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Human consumption of hemp seed: prospects for Australian production

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Summary

Food Standards Australia New Zealand commissioned ABARES to advise on the likely change in price and quantity of hemp seed produced and sold in Australia and New Zealand that might result from legalising use of hemp seed for human consumption.

Production of hemp seed is currently legal, under licence, in most Australian states. In 2011, the area planted to hemp was an estimated 185.5 hectares. Assuming an average yield of 0.5 tonnes per hectare, Australian production of seed is estimated at around 93 tonnes in that year. An additional 35 tonnes were imported into Australia from Canada, meaning an estimated 128 tonnes (5.7 grams per person) were used in Australia in 2011 for purposes such as body care products, pet food and possibly some livestock feed.

Legalisation of hemp seed for human consumption in Australia and New Zealand would be expected to lead to increased demand, providing a stimulus for increased production. However, the magnitude of these effects may be small.

Very limited data are available on consumption of hemp seed. To estimate the possible human consumption of hemp seed in Australia, two alternative assumptions, based on experience in the United States, were used. The first approach was to assume consumption in the United States of 3.8 grams per person is all for human consumption, and that human consumption in Australia would reach the same level, in addition to other uses. In the second approach, it was estimated that hemp seed use in the United States grew by 20 per cent between 2006 and 2011, and this same growth rate was applied to the present level of use in Australia.

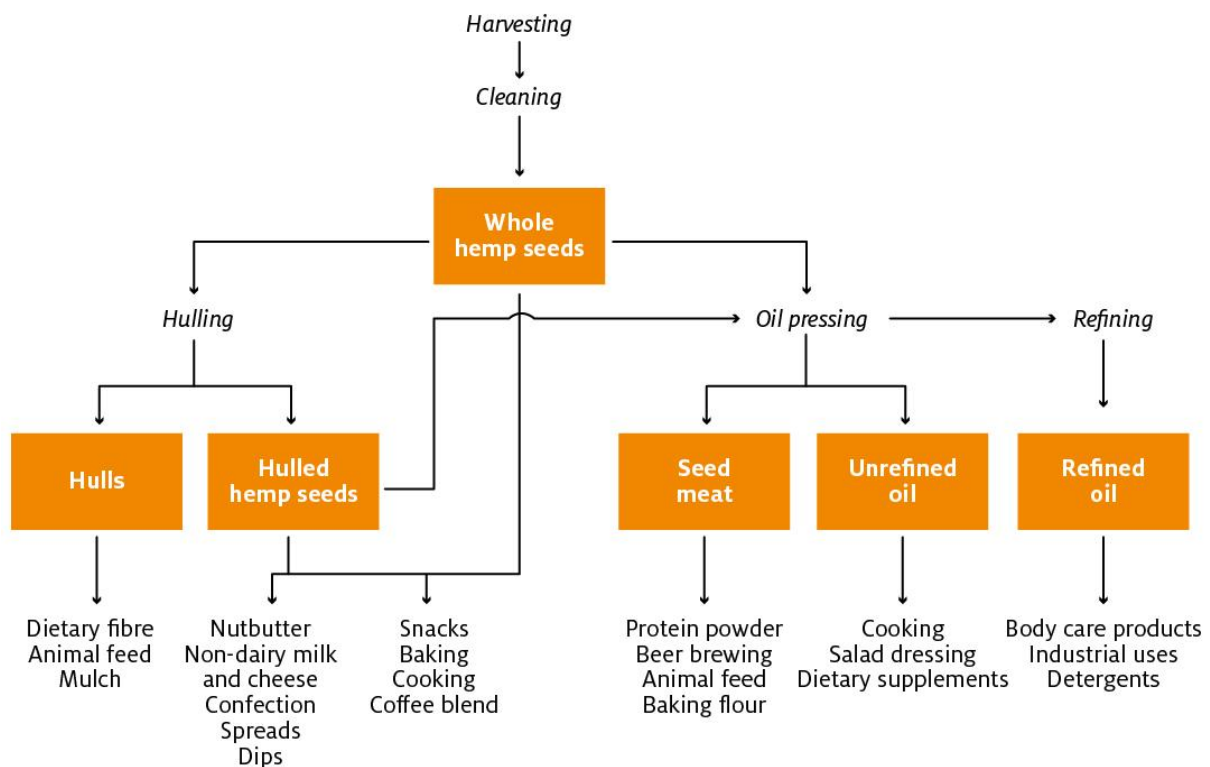
On this basis, hemp seed use in Australia and New Zealand might grow from around 155 tonnes (5.7 grams per person) at present to somewhere between 250 tonnes (9.5 grams per person) and 380 tonnes (14 grams per person) per year over five years as a result of legalisation for human consumption. However, any price increase that resulted from increased demand would dampen the demand for hemp seed for existing applications. Additionally, as hemp seed use per person in the United States (3.8 grams) and Europe (2 grams) remains well below the use levels being suggested for Australia and New Zealand, there is a risk that these levels may be overestimates.

The potential for increased production of hemp seed depends on the returns from producing it compared with the returns from other crops. If prices remain high and yields can be increased to reach the levels claimed possible, the returns from producing hemp seed could be higher than for many other crops, and the increased demand could be met from increased domestic production. Under these assumptions, up to an additional 190 tonnes might be produced which, at \$3500 per tonne, would bring an estimated gross revenue of \$665 000 to Australian hemp seed producers. However, if yields remain around present levels, and if world prices return to those seen between 2008 and 2010, Australian farmers may have little incentive to produce any hemp seed. It is possible that most, if not all, of the estimated increase in demand resulting from legalisation would be met from imports, especially if prices proved less favourable or yields proved lower than expected.

1 Introduction

Hemp seed is produced commercially from a low tetrahydrocannabinol (THC) strain of the plant *Cannabis sativa*, which is commonly used for fibre production. The outer stem (bast) fibre is used for producing clothing, canvas and ropes, while the inner stem (hurd) can be used for more coarse-fibre products, including animal bedding. The bast fibres can be used to create 100 per cent hemp products but are often combined with other fibres, such as cotton or silk, for apparel and furnishings. Hemp seed can also be used for human consumption, body care products and animal feed. In countries where human consumption is legal, hemp seeds are used in a variety of food products including margarines, cereals and hemp milk, or is consumed raw. Components of whole hemp seed include around 45 per cent oil, 35 per cent protein and 10 per cent carbohydrates and fibre. Hemp seed oil can be used in a range of cosmetics and pharmaceutical products while hemp seed meal is mostly used as animal feed and protein powder. The hemp seed processing channels and products are illustrated in Figure 1.

Figure 1 Hemp seed processing and products



Source: North American Industrial Hemp Council

Hemp seed can be legally produced under licence in most states of Australia and in New Zealand and can be used for pet food, body care products and (under specified conditions in some Australian states and in New Zealand) for livestock feed. It may not currently be used for human consumption in Australia, but hemp seed oil may be consumed in New Zealand. Compulsory compliance monitoring programs ensure production can occur without risk to drug law enforcement (NSW DPI 2008).

Food Standards Australia New Zealand (FSANZ) is considering an application to permit use of hemp seed for human consumption. ABARES was commissioned to advise on the likely change in the price and quantity of hemp seed sold in Australia if FSANZ approved this application. This

study analyses the market developments that may arise as a result of legalisation of human consumption of hemp seed. Independently there may be developments in other hemp seed markets, including body care products, pet food and livestock feed, or development of export markets, but these are outside the scope of this study.

There is a paucity of data on world hemp seed markets. In Australia, hemp seed has not been used for human consumption and in countries where it is, no regular collection of relevant statistics has been undertaken.

The limited data available to this study have therefore been supplemented by assumptions. The results may be interpreted as plausible ballpark scenarios; they should not be treated as predictions with any degree of certainty.

2 The Australian hemp industry

Industrial hemp for seed in Australia is planted in late summer or early autumn and has a similar growth cycle to winter grains and oilseeds. A large proportion of its production is irrigated.

Industrial hemp offers benefits to farmers when used in rotation with other crops. The benefits include suppressing weeds (Ehrensing 1998), rebuilding soils (Kraenzel et al. 1998) and helping prevent nematodes and fungi (Poitrowski & Carus 2011). Hemp can also benefit later grown crops by increasing yield potential (USDA 2000). One study estimates that under average seasonal conditions wheat yields can be up to 20 per cent higher after cultivation of hemp (Poitrowski & Carus 2011). No attempt was made to explicitly quantify these benefits in this report.

The state and territory governments control legalisation and licensing of industrial hemp production in Australia. Consequently, hemp production has been legalised at different times throughout Australia (Table 1) and the restrictions applied to hemp production differ. Each state, except South Australia, has an existing licensing scheme for industrial hemp production. Tasmania was the first state to legalise industrial hemp in 1995, followed by Victoria (1998), Queensland (2002), Western Australia (2004) and New South Wales (2008). New South Wales has 31 licensed hemp growers covering a total area under cultivation of around 630 hectares of planting for seed and fibre; the largest hemp growing area in Australia. The Australian industrial hemp industry is dominated by a few large companies that contract out the growing of industrial hemp to farmers in nearby regions. Each hemp producer must have a current license and comply with state biosecurity measures.

Table 1 Australian hemp seed production, by state

State	Year legalised	Maximum allowed THC level		Approx. planted area for seed production in 2011–12 (ha)
		Seed for planting (%)	Cultivated plant material, including seed (%)	
New South Wales	2008	<0.5	<1	78
Victoria	1998	na	na	10
Queensland	2002	<0.5	<1	32.5
Western Australia	2004	<0.35	<0.35	0
Tasmania	1995	<0.35	<0.35	65
Australia				185.5

Note: na = no data available; THC = tetrahydrocannabinol.

Source: Macquarie Franklin 2011; Ecofibre, pers. comm.; Department of Agriculture and Food Western Australia.

Prices, costs and gross margins

Prices of up to \$3500 per tonne are paid to farmers for hemp seed (Macquarie Franklin 2011). One hemp company undertakes harvesting for farmers and pays \$2500 per tonne for the seed. If harvesting and cartage amounted to \$900 per hectare, this price per tonne plus harvesting costs would, depending on the yield, be equivalent to a price of between \$2900 and \$3400 per tonne.

Estimates of the cost of growing a crop, including harvesting, range from \$1700 to \$2200 per hectare (Macquarie Franklin 2011; Ecofibre, pers. comm.).

Gross margin analysis for industrial hemp should consider the compulsory monitoring and inspection costs (Table 2). In some states these fees are included in the cost of a producer's licence while in other states it is paid after the inspection.

Industrial hemp seed prices are high at present as supply is relatively low. If production increased without a matching strengthening in demand, prices would probably decline.

Hemp seed yields of between 400 and 700 kilograms per hectare are typical. However industry sources believe that an average of around 1 tonne per hectare would be achievable as expertise develops (Ecofibre, pers. comm.). This expectation is within the yield range in Canada for irrigated hemp of 560 to 1680 kilograms per hectare (Serecon 2012).

Table 2 Indicative gross margins for hemp seed production at various yield, price and cost assumptions

Cost \$/ha =	2200			1700		
	yield, t/ha			yield, t/ha		
price, \$/tonne	0.5	0.7	1.0	0.5	0.7	1.0
	Gross margin, \$/ha			Gross margin, \$/ha		
1600	-1400	-1080	-600	-900	-580	-100
2500	-950	-450	300	-450	50	800
2800	-800	-240	600	-300	260	1100
3500	-450	250	1300	50	750	1800

Note: Cost per hectare includes harvesting costs

The Grains Research and Development Council (GRDC 2012) compared various grains and oilseeds gross margins based on New South Wales prices in 2011 (Table 3). Only with the more optimistic price and yield assumptions would hemp seed have been an attractive alternative for producers in New South Wales.

Table 3 Gross margin calculations for other crops: New South Wales

Crop	Grain yield (t/ha)	Gross income (yield x price) (\$/ha)	Total variable costs (\$/ha)	Gross margin (\$/ha)
Canola—low	3.2 (46% oil)	1581	381	1199
Canola—high	3.3 (49% oil)	1604	520	1085
Lentils—medium	3.2	1165	331	834
Lupin—medium	3.5	980	319	661
Barley—low	6.3	945	386	559
Wheat—low	4.8	744	319	425
Chickpeas—high	1.8	792	406	386
Wheat—high	5.2	806	539	267

Source: GRDC 2012; all prices used in the calculations assumed delivery to Junee except canola to Stockinbingal (extra freight cost = \$5 per tonne) and lentils to Victoria (extra freight cost = \$36 per tonne).

Australian production and consumption of hemp seed

In 2011, an estimated 185.5 hectares were planted to hemp seed. With yields presently at around 500 kilograms per hectare, it is estimated that production in 2011 was around 93 tonnes.

Canadian data show 35 tonnes of hemp seed exported to Australia in that year. In the absence of information to the contrary, it is assumed no hemp seed was imported from other sources and that none was exported.

Under this assumption, domestic use (production plus imports minus exports) in Australia is estimated to have been around 128 tonnes in 2011, or 5.7 grams per person (Table 4). This is

higher than estimates of use in the United States (3.8 grams) and well above that of the European Union (around 2 grams).

Table 4 Production and domestic use of hemp seed in Australia, 2011

	Area sown	Estimated production (tonnes)	Imports (tonnes)	Domestic use (tonnes)	Domestic use (grams per person)
Australia	185.5	93	35	128	5.7

Source: Estimated production derived from estimate of area sown, assuming a yield of 500 kilograms per hectare; imports are from Canadian export data.

Hemp seed is used in Australia for body care products and, to a lesser extent, pet food. In some states and in New Zealand it may be fed, under certain conditions, to livestock but it appears little, if any, is used for this purpose. The Australian hemp industry is considered a niche market with products available from specialty stores and online. According to industry sources, demand is growing steadily for hemp body care products in Australia. Industry sources also believe there will be demand for hemp seed food products if legalised (Ecofibre, pers. comm.). Domestic marketing strategies will aim to highlight the health benefits of hemp oil and seed products.

Hemp seed processing in Australia

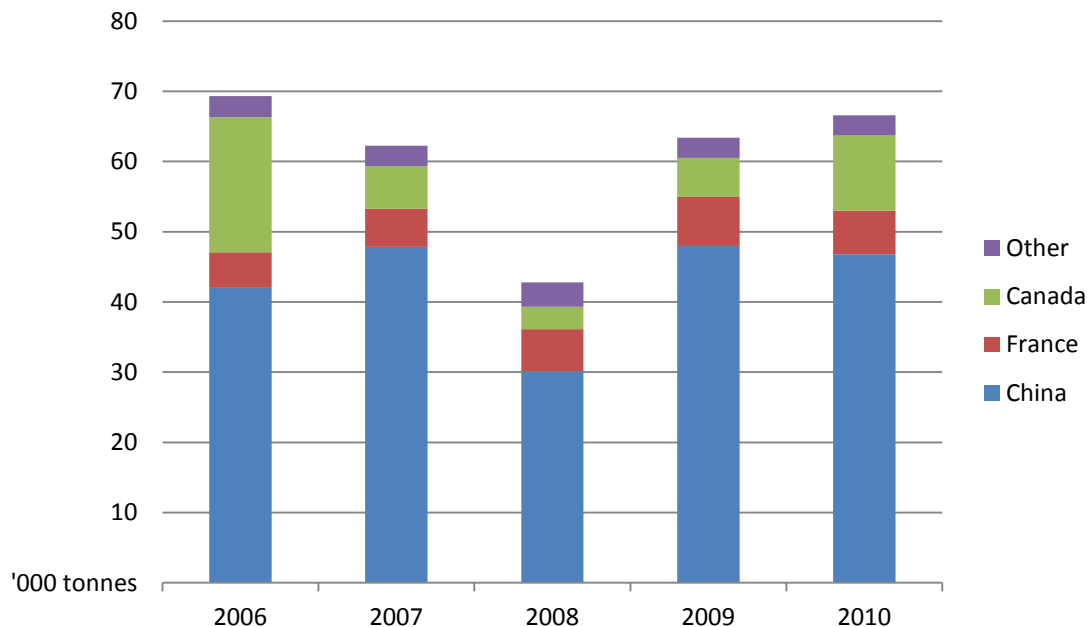
Industrial hemp can be processed for seed using existing infrastructure and equipment in Australia. The crushing mills used to process hemp seed into oil are the same ones used to process grains and oilseeds. For a mill to legally crush hemp seed, a license needs to be purchased for a nominal fee. Processing licenses are available from most states in Australia and are valid for up to five years. The Australian grains industry has ample processing facilities with the capacity to process large volumes of grain.

Hemp seed products, such as cosmetic goods, can be made on-farm from hemp seed oil, once the seed has been crushed. Some of these small operations send their seed out to be crushed, while others have their own crushing capacity. Based on available data, hemp seed products made in Australia have been confined to the domestic market.

3 World markets for hemp products

World hemp seed production in 2010 is estimated to have been around 67 000 tonnes (Figure 2). In 2010 China was the world's largest producer of hemp seed, accounting for 70 per cent of world production, followed by Canada (16 per cent) and France (9 per cent).

Figure 2 World hemp seed production



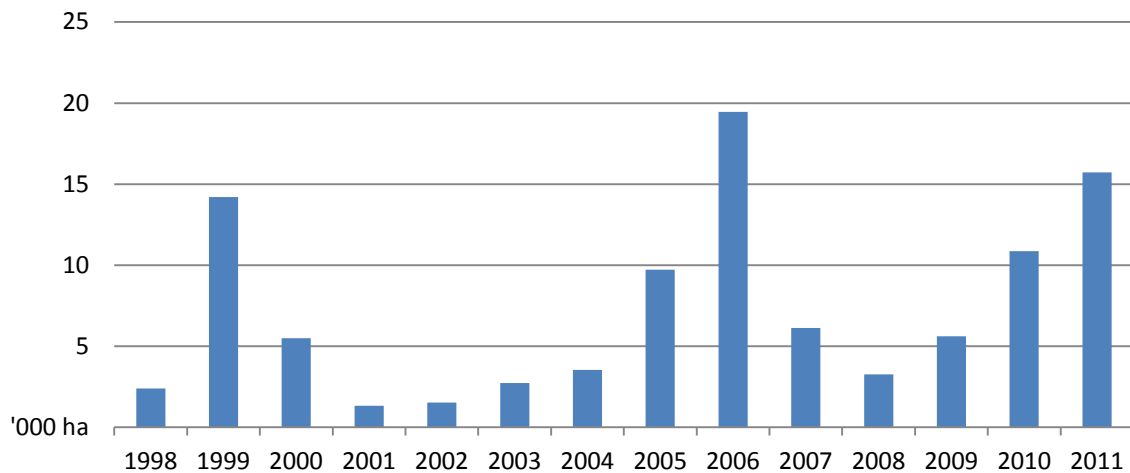
Data source: FAO data are used in conjunction with an estimate for Canadian production based on 80 per cent of area planted (assumed 20 per cent for fibre) and an average yield – Agriculture and Rural Development Alberta.

Although China is the world's largest producer of hemp seed, it only exports a small amount, mainly for planting. However, China does export other hemp products, such as hemp fibre and hemp textiles.

Canada

In 1998 the Canadian Government (Health Canada, Office of Controlled Substances) began issuing commercial licenses for hemp-related activities, including cultivation, distribution, importation, exportation, transportation and processing.

Since 1998 when it became legal, industrial hemp seed production in Canada has been variable. An initial spike in planted area in 1999 (Figure 3) was driven by proposed development of processing facilities in Manitoba. However, this facility was not constructed and the planted area declined over the next two years (2000 and 2001), reflecting excess supply and falling prices. From 2002 planting increased, reaching a record 19 500 hectares in 2006, but again industry expectations exceeded market demand. Stocks accumulated and prices fell, prompting another decline in production. In 2009 the area planted to hemp seed began to recover, reaching the second highest recorded area of almost 16 000 hectares in 2011.

Figure 3 Hemp planted area, Canada

Data source: Alberta Agriculture and Rural Development

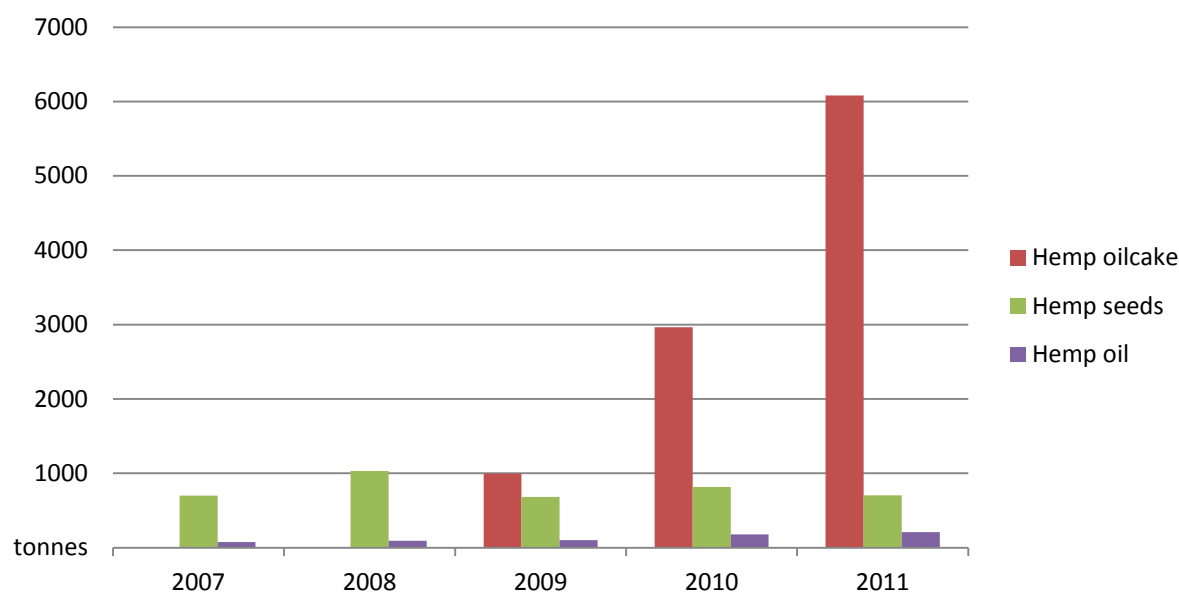
Canadian hemp is mainly grown in Alberta (41 per cent), Manitoba (29 per cent) and Saskatchewan (26 per cent). Alberta Agriculture and Rural Development estimates that more than 80 per cent of the hemp planted area in 2011 was for seed production reflecting a stronger supply and value chain compared with hemp fibre (Serecon 2012).

Canadian hemp seed production is estimated to have been around 15 500 tonnes in 2011 (Laate 2012). It is mainly used for human food and body care products and as well as a small amount for planting. However, as the markets for hemp seed products are not fully developed, demand is variable. This has led to oversupply and large on-farm stocks, such as in 1999 and 2006. The Canadian Hemp Trade Alliance announced a goal of 100 000 seeded acres, which would generate around C\$100 million in revenue for the Canadian economy, if a market exists for this quantity of hemp products. This reflects a fourfold growth from the current seeded area and would result in a larger export capacity.

The Canadian hemp seed processing industry has received some support from federal and provincial governments since April 2010. The assistance aims to improve processing practices, increase production capacity and expand product markets. There is also a trend toward organic hemp production. It is estimated that around one-third of Canadian hemp seed production is certified organic (Laate 2012).

Canadian Government estimates of hemp seed prices received by producers ranged from C\$1433 (or A\$1380) per tonne to C\$2205 (A\$2123) per tonne. Producers generally receive a 30 per cent to 40 per cent price premium for organic hemp seed (Serecon 2012; Manitoba Agriculture, Food and Rural Initiatives 2012). In Canada, the only market for unprocessed hemp seed is for bird feed, for which the market price is about one-third that of seed for processing.

Canada exports industrial hemp in the form of seeds, oil, oilcake and fibre. Over the five years to 2011, Canadian exports of hemp seed rose by only 1 per cent to just over 700 tonnes (Figure 4). In the same period, Canadian hemp oil exports rose by 174 per cent to around 210 tonnes. Although Canada did not export hemp oilcake in 2007 and 2008, exports of hemp oilcake showed the highest growth rate of hemp seed related products, increasing by around 510 per cent from almost 100 tonnes in 2009 to 6800 tonnes in 2011. The growth in oilcake exports was primarily driven by demand from India, which accounted for 70 per cent of Canadian exports in 2011.

Figure 4 Canadian exports of hemp seed and seed products

Data source: Statistics Canada

The value of Canadian hemp exports (excluding fibre) grew by around 220 per cent in real terms since 2007, reaching almost C\$12 million in 2011. Hemp seed exports contributed to 57 per cent of total value, followed by hemp oilcake exports (34 per cent) and hemp oil exports (9 per cent).

Canada's imports are mainly hulled hemp seeds or hemp seeds for sowing; its exports are mainly manufactured seed products such as hemp nuts and other snack food items for human consumption. For this reason the unit value of hemp seed exports is markedly higher than that for hemp seed imports (Table 5).

Table 5 Canadian hemp seed prices

	2007	2008	2009	2010	2011
			C\$/tonne (real)		
Hemp seed exports	4083	6114	6760	8193	9616
Hemp seed imports for sowing		3123	1750	1718	
Hemp seed imports, except for sowing		1666	1758	1599	

Note: Deflated by Canadian Consumer Price Index, 2011=100. Exports include raw seed and products made from seed.

The United States is Canada's largest export market for hemp seed and hemp oil. The United States accounted for 88 per cent and 56 per cent of Canadian hemp seed and hemp oil exports in 2011, respectively, with total hemp exports to the United States worth C\$9.5 (or A\$9.1) million.

The United States

Hemp seed is used legally for human consumption and for body care products in the United States, but not for livestock feed. While hemp production is not strictly illegal in the United States, no production takes place because of the restrictive conditions applied.

The United States imports hemp seed, hemp oil, hemp oilcake and hemp fibre. In 2011, 86 per cent of hemp seed, 75 per cent of hemp oil and 100 per cent of hemp oilcake were sourced from Canada.

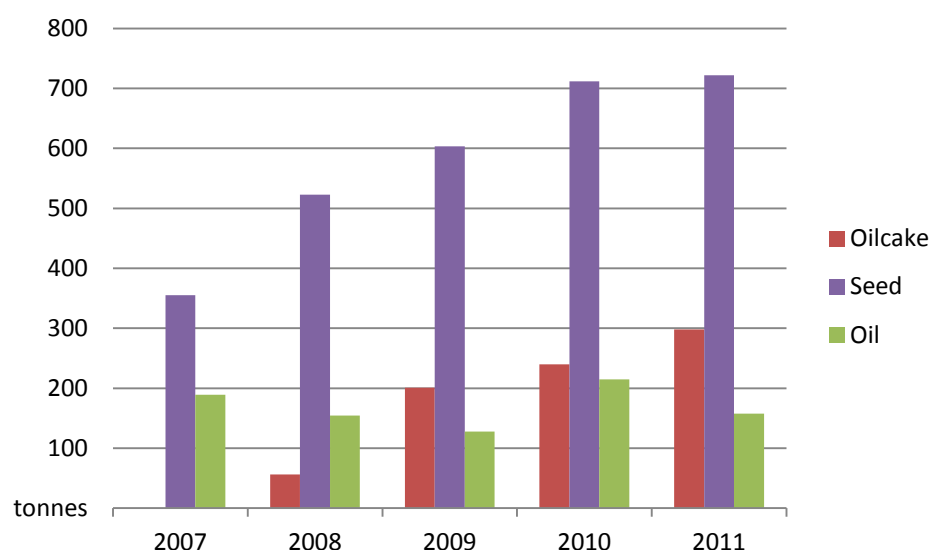
Over the five years to 2011, hemp seed imports rose by 103 per cent to around 720 tonnes, while hemp oil imports declined by 17 per cent to almost 160 tonnes. This suggests that the hemp seed processing industry in the United States is growing. Over the four years to 2011 hemp oilcake imports grew by 432 per cent—albeit from a low base—to almost 300 tonnes. Overall, there appears to be growing demand for hemp seed and hemp seed products in the United States.

Growth in demand

As no production takes place in the United States, it is assumed that imports equal apparent consumption, which in 2011 totalled 722 tonnes of seed, oil and oilcake (Figure 5). This amounts to 3.8 grams per person.

Between 2004 and 2011 imports of hemp seed, oil and oilcake combined into the United States grew at an annual average rate of around 20 per cent. Import growth has shown considerable volatility, varying from 35 per cent in 2008, to only 1 per cent in 2011.

Figure 5 United States imports of hemp seed and seed products



Data source: USDA FAS trade data.

Other niche markets—quinoa and chia

There is potential in Australia for small industries to grow and prosper. For example, quinoa and chia are niche markets established in Australia in the past decade. Both industries began with products available only in speciality stores and low demand. However, with strong domestic marketing campaigns, both are now stocked in major retail chains.

The chia plant (*Salvia hispanica*) originated in South America and grows best within latitudes of 15 degrees north and south of the equator. Chia was first introduced into Western Australia's Kimberly region around 10 years ago. Chia is grown to produce seed, oil and bran, and is considered a niche market throughout the world. Chia seeds add nutritional value to food as they are the richest plant-based source of omega 3, dietary fibre, protein and antioxidants. Over the past decade the Australian company the Chia Company has become the largest producer of chia worldwide, growing more than 2000 hectares of the plant in 2011. Australia has been exporting chia to the United States, Canada, Asia and parts of Europe for around five years.

Although chia is still considered a niche market in Australia, partnerships with Bakers Delight and a strong domestic marketing campaign have led to a substantial increase in demand. Until around five years ago, chia products were only available online or in some specialty stores, but today it can be purchased in mainstream supermarkets.

Quinoa is an ancient seed traditionally grown in Bolivia and Peru. It has become popular in the past decade due to the claimed 'superfood' properties of the seed, including a beneficial balance of amino acids essential for human growth. A strong marketing campaign led to rapid growth in demand in western countries and a tripling of the world price of quinoa over the past five years. Quinoa production in Australia began around four years ago in Tasmania, and in recent years small-scale production has begun in Western Australia and New South Wales. Australia also imports quinoa from South America and Italy. Originally quinoa was available only in specialty stores, but as demand has grown Australian supermarkets have begun selling quinoa products. Sales of quinoa in Coles and Woolworths have more than doubled in the past year.

Hemp seed consumption could follow a similar path to quinoa and chia; its success is likely to depend on development of an effective marketing campaign.

4 Australian and New Zealand supply and demand response to legalising hemp seed for human consumption

Australia

Legalisation of hemp seed for human consumption would be expected to lead to increased demand, providing a stimulus for increased production; however, these effects may be small.

Two alternative assumptions, based on the US experience, might guide Australian expectations. It can be assumed that per capita use in the United States of 3.8 grams is entirely for human consumption. It may be further assumed that human consumption in Australia would be similar if human consumption became legal here. On this basis, total Australian use would increase from 5.7 grams per person to around 9.5 grams per person, or to a total of around 212 tonnes.

If, based on the US experience, a growth rate of 20 per cent were applied to Australian use post legalisation, use would grow from 128 tonnes to 318 tonnes over five years. However, growth of 20 per cent may be less likely to be realised in Australia, where per person use is now at a somewhat higher level than it was in 2006 in the United States.

Thus, hemp seed use in Australia might increase from around 128 tonnes at present to somewhere between 200 and 300 tonnes per year over five years as a result of legalisation for human consumption. However, any increase in demand would tend to strengthen prices and dampen demand somewhat for existing non-food uses. In part, increased human consumption of hemp seed would depend on efforts the industry made to promote this market. Additional changes in demand for using hemp seed in other applications, such as body care products and pet food or for export, may occur independently but are not part of this analysis. Given the lower consumption in Europe and the United States where use of hemp seed for human consumption has been legal for some years, consumption may fall below or not expand beyond the levels suggested for Australia and New Zealand.

If the gross margins for hemp production are among the largest of those shown in Table 2, it might be expected that the domestic supply response would be strong and that most or all additional demand would be met from domestic production without a significant change in price or the quantity of seed going to non-food uses. Indeed, it may be that initial expectations following a change to the legislation would lead to overproduction for a period with consequent reduced prices and small or negative margins realised by producers. This was the effect observed in Canada when production was legalised in 1998.

As infrastructure already exists for crushing, the Australian hemp seed market could expand without facing significant barriers to processing capacity.

Using optimistic assumptions of yield, cost and price (\$3500 per tonne), and assuming a gross margin of \$1800 is sufficient to ensure increased consumption at the upper limit of 190 tonnes per year is met from Australian production, an upper bound estimate of gross revenue to Australian producers from this production would be \$665 000. The net increase in revenue to producers would be less than this to the extent that hemp production would be substituted for production alternatives.

Comparing the range of possible gross margins indicated in Table 2 with those of other crops in Table 3 it is only with higher yield and price combinations that returns from hemp seed production compare favourably with alternative crops. However, the price of \$3500 per tonne is high compared with some indications of world prices; Canadian data show import values of around C\$1500 (A\$1450) per tonne between 2008 and 2010 (Table 5). Further, yields of 1 tonne per hectare may not be achieved. At the lower ranges indicated in Table 3, hemp would not be an attractive crop for Australian producers and most if not all additional demand could be met from imports sourced from countries such as Canada. The availability of hemp products from overseas producers would help cap the domestic price at the price on world markets plus transport costs.

New Zealand

Late in the project, FSANZ asked if any information could be provided for New Zealand; in the limited time available it was possible to collect little useful information.

Using the same assumptions about per person use in New Zealand that were used for Australia, use might increase from 25 tonnes at present to between 40 tonnes and 60 tonnes if consumption of hemp food products was legalised, although the increase to be expected in New Zealand may be lower as consumption of hemp seed oil is already legal there.

No information could be located, in the time available, that would allow any estimate of the changes that might occur in New Zealand production or imports in response to possible increased demand.

5 Conclusion

This study was conducted to examine the likely changes in production, use and price of hemp seed that might follow legalisation of hemp seed for human consumption.

On the basis of limited available data, supplemented by assumptions, it is reasonable to conclude that hemp seed use in Australia and New Zealand might increase over five years following legalisation from around 155 tonnes to somewhere around 250 tonnes to 380 tonnes per year.

If prices and yields at the upper end of the possible range were to prevail, additional demand might be met from domestic production. However, if prices were more in line with those seen on world markets between 2008 and 2010, Australian and New Zealand hemp seed producers may seek more favourable returns from producing other crops, particularly if little or no yield increase is achieved in hemp production. Following an initial period in which some volatility is likely, it may be that only part of any additional demand would be met from domestic production; the remainder would be imported. The availability of hemp products from overseas producers would help cap the domestic price at the price of world markets plus transport costs.

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