billion dollars (United States)	
cif	cost, insurance and freight	
EVAO	estimated value of agricultural operations	
fas	free alongside ship	
fob	free on board	
GDP	gross domestic product	
nec	not elsewhere classified	
nes	not elsewhere specified	
p	provisional	
ABARE	Australian Bureau of Agricultural and Resource Economics	
ABS	Australian Bureau of Statistics	
DAFF	Australian Government Department of Agriculture, Fisheries and Forestry	
DBIRD	Department of Business, Industry and Resource Development, Northern Territory	
FAO	Food and Agriculture Organisation of the United Nations	
RIRDC	Rural Industries Research and Development Corporation	
WTO	World Trade Organisation	
UNCTAD	United Nations Conference on Trade and Development	

Small discrepancies in totals are generally caused by rounding.

0 is used to denote nil or a negligible amount.