CENTRAL AUSTRALIAN COMMERCIAL CAMEL MEAT VIABILITY STUDY

Report to the Northern Territory and South Australian governments

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Executive Summary

This study is the third of three major studies of the viability of the camel industry in central Australia. We have analysed the scale and specific product demand of current and anticipated domestic and international marketplaces. We have identified and analysed cost and revenue streams (i.e. viability of each business) for each stage along the supply chain for the supply of feral and farmed camels. We have also considered two abattoir investment scenarios for Central Australia.

Our analysis of the immediate market outlook for camel meat, including current markets, suggests there is capacity for further growth but not much beyond 10,000 camels. Further growth to the equivalent of 14,000 camels per annum could be possible beyond 3 – 5 years, but this would require strong government support and vigorous marketing. The market will also require a guaranteed supply. We suggested that high-end markets may be willing to pay A$4.50 per kg, and sometimes above A$5.20 per kg for boxed meat. On the other hand, low-end (protein) markets are likely to want to pay less than A$4.00 per kg, particularly with Indian buffalo in the protein market as low as A$3.20 per kg.

We modelled wild harvesting operations over a large area of inland Australia. We assumed three major operations (although there could be many more) could repeatedly remove camels off the landscape. Not surprisingly, we found repeated removal of camels in this large area eventually creates a vacuum effect. We also assumed that only 70% of the camels go to slaughter. A transition to camel farming is essential, and for a range of reasons. When attempting to find camels further out, the profit margins in wild harvest drop significantly, but more camels can go to farm and sooner. This ensures a more stable market growth and capacity, and it is possible to attain a target market of 14,000 camels in a few years.

Aside from needing a continuous chain of supply, the issues facing new and existing abattoirs include maintaining a stable, trained and reliable workforce, utility costs including water and power, and transport costs and delays incurred through breakdowns, particularly in inland Australia where securing specialist equipment can delay operations due to isolation. To-date, the SAMEX operation at Peterborough has been the only successful processor and exporter of camel meat in Australia.

If the industry is to grow to a volume of more than double the current export market in the next 3 – 5 years, an Alice Springs abattoir must be multi-species, Tier 2 export compliant and have reliable access to international markets. However, given the infancy of the camel meat export market, establishing a new abattoir could risk losing the Peterborough operation and reversing some of the gains in the overseas market by several years.

We nevertheless explored two Alice Springs abattoir options as part of the project objectives. Net Present Value (NPV) was used to determine if the investment was viable. A negative NPV means there is no future value in the investment. Assuming a $3.5 million investment was required to upgrade the existing Wamboden facility (immediately north of Alice Springs) for domestic supply of 1000 camels per annum at A$4.50 per kg delivered and boxed, without other inputs other than camel, the above concern has a negative NPV of $7.8 million, projecting 10 years ahead, thus
requiring other species inputs. We suggest a staged development approach might work where the abattoir starts out as a smaller domestic concern.

Discussions with a range of meat industry representatives provided us with estimates of between $35 million to $40 million to develop a new Tier 1 (export license) abattoir at Alice Springs. Hypothetically, if 14,000 camels were delivered and boxed to overseas destination ports from just Alice Springs, for an average of A$4.20/kg, the above concern still has a negative NPV of $28.5 million by 2026. This is if it only processed camels, thus also needing a large number of other species inputs. This carries a lot of risk.

It is hoped our report provides a clear roadmap for the future but in order for the industry to gain traction and aim for export sales of 14,000 camels per annum, there needs to be significant support to market camel meat (perhaps alongside of other niche products). This can be in the form of development grants, government policy changes and federal/state facilitation in bringing niche products (perhaps badged as clean and healthy) into trade agreement and investment discussions. There must also be a rapid transition from wild camel harvest to camel farming.

However, to achieve all of the above, there must be a more cohesive camel industry and a single point of contact that equitably represents all players. We do not recommend governments provide investment incentives for an Alice Springs abattoir, instead leaving the decision to private investors, who from this report hopefully have more certainty around what can be achieved. We strongly suggest there needs to be co-investment, perhaps using seed grants and investment from indigenous communities, processor(s) and the private sector, in an independent organisation (with marketing and/or supply agents) that has sufficient separation from the industry body and the current chain of supply. To reduce costs associated with fencing and mustering camels, we highly recommend trialling an unfenced managed herd approach, similar to the self-herding method being trialled with cattle in WA, and with early signs of success. This approach could be pivotal to industry’s success. It needs to be located in areas in central Australia where there is strong community support and it does not affect adjacent cattle operations. A ‘fence-less’ option also provides incentives for camel farmers to remove feral camels from the landscape, as over time wild camels will compromise higher quality meat products that come from a farmed operation. Improved industry cooperation with government is also paramount for a successful camel industry in Australia.

In our desktop study we suggested that 0.33 – 0.63 camels per km² could be sustainably supported as stock in the semi-arid regions of Australia. However, our analysis need to use overseas data to derive this and it did not consider the cultural context of impact or impacts on water points and highly palatable plant species, which will always be more sensitive to camels. Using the figure of 0.33 camels per km², a managed population of 68,000 farmed camels (for the current export market) would require an area of 206,060 km², and a managed population of 140,000 farmed camels (for a hypothetical 14,000 annual camel export market) would require an area of 424,200 km² most of the time. By way of context, currently, in the 290,000 km² hotspot of camels in Central Australia, there are “0.41 camels per km². Finally, as a matter of urgency we recommend that NRM agencies derive a defensible camel density/impact relationship to justify further NRM removal activities but also provide certainty for the industry.
1.0 Introduction and objectives

1.1 Introduction

This study is the third of three major studies relating to the viability of the camel industry in central Australia. We extend on the notable work of M’Kinna (2005), the Department of Business, Economics and Regional Development (DBERD, 2005), Wu et al. (2011) and Garnet et al. (2010), and more recently the views of industry representatives, Aboriginal community representatives and government staff. Importantly, new data was made available about camels collected before, during and after the Australian Feral Camel Management Project (AFCMP). Combining economic development assessments with ecological data is a relatively new approach (Lethbridge 2016). In this study these two disciplines meet when the chain of supply of camels relies (at least in-part) on the availability of wild camels. Above all, the success of a camel industry is wholly reliant on the markets for meat and by-products.

Objectives

The purpose of the study is to identify and analyse the scale and specific product demand of current and anticipated domestic and international marketplaces, including price sensitivity and quality requirements. Identification and analysis will be undertaken of the cost and revenue streams (i.e. viability of each business) for each stage along the supply chain for the supply of feral and farmed camels into an abattoir in Central Australia.

Outputs

1. A comprehensive study will be undertaken of domestic and export markets for camel meat and by-products, including direct consultation with relevant agencies. The market will be segmented into domestic and export, and the current state, price and market specifications will be analysed for a number of sectors, including fresh chilled camel meat, frozen camel meat, edible offal, pet food and other by-products.
2. An analysis will be conducted of the number of feral camels in Central Australia (NT, SA and WA) that can be sustainably harvested (to prevent environmental damage) per annum at current and future herd levels.
3. An analysis will be conducted of the likely herd size required for farmed camels if abattoir(s) in Central Australia were to process mainly farmed camels, supplemented with occasional wild capture supply.
4. Details of the quantum of capital investments and annual operating costs and the required commercial return on investment for each stage along the supply chain, including a new multi-species abattoir as a scenario. An assessment of the risks, impacts and uncertainty of the abattoir and ancillary businesses will also be undertaken.
5. Commentary will be provided on the ownership of feral camels and responsibilities of landowners and land trusts under Commonwealth, NT, WA and SA legislation.
Our overall methodological framework, project logic and workflow chart is described in Figure 1. A combination of desktop research, computer modelling and analyses, phone interviews and discussion, and face-to-face meetings were undertaken to complete the project.
PART A
Market Assessment
2.0 Market assessment

Worldwide commercial camel uses include racing, tourism, ceremonial/beauty purposes and beasts of burden. There is a world trade in live camels of between 200,000 and 300,000 head per annum (Clarke 2014). Camel products include meat, leather, oil and milk. By volume and value, meat is the most important product sourced from camels.

The National Heart Foundation has recognised camel meat as a health food. It is a free range, lean and chemical free product (samex.com.au).

2.1 World situation

Worldwide there is only a small recorded trade in camel meat – between 5,000 and 10,000 head\(^1\). Camels tend to be locally slaughtered and consumed fresh in their country of origin. Camel meat is culturally important in the Middle East and North Africa and in places where there is a long established Muslim population (e.g. the western parts of China). These populations express a strong preference for freshly slaughtered meat and product is sold through traditional wet markets. Camel meat is also finding a market in areas with a migrant Muslim population (e.g. Western Europe, North America and Australia) and with resident populations with an interest in alternative protein sources (e.g. Western Europe).

United Nations Food & Agriculture Organisation (FAO) camel meat world trade values are summarised in Table 1.

Table 1 World trade in camel meat by value 2012 and 2013 (US$’000)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Australia</td>
<td>5,005</td>
<td>5,754</td>
<td>Belgium</td>
<td>2,206</td>
<td>2,217</td>
</tr>
<tr>
<td>Belgium</td>
<td>706</td>
<td>552</td>
<td>Malaysia</td>
<td>0</td>
<td>172</td>
</tr>
<tr>
<td>Chile</td>
<td>261</td>
<td>166</td>
<td>Oman</td>
<td>99</td>
<td>134</td>
</tr>
<tr>
<td>United States</td>
<td>0</td>
<td>132</td>
<td>Canada</td>
<td>65</td>
<td>133</td>
</tr>
<tr>
<td>Germany</td>
<td>5</td>
<td>7</td>
<td>Australia</td>
<td>0</td>
<td>122</td>
</tr>
<tr>
<td>UAE</td>
<td>16</td>
<td>3</td>
<td>Spain</td>
<td>130</td>
<td>119</td>
</tr>
<tr>
<td>Netherlands</td>
<td>0</td>
<td>3</td>
<td>France</td>
<td>53</td>
<td>93</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>0</td>
<td>1</td>
<td>Switzerland</td>
<td>29</td>
<td>42</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>United Kingdom</td>
<td>5</td>
<td>35</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Germany</td>
<td>26</td>
<td>27</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Japan</td>
<td>11</td>
<td>25</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Netherlands</td>
<td>32</td>
<td>17</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>United States</td>
<td>0</td>
<td>16</td>
</tr>
<tr>
<td>World</td>
<td>5,995</td>
<td>6,618</td>
<td>World</td>
<td>2,669</td>
<td>3,195</td>
</tr>
</tbody>
</table>


\(^1\) AgEconPlus estimate based on FAO world trade data of approximately 1,662 tonne in 2014, add one third for non-saleable waste, a slaughter efficiency of 0.56 and an average carcass weight of 500kg to give a total of 8,772 head
Australia dominates world camel meat exports, accounting for US$5.7 million in a 2013 world total of US$6.6 million. Belgium, the next biggest ‘exporter’ is also the world’s largest importer of camel meat and re-exports imported product. Most of the product re-exported by Belgium is distributed within the European Union to Europeans with an interest in chemical-free game meats. Frozen cuts suitable for roasts and steaks, cubed goulash and bulk mince are acceptable in this market (see for example Deli Ostrich of Belgium www.deli-ostrich.com).

FAO data reported in Table 1 was assembled for ‘camelids’, a group that also includes llama and alpaca. Exports of ‘camel’ meat from Chile are thought to be from these two South American species. The consultants note that FAO import data is only around half the export total, with key markets such as Morocco, Libya and Egypt not recorded in the 2012 and 2013 data.

In 2014 Australia once again dominated camel meat exports and Belgium was the largest importer of product. However, Belgium’s 2014 imports are well below those recorded in 2012 and 2013 (Figure 2). In 2014, Belgium imported a relatively modest 79 tonnes of camel meat (212 live camel equivalents) with a value of US$0.577 million (an average price of US$7.30/kg) (Index Box Marketing 2015). Belgium’s average import price (US$7.30/kg) is considerably higher than the ruling international market price of US$3.98/kg.

![Figure 2](image)

**Figure 2** Belgium’s import of camel meat, 2012 to 2014 (US$’000)

Source: Index Box Marketing 2015

### 2.1.1 Competition/alternative sources of camel meat

Alternative sources of camel meat not included in the FAO data include live exported and freshly slaughtered young and purpose-bred camels from Somalia, Somaliland and Djibouti. These camels are supplied into Middle East and North African (MENA) markets at very low cost (Dioli, M., ‘Camels for Ever’, written communication, December 2015). Clarke (2014) found these camels can be supplied live to MENA markets for less than US$200/head.
2.2 **Current situation in Australia**

2.2.1 **Australian camel meat exports**

Australian exports of camel meat have been growing in recent years. Australian exports of camel meat (fresh, chilled or frozen meat and offal) were 1,136 tonnes in 2012, with an export value of A$4.84 million (ABS 2013). The main export markets for Australian camel meat in 2012 were Morocco (960 tonnes), the US (169 tonnes), Qatar (3.5 tonnes) and Hong Kong (1.1 tonnes) (Foster 2014). In 2012 there were export accredited abattoirs in Peterborough, South Australia (SAMEX) and Caboolture, Queensland (Foster 2014). The Caboolture Abattoir no longer processes camel meat (Mike Eathorne, Meramist Abattoir, Caboolture, pers. comm. December 2015), thus leaving SAMEX as the only current purchaser who requires camels in volume (Alan Keeling, Central Australian Camel Industry Association, pers. comm. December 2015).

In 2014 Australia exported 1,406 tonnes of camel meat valued at US$5.598 million (an average price of US$3.98/kg) (Figure 3). Australia exported this camel meat to only four destinations: Morocco, Canada, Libya and the US. Some 93% of Australian camel meat exports were sent to Morocco and the consultant understands that this trade is held by a single Australian exporter supplying the Moroccan Army. For the period 2012 to 2014, Morocco increased its share of total Australian exports by 14%, while the US fell by 18% (Index Box Marketing 2015).

The Australian camel meat export market is largely dependent on a single purchaser (the Moroccan Army) and this is a high risk situation for those looking to develop a larger Australian industry.

![Figure 3](Image)

**Figure 3** Australian exports of camel meat, 2012 to 2014 (US$’000); Source: Index Box Marketing 2015

Malaysia has been an important but somewhat erratic market for live Australian camels. Meat from these animals needs to compete against low cost imports of comparable protein sources. In recent years low cost frozen buffalo meat from India has displaced Australian camels from the Malaysian market.
Analysis of offer prices by exporters for halal certified camel meat are presented in Table 2. Camel meat is mostly marketed as a low cost protein that can be substituted for cheaper supplies of beef, Indian buffalo and sheep meat.

Table 2  International supply prices (FOB) camel and comparable protein (December 2015)

<table>
<thead>
<tr>
<th>Product</th>
<th>Country of Origin</th>
<th>Minimum Order</th>
<th>Price (A$/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beef – carcass fresh</td>
<td>Australia</td>
<td>1 forty foot container</td>
<td>$7.00-$18.00</td>
</tr>
<tr>
<td>Beef - frozen</td>
<td>Australia</td>
<td>27 tonne</td>
<td>$2.60 - $3.90</td>
</tr>
<tr>
<td>Beef - frozen</td>
<td>New Zealand</td>
<td>25 tonne</td>
<td>$6.50</td>
</tr>
<tr>
<td>Buffalo – frozen</td>
<td>India</td>
<td>28 tonne</td>
<td>$3.25-$4.50</td>
</tr>
<tr>
<td>Camel – boxed frozen</td>
<td>Australia</td>
<td>200 cartons</td>
<td>$3.90</td>
</tr>
<tr>
<td>Camel – bulk meat</td>
<td>Thailand</td>
<td>2,000 tonne</td>
<td>$1.30 - $2.60</td>
</tr>
<tr>
<td>Camel – tendons frozen</td>
<td>Saudi Arabia</td>
<td>1 forty foot container</td>
<td>$4.55</td>
</tr>
<tr>
<td>Camel – feet frozen</td>
<td>Saudi Arabia</td>
<td>1 forty foot container</td>
<td>$4.55</td>
</tr>
<tr>
<td>Goat – boxed frozen</td>
<td>Kenya</td>
<td>1,500 kg</td>
<td>$5.46</td>
</tr>
<tr>
<td>Sheep meat – boxed frozen</td>
<td>Brazil</td>
<td>1 forty foot container</td>
<td>$2.60 - $3.90</td>
</tr>
<tr>
<td>Sheep meat – boxed frozen</td>
<td>France</td>
<td>16 tonne</td>
<td>$3.25 - $5.20</td>
</tr>
</tbody>
</table>

Source: [http://www.alibaba.com/products/F0/halal_camel_meat_for_sale.html](http://www.alibaba.com/products/F0/halal_camel_meat_for_sale.html)

NB: Forty foot shipping container typically holds 25 tonne of meat

Most camel meat is currently traded as a commodity. Development of higher value niche markets (like those serviced in Belgium) will take time and investment in promotion.

2.2.2 Australian camel meat domestic sales

The Australian domestic camel meat market consists of slaughter for human consumption and slaughter for pet food. In the five years to 2012, there was a decrease in the number of camels processed for pet food and an increase in camel processing for human consumption (Table 3).

Table 3  Australian camel markets – approximate harvest (head)

<table>
<thead>
<tr>
<th></th>
<th>2006-07</th>
<th>2011-12</th>
</tr>
</thead>
<tbody>
<tr>
<td>Human consumption – export</td>
<td>700</td>
<td>4,000</td>
</tr>
<tr>
<td>Human consumption - domestic</td>
<td>300</td>
<td>500</td>
</tr>
<tr>
<td>Pet food</td>
<td>3,600 – 4,600</td>
<td>1,250</td>
</tr>
<tr>
<td>Live export</td>
<td>363</td>
<td>36</td>
</tr>
<tr>
<td>Total</td>
<td>5,000 – 6,000</td>
<td>5,800</td>
</tr>
</tbody>
</table>

Source: Zeng and M’Gregor (2008) and adapted from Foster (2014)

Pet food sales were adversely affected in 2012 by a scientific study (Fitzgerald et al. 2011) that associated some dog deaths with a diet of camel meat (Foster 2014). It is understood that the toxin involved does not affect human consumers of camel meat in the same way. Pet food sales have subsequently rebounded and there is strong demand for camel meal and tallow (rendered fat) from pet food manufacturers, especially in Western Europe.

Domestic human consumption of camel meat includes local sales in butchers’ shops in Central Australia where it competes on price, sales to restaurants and resorts providing gourmet meals to
international and domestic visitors, and sales to specialist retailers serving Muslim populations in urban centres. The domestic market is serviced by Wamboden Abattoir (Alice Springs), an abattoir at Condamine (Queensland) and small amounts of product from export certified processors.

While sales to Central Australian butchers and the tourist trade have been somewhat static, sales to wholesalers and meat processors supplying urban Muslim populations, who are culturally familiar with camel meat, have been growing albeit off a low base.

Typically, the supply chain serving specialist urban retailers involves trucking wild caught Central Australian camels to an abattoir closer to market, and processing into quarter carcasses and chilled meat for sale to city wholesalers, smallgoods manufacturers and retail butchers. Examples include:

- Macca Halal Foods (Flemington, Victoria; Figure 4) sources live camels from Alice Springs and has them slaughtered in Victoria. Macca Halal Foods retails to the Somali, Afghani and wider Middle Eastern and North African communities in Melbourne. Bone in hindquarter cuts retail for $10/kg and off-the-bone forequarter meat in value-added cube form sells for $19.50/kg. Camel meat sells for less than equivalent cuts of lamb and beef.

- Abu Ahmad Butchery (Punchbowl, NSW) sources Halal certified camel meat patties from Fettayleh Smallgoods (Strathfield South, NSW). Fettayleh manufactures patties from bone-in quarter carcass meat. Halal certified camel meat patties retail in December 2015 for $15/kg.

Figure 4  Macca Halal Meats, Flemington Melbourne
2.3 **Product specifications**


Camel carcass prime cuts include hind quarter, forequarter and neck. Hindquarter cuts are topside, denuded topside, outside, outside flat, eye round, knuckle, denuded knuckle, rump, denuded rump, striploin and tenderloin. Forequarter cuts are blade, bolar blade, cube roll, chuck eye roll, chuck tender, brisket point end, shin/shank, flank steak, thin and thick skirt.

Neck is mainly processed into manufacturing meat. Manufacturing meat also includes lean offcuts. Offcuts with a higher fat content are allocated to sausage trim. Edible offal include kidney, liver, heart and tail. Variety items include camel fat (bulk packed), camel feet (frozen), camel tendons (frozen), camel bones (frozen).

Higher value cuts and offal tend to be available in vacuum-packed form; manufacturing meat and sausage trim are bulk-packed.

2.4 **Camel meat co-products**

Camel processing creates a range of co-products that complement meat and offal sales. Australia has pioneered the commercial tanning of camel leather and the product is suitable for manufacture into a range of consumer goods including footwear, upholstery and sporting goods. Camel hides are of lesser value than cattle hides. Market opportunity for camel hides will be linked to the industry’s ability to build supply chain relationships and deliver a consistent supply of products that meet manufacturers’ needs (Goulding *et al.* 2007).

Mike Eathorne, of Meramist Abattoir Caboolture (*pers. comm.* December 2015) confirmed business relationships and consistent supply were important. Trial shipments of camel hides to Italy were well received, but low and inconsistent volume prevented the manufacturer from committing to camel leather products. Hides have also been sent to Bangladesh with some success, but most recently Mike Eathorne had resorted to rendering hides due to low revenue (A$20 to A$30/hide) and high salting and stacking costs (A$10/hide). By the time the abattoir assembled a shipping container load there was also the risk that the older hides would start to deteriorate.

Fat recovered from the hump and other parts of the carcass is lower in cholesterol than other animal cooking fats ([www.camelsaust.com.au](http://www.camelsaust.com.au)). Mike Eathorne notes that camel fat is very close to being polyunsaturated. There is a strong market for camel hump fat in the US where the product is purchased and consumed by the Somali community as a hot oil, a meal accompaniment into which bread is dipped (Mike Eathorne). Camel fat also has value in Chinese medicine (Wu *et al.* 2011). Camel fat is suitable for the manufacture of soaps, cosmetics and dermatological creams.
Camel fat may be used on-site by the abattoir as a renewable energy source.

Mike Eathorne indicated that there was strong demand for camel meat meal, offal and tallow. These three by-products are supplied into both the domestic and European pet food manufacturing sectors. Pet food makers are finding that dogs and cats are underperforming on single diets of beef and pork and that they respond well to the introduction of a new species. Demand for camel meal, offal and tallow for the pet food industry exceeds supply many times over.

### 2.5 Summary

In summary:

- The primary world market is low cost commodity protein. The market is small (5,000 to 10,000 head per annum), dominated by Australia and a single contract to supply the Moroccan Army – a high risk situation working against further investment in abattoir capacity
- There is a small market for higher value cuts in Western Europe i.e. hindquarter cuts. Further development of this market will require time and investment in camel meat promotion
- The Australian domestic market is niche high quality game meat for tourism ventures and lower cost meat for sale to Central Australian local populations and urban Australian Middle East and North African communities
- Camel meat in butcher shops serving Australian Middle East and North African communities retails for less than the equivalent cut of lamb and beef
- Development of co-product markets is dependent on a much larger industry and consistent supply

### 2.6 Product Assessment

Hindquarter cuts exported to European wholesalers supply the restaurant trade and some supermarkets. A product guide for a leading Belgium wholesaler is reproduced in Table 4.
Table 4
Product guide – high-end Belgium wholesaler of camel meat

<table>
<thead>
<tr>
<th>KAMEEL</th>
<th>CAMEL</th>
<th>CHAMEAU</th>
<th>DIEPVE</th>
<th>SURGELÉ</th>
<th>FROZEN</th>
</tr>
</thead>
<tbody>
<tr>
<td>857005</td>
<td>Tenderloin</td>
<td>Filet</td>
<td>Tenderloin</td>
<td>20 * 1 kg</td>
<td>+/- 20 kg</td>
</tr>
<tr>
<td>857105</td>
<td>Striploin</td>
<td>Faux filet</td>
<td>Striploin</td>
<td>10 * 2 kg</td>
<td>+/- 20 kg</td>
</tr>
<tr>
<td>857106</td>
<td>Cube roll</td>
<td>Noix d'entrecôte</td>
<td>Cube roll</td>
<td>20 * 1 kg</td>
<td>+/- 20 kg</td>
</tr>
<tr>
<td>857206</td>
<td>Goulash</td>
<td>Sauté</td>
<td>Goulash 30 - 60g</td>
<td>4 * 5 kg</td>
<td>+/- 20 kg</td>
</tr>
<tr>
<td>857505</td>
<td>Inside</td>
<td>Tende de tranche</td>
<td>Inside</td>
<td>10 * 2 kg</td>
<td>+/- 20 kg</td>
</tr>
<tr>
<td>857506</td>
<td>Trimming</td>
<td>Trimming</td>
<td>Trimming</td>
<td>block</td>
<td>+/- 27 kg</td>
</tr>
<tr>
<td>857605</td>
<td>Outside flat</td>
<td>Gite de noix</td>
<td>Outside flat</td>
<td>10 * 2 kg</td>
<td>+/- 20 kg</td>
</tr>
<tr>
<td>857705</td>
<td>Eye of round</td>
<td>Rond de gite</td>
<td>Eye of round</td>
<td>10 * 2 kg</td>
<td>+/- 20 kg</td>
</tr>
<tr>
<td>857805</td>
<td>Knuckle</td>
<td>Tranche grasse</td>
<td>Knuckle</td>
<td>10 * 2 kg</td>
<td>+/- 20 kg</td>
</tr>
<tr>
<td>857905</td>
<td>Rump</td>
<td>Rumpsteack</td>
<td>Rump</td>
<td>10 * 2 kg</td>
<td>+/- 20 kg</td>
</tr>
<tr>
<td>897908</td>
<td>Hamburger</td>
<td>Hamburger</td>
<td>Hamburger</td>
<td>30 * 105 g</td>
<td>3,15 kg</td>
</tr>
</tbody>
</table>

Source: Deli-Ostrich

European wholesalers have expressed a strong preference for cube roll, striploin, tenderloin, denuded knuckle, denuded outside and lean pieces with no sinew diced for goulash. Goulash pieces need to be hand-cut and this makes them relatively expensive to produce. Most product supplied to the European market is aged for 14 days to increase its tenderness and then frozen. A small amount of camel meat is air freighted fresh to Europe.

Product form is less important in the commodity sector which dominates world camel meat trade. Careful description is important and buyers are primarily interested in lean meat yield.

Figures 5 and 6 are preliminary. Data to inform supply chain analysis can be found in Appendix A.

Figure 5
Export supply chain Australian camel meat
Figure 6  Domestic supply chain Australian camel meat

Price ex-works includes camel purchase, processing, packaging and profit. The export CIF (cost insurance freight) price includes the ex-works cost of A$4.50/kg plus the cost of road freight to either Adelaide or Darwin (A$0.25/kg), the cost of sea freight to the export market (A$0.25/kg) and the cost of freight insurance and customs clearance (A$0.20/kg). A commodity sale price of CIF A$5.20/kg for commodity meat would be at the higher end of what the market would bear (see Table 2) and long term success would be dependent on a low Australian dollar and/or development of game meat sales.

Domestic price includes the ex-works cost of A$4.50/kg plus freight to Melbourne or Sydney – the markets with the largest number of consumers familiar with camel meat (A$0.50/kg). Prime cuts are then further processed into retail cuts (bone in steaks and cubed forequarters), and meat patties which retail for around A$15.00/kg. This market is viable and will slowly expand over time. Note prices are less than equivalent lamb and beef cuts in Halal butcher shops.

2.7 Market outlook

A preliminary comment on the market outlook for Australian camel meat is provided in bullet point form.

Domestic
- Ongoing niche sales into the tourist industry – a limited volume of high value sales. Sales are not yet significant (Alan Keeling, Central Australian Camel Industry Association, pers. comm. Dec 2015)
- Small volumes of product sold to Central Australian residents through butchers’ shops
- Modest growth in sales to people who are culturally familiar with camel meat, fat and offal e.g. the Somalian and Sudanese population of Sydney and Melbourne. These consumers are price sensitive and will switch to low value cuts of Halal certified chicken, beef and sheep meat if camel meat is not price competitive

Industry Advice
- Domestic sales are small
- Max Nunn (Condamine Qld) and Gary Dunn (Alice Springs NT) process a few camels for the domestic market but not many
- The domestic market is price sensitive and product is sold by the processor bone-in to maximise value and yield
- Pet food has significant growth potential
**North America**

**United States**
- 169 tonnes of Australian camel meat supplied in 2012 (Foster 2014)

Industry Advice
- A stable market of 250 to 300 tonnes exists in the US for Australian camel meat. However salmonella is endemic in Australian camel meat. Mainstream imported meats, such as beef and lamb, are inspected by the US Food Safety Inspection Service (FSIS) and if salmonella is detected the product is saleable only in a cooked form. For specialty meats such as camel, US inspection is completed by the US Department of Agriculture (USDA) and if salmonella is detected the entire shipment is rejected. Industry has suggested that the possible solution is irradiation here in Australia and this would add $A0.30/kg to cost of supply
- In addition to camel meat strong demand exists in the US amongst the migrant Somali community for both camel fat and offal. Liver, kidney and heart are preferred

**Canada**
- No record of exports to Canada in the published data

Industry Advice
- Canada is a 50 to 60 tonne per annum market for Australian camel meat
- Canada is prospective but difficult to develop without a consistent camel supply

**Western Europe**
- FAO data indicates that 79 tonnes of camel meat was supplied to Belgium in 2014, most of which was Australian
- Relatively stable high value sales to Belgium, Germany and other parts of Western Europe
- Increased sales require investment in market development and promotion

Industry Advice
- Small high-end sales only
- Western Europe is a new market and requires development (price discounting and promotion)
- Currently wholesalers are discounting to promote the product and establish a demand
- Total sales are less than 100 tonnes per year
- Believed there should be profitable sales in UK with its large Muslim population, however business partners have not been identified

**Eastern Europe**
- Mentioned in the proposal as prospective
- Enjoy game meats and have a large Muslim population
- Inspection and testing requirements may not be as onerous as exporting to the EU
Middle East

Morocco
- 960 tonnes of Australian camel meat supplied to Morocco in 2012 (Foster 2014)
- Single customer and largest market for Australian camel meat – Moroccan Army
- Price and consistency of supply are important

Qatar
- 3.5 tonnes in 2012 (Foster 2014)

United Arab Emirates (UAE)
- No established international trade (see Table 1)
- Find out from Rayan International Pty Ltd how prospective
- Austrade (Dubai office) are currently investigating on behalf of AgEconPlus
- Market has capacity to pay
- Preference likely to be for locally slaughtered fresh product
- Frozen product will sell to Indian worker population and will compete as a commodity
- Increased sales will require investment in promotion

Saudi Arabia

Industry Advice
- Lots of inquiry but extremely price sensitive market
- Are very particular and there is only a market for meat from 12 to 18 month old camels – this is the meat the Saudis are familiar with
- Industry advise that they could not profitably supply the Saudi market

Libya and Egypt
- ‘Grey’ literature indicates that SAMEX has a contract to supply Egypt as well as Morocco
- Niches as the political situation stabilises?
- Will want low cost protein

Asia

Malaysia
- Important but erratic market for slaughter camels
- Extremely price sensitive

Industry Advice
- Halal slaughter methods used in Australia are unlikely to meet Malaysian needs
- Acceptance of Australian product unlikely in the medium to long term
Japan

- Mentioned in proposal
- No record of a trade in the FAO data or from talking to industry stakeholders

China and Hong Kong

China has a 3,000 year history of consuming camel meat. However with a declining wild camel population, a small farmed population and the availability of alternative meats, the popularity and awareness of camel meat has declined across the Chinese population. Camel meat has been consumed in China for its richness in protein, low fat content, valuable vitamins and minerals. Camel meat, especially hump fat, has value in Chinese medicine. Potentially a market could be developed in traditional medicine and for those seeking an exotic meat and willing to pay for a luxury item (Wu et al. 2011).

In the second decade of the twenty-first century, consumption of camel meat is concentrated in Western China where it is consumed by China’s large Muslim population. While camel is a premium meat consumed during Ramadan, the capacity to pay for camel meat by China’s Muslim population is low (Wu et al. 2011).

Wu et al. (2011) found that camel meat is sold at 20 Yuan per kg ($3.06/kg) and camel feet at 25 Yuan each ($3.83), a price considerably lower than domestically produced pork, lamb (40 Yuan per kg, $6.06) and beef (35 Yuan per kg, $5.30/kg). This price difference, Wu et al. (2011) concluded, was due to higher market demand for the alternative meats and the restricted spending power of consumers in Western China.

A price of $3.06/kg is less than the current Australian cost of supply ($A4.50/kg ex works, $A5.20/kg CIF). Also working against development of an export trade with China is:

- Major Chinese Government investment in revival of the camel farming industry in Western China for poverty alleviation purposes
- The lack of a functioning supply chain – a modest 29 distributors of camel meat country wide, retailers in western China who switch refrigerators off during the day to conserve electricity resulting in poor camel meat shelf life and fraudulent practices by retailers who deliberately pass off beef as camel meat
- Low awareness of camel meat and the high cost of awareness raising (marketing) needed to revive historic consumption levels and establish a luxury goods market
- An export protocol agreement that would allow Australia to export camel meat to China.

Chiu-Hing Chan, a co-author of Wu et al. (2011) worked with the Australian Government to lodge an EOI for an export protocol with China in 2011. Although the EOI was lodged by the Australian Government in 2011, as of 11 December 2015 there had been no response from Chinese officials. Chiu-Hing Chan also noted that Hong Kong now requires a MOU and protocol for import of Australian
camel meat and an application was rejected in 2013. Alex Knight, Ngaanyatjarra Camel Company, has also attempted to secure an export protocol with China for Australian camel meat.

2.8 Preliminary investigation of the donkey market

Our study needed to consider a multi-species abattoir at Alice Springs. This could include cattle and donkeys. So while it was not part of this study, we conducted a preliminary investigation of one promising species. The population of feral donkeys on pastoral leases and Aboriginal Land Trust lands in the Northern Territory, South Australia and Western Australia is thought to number 5 million head and a number of Chinese-led delegations have already courted government and Aboriginal communities about harvesting and farming donkeys.

Feral donkeys have long been harvested for pet meat in Australia and the product finds a ready market with small animal breeders and owners keen to diversify pet diets. There may also be a market for donkey meat in commercial pet food formulations if the supply was both large and consistent.

There is currently no market for donkey meat or hides in Australia for human consumption (www.nt.gov.au/d/Content/File/Donkeys_Meat-Industries-factsheet.docx). Industry reports suggest there has been a long history of donkey meat consumption in smallgoods in Europe and in parts of Eastern Europe, donkey meat is considered an essential ingredient in salami production.

FAO data indicates that the trade in donkey meat is small and that exporters include Botswana, Canada, France, Giana, India and Zambia. Import markets include Thailand, Germany, South Africa, Qatar, the United States, Korea and Nepal.

Since about 2008 and as recent as 2015, Chinese companies have continued to express interest in importing both donkey meat and edible hides. However, these interests have never led to any real investment dollars, probably because of logistical issues in maintaining a continuous supply and the continued focus of investors on only one species. Recently, these delegations have begun to be more interested in farming donkeys. Donkey meat is considered to be a delicacy in China and there are restaurants that specialise in donkey dishes. For example, restaurants known as Guo Li Zhuang offer dishes that utilise donkey genitalia.

Donkey skins are soaked and stewed to produce a product known as Ejiao, which is used in traditional Chinese medicine to increase female libido. Industry reports recent interest from China in purchasing donkey skins with prices as high as A$200/hide. The hides are also used for medicinal purposes (http://www.abc.net.au/site-archive/rural/nt/content/200807/s2303091.htm).

A protocol was put in place enabling Australia to export donkey meat and hides to China in 2009. NT DPI&F (undated, www.nt.gov.au/d/Content/File/Donkeys_Meat-Industries-factsheet.docx) report that the protocol has now lapsed. Protocol status and any established trade post-2009 requires further investigation.
PART B
Abattoir Assessment
3.0 Abattoir assessment

3.1 Introduction

Aside from needing a continuous chain of supply, the issues facing new and existing abattoirs include maintaining a stable, trained and reliable workforce, utility costs including water and power, and transport costs and delays incurred through breakdowns, particularly in inland Australia where securing specialist equipment can delay operations due to isolation.

Currently, the SAMEX operation at Peterborough has been the only successful processor and exporter of camel meat in Australia. The likely reasons for this include a loyal workforce in an area of high unemployment, adaptable infrastructure for multiple species, proximity to port and above all, the intensive efforts put into overseas marketing. Wamboden is a small domestic abattoir situated near Alice Springs. Gary Dann is the current lessee of this abattoir and at the present time only opportunistically slaughters camels. Meramist Pty Ltd (Caboolture QLD) used to process and export camels, but the camel operations have now ceased. Importantly, the cost of transporting camels to Caboolture from central Australia became prohibitive.

The main impetus for investigating an abattoir at Alice Springs is the likely transport cost savings, thus improving the margins for suppliers and increasing the number of suppliers. After contacting several transport operators who currently move camels, the current price to transport live camels is 14 cents per camel per km (triple trailers, 19 per trailer). Using Eldunda as a centre point, the distance from Eldunda (on the Stuart Highway intersection with the Uluru road) to Peterborough is 1,155 km. The distance from Eldunda to Alice Springs is 199 km. Assuming most camels would pass through this intersection, the price difference between transporting to Peterborough versus Alice Springs is $133. More recently SAMEX, through Troy Coe, paid on average A$1.65 dress weight. This equates to A$0.825 cents live weight. Using an average of 524 kg per camel (see Section 4.4 below for explanation), the current average price paid for delivered camels is $432. While our assumption that camels pass through Eldunda is not always the case, these figures suggest that an Alice Springs abattoir on average would need to be paying a minimum of $300 per camel to be price competitive with Peterborough.

Earlier in this report, we suggested that high-end markets may be willing to pay A$4.50 per kg, and sometimes above A$5.20 per kg for boxed meat. On the other hand, low-end (protein) markets are likely to want to pay less than A$4.00 per kg, particularly with Indian buffalo in the protein market as low as A$3.20 per kg.

If the industry is to grow to a volume of more than double the current export market in the next 3 – 5 years, an Alice Springs abattoir must be multi-species, be Tier 2 export compliant and have reliable access to international markets. However, given the infancy of the camel meat export market, establishing a new abattoir could risk losing the Peterborough operation and reversing some of the gains in the overseas market by several years. We nevertheless explored two Alice Springs abattoir options and later discuss a stage approach, as well as maintaining the status quo. Ultimately
investors would undertake more detailed market analysis and costings and the following should not be considered to be an investment or business plan.

3.2 **Abattoir investment**

Net Present Value (NPV) is a popular accounting measure used by investors to determine if an investment is viable. It is the present value equivalent of the future net cash flow of a business investment. A negative NPV means there is no future value in the investment. NPV has the advantage of determining when cash will flow into the company rather than just looking at total earnings. In our analysis, we considered a 10 year payback on loans and investment. Our NPV calculations consider Consumer Price Index (CPI) and company tax, and have been checked by Hood Sweeny Accountants, Adelaide.

We spoke with a range of people about the existing abattoir at Alice Springs and the potential to upgrade it versus building a new abattoir at Alice Springs. These included Mike Eathorn, General Manager, Meramist Pty Ltd; Gary Marriot, Director SAMEX; David Frost, Senior Meat Industries Officer (SMIO) Biosecurity and Product Integrity; Phil Gee, Rural Solutions SA; and Peter Saville, Regional Veterinary Officer, Arid Zone Research Institute, Department of Regional Development, Primary Industries, Fisheries and Resources. Important insights were provided by Mr Gary Dann at a meeting at Alice Springs in late 2015 and March 2016. Mike Eathorn also provided important insights about abattoir operations and staffing.

The key response was that, to be viable, an Alice Springs abattoir must either be multi-species or be a smaller domestic-only operation. This could be staged. Unfortunately to date, a large volume of potential investors have only focussed on single species, whereas our work strongly indicates the need for a study of the market and supply chain characteristics of other species, including donkeys and horses.

An inventory of abattoir status in Australia in 2014 (the last occasion these were summarised) is shown in Figure 7. There are very few surviving domestic abattoirs in central Australia, and not surprisingly those with export status are all near the coast and ports. Wamboden is the only abattoir operating at Alice Springs and in central Australia.
Tier 1 markets accept product prepared in accordance with the relevant Australian Standards (AS 4696 and AS 4464) and where the establishments have oversight by a State or Territory Regulatory Authority (SRA). This allows exporters to access Indonesia, Vietnam, the Middle East and North Africa, to name a few. Conversely, Tier 2 establishments require registration and oversight by the Australian Government (Meat Notice 2014/04), accessing markets in China, US, Japan and Korea.

### 3.3 Camel line-slaughter system

A modern abattoir operation generally uses a line-slaughter system, using tracks in a ceiling. In small slaughter operations, a booth slaughter system (or hybrids) may be adopted. While it varies between different plants, a full team for up to 60 camels per day throughput might consist of a Halal slaughterman, a neck slaughterman, 1st and 2nd leg slaughterman, a gut slaughterman (perhaps also on saw) and two hide slaughtermen, in addition to a manager, office staff, a maintenance person and a stockman. In the boning room there would typically be three trimmers. A person would also be weighing and a second person chilling, with six casual labourers required for packing and boxing at the end of the line. A further one or two people may be required if the camel head is processed or hides are to be sold. Apprentices would need to be added to this list, depending on their role at the time. For a small operation (say less than 40 camels per day), staff could be cross-trained in slaughtering and butchery (trimming) with only one shift required. This constitutes a half-team (Mike Eathorn pers. comm.).
For high volume operations, where bigger returns on investment are sought, it would be usual to consider a fully-staffed two to three shift operational model. In all cases, there would need to be a mix of casual and permanent staff. While using casual staff has its advantages, in inland Australia a consistent supply of skilled labour may be an issue, thus placing preference on an abattoir business model towards holding onto a larger percentage of permanent skilled staff. Apart from an Approved Arrangement Food Safety program there is also a requirement for a government (AQIS) veterinarian for a Tier 2 export standard. This is estimated to cost $200,000 per annum.

We explored two options and list a third option.

**Option1 ** Upgrade of the existing facility Wamboden, Alice Springs - domestic

From the interviews we conducted, there were mixed views about the costs of upgrading Wamboden to full export license. For an export operation the following uncertainties were identified:

- water quantity and quality,
- water storage,
- hidden costs associated with upgrading an older infrastructure,
- the need for a larger floor area,
- a lack of rendering facilities,
- need for more staff facilities,
- yard standards.

Donkeys were also explored as another species Wamboden could process, but only hides from donkeys for the production of non-edible products can be exempt from the Tier 2 export standards. Since there is a low domestic demand in Australia, with China the most promising market, donkeys are an unlikely prospect for Wamboden. We also note the following extract from NT DPI&F (undated www.nt.gov.au/d/Content/File/Donkeys_Meat-Industries-factsheet.docx).

“It would be necessary to construct a new abattoir in the NT if production of [donkey] hides and/or meat for human consumption is considered as a feasible export option. Old or existing facilities in the NT would be unlikely to gain this listing as most would contain a large amount of wood and possibly asbestos which would require significant upgrade. Refrigeration technology in these existing facilities would also likely be outdated and expensive to operate.”

For the reasons above we instead looked at the opportunity for Wamboden to continue to provide a domestic camel meat market only, with a facility upgrade and a higher capacity. From our discussions, we estimate this could cost up to $3.5 million, including buying the current lease. This would be for the domestic market, and meeting the concerns above. We also considered using modular building units around the size of a standard shipping container, which can be readily preassembled and fitted out before delivery (see http://www.capitalhouse.com.au/products/miniaattoirs/).
Analysis assumptions

We assumed:

1. Camels can be sold domestically at a wholesale price of A$4.50 per kg delivered and boxed,
2. 28% of live weight is saleable meat (see M’Kinna 2005, p. 20),
3. Camel hides can be sold for between A$30 and A$40 each,
4. A single-shift of ½ a team of 13 in the line, a general manager, administration staff, a maintenance/stockman,
5. 4 to 5 staff are permanent and 11 to 12 staff are casuals,
6. Casuals on the line only work 10 weeks of the year processing camels,
7. Apart from upgrades, modular building units (see above) are used for additional killing floor space, boning room, packaging and chilling,
8. Over ten years, there would only be a need for two $20,000 infrastructure upgrades,
9. Basic running costs include power, rent, water etc.
10. A capacity of up to 20 camels per day but fluctuating to meet a maximum of 1000 per annum (domestic supply only). This assumes a domestic camel meat marketing campaign could be supported.

Assuming a $3.5 million investment was required to upgrade Wamboden, the above concern still has a negative NPV of $7.8 million, projecting 10 years ahead. These calculations suggest it is not profitable to operate a domestic abattoir at Alice Springs that only processes camels, with annual losses ranging between ~$686,000 and ~$869,000, even using an ambitious target of 1000 camels per annum. Moreover, it would be extremely difficult to procure and maintain a skilled casual labour force for just 10 weeks per annum. In fact, a positive NPV from domestic camel sales could only be made if there were a capacity to process ~31 per day and sell 8000 per annum. Clearly, the NPV shortfall would need to be found by processing cattle and selling it locally.

At the other extreme, using just 1 permanent staff and 9 casuals, together with a small $1.0 million investment (in other words little or no infrastructure upgrades), processing only 200 camels per annum still remains unprofitable. Tier 2 status was also discussed at a March 2, 2016 meeting but this would require a considerably higher investment.

Option 2 New export standard Tier 2 abattoir at Alice Springs

Discussions with a range of meat industry representatives provided us with estimates of between $35 million to $40 million to develop a new multi-species abattoir at Alice Springs, most probably in a new industrial area to the south of the town. Interestingly, some in government suggest this is conservative. This industrial site has access to ample land, water and power with sealed roads connecting to the highway. Waste disposal may present a problem, given that a disposal pit may not be acceptable near to the water supply.

To be viable, an operation of this scale would ideally need to operate with a two or three shift staff roster. For the purpose of calculating camel processing in isolation, we assumed 14 permanent staff
and 16 casuals (a full line team, administration staff, one stockmen, one maintenance worker) and only one shift would be required to process camels. We have included the cost of a government Veterinarian ($200,000 per annum AQIS fee for service).

For the purpose of the calculation only, we have needed to ignore the presence of the Peterborough abattoir in the market and assume 6,800 camels quickly builds to 14,000 camels (as per our supply chain calculations), delivered to destination ports for an average of A$4.20/kg. We use a price of $300 per head, delivered to Alice Springs. Using the $35 million investment, not surprisingly the above concern still has a negative NPV of $28.5 million by 2026 if it only processed camels. See Appendix B.

While not part of this study, we then considered adding donkey hides and meat sold to China as another species throughput for the abattoir. This definitely requires a Tier 1 abattoir because the hides are rendered for a gelatine human consumption. For the purpose of the calculation, we assumed this would be on a separate shift, without fixed operating costs, maintenance staff and office staff since these were already accounted for as permanent staff in the camel processing calculation. We also assume there are fewer processing staff required on the line for donkeys.

We have not assessed donkey meat market pricing, so for this calculation assumed the same price would be paid for donkey meat as camel. We also assume 50% of the live weight of donkeys is usable meat and the hides can fetch A$170 each. The higher population of donkeys is in the north of Australia across a large band, well into WA. For this exercise we assumed transporting live donkeys for processing at Alice Springs was practical and economical for the supply chain if they cost $150 per head delivered. This cost may be reduced substantially if donkeys were farmed, an important corollary subject requiring further research if a multi-species abattoir is the preferred option. We calculate that processing 12,000 donkeys per annum at Alice Springs would be able to generate $11 million NPV by 2026. This still leaves shortfall of $17 million of the original investment which would have to be made up with cattle and perhaps horses. Therefore, an economically viable Alice Springs export-standard (Tier 2) abattoir would need at least three species inputs.

**Option 3 SAMEX operation at Peterborough**

Maintaining the status quo requires careful consideration and governments should look at how SAMEX could potentially facilitate industry growth. See discussion later.
PART C
The Supply Chain
4.0 The supply chain

4.1 Knowledge elicitation

On the 8\textsuperscript{th} December 2015 a short presentation of the conceptual model below (Figure 8) was made to representatives from the Australian Camel Industry Association (ACIA), ex-members of the Central Australian Camel Industry Association (CACIA) and other interested parties invited by these members. This was not intended to be a general stakeholder engagement meeting. Instead the meeting was specifically designed to request information about the capital costs, infrastructure and variable costs associated with harvesting wild camels. Aboriginal communities, government staff and individuals were subsequently contacted to obtain their views. As the scope of our study is not about Aboriginal economic development specifically, we confined our questioning to technical issues about chain of supply costs and abattoir intention, and how a transition to farming camels may work.

4.2 Conceptual model

A conceptual model of the supply inputs is shown in Figure 8. We have assumed there needs to be a transition to farmed camels at some point into the future, if, in fact, a sufficient volume and continuous supply can be achieved from camels as ‘stock’. The model assumes that a proportion of mustered wild camels (mainly cows, yearlings, calves) need to be tagged and become breeding stock. How this is undertaken and the infrastructure required will be discussed in a later section.

![Figure 8: Conceptual model of the supply chain inputs and transition to stock](image)
4.3 Muster ing and transport costs

General considerations

From the participant feedback at the Alice Springs meeting in December 2015 and subsequent discussions with several camel operators, it was apparent most operators already have at least one holding yard and/or portable yard infrastructure (sometimes combined), depending on the size of the patch from which they harvest camels. In one case, two R22 helicopters have been used for forward searching and mustering. When there are enough camels to justify it, having two helicopters enables one helicopter to keep the main group of camels moving towards the yards, while the other R22 brings in other additional small groups (Ian Conway pers. comm.). However, we found that many operators use one helicopter for larger numbers whilst smaller numbers could be opportunistically mustered cheaply without the use of a helicopter. All of this depends on labour availability, skill levels and flexibility of team members. For example, 4WD vehicles tend to be used most of the time, but motorbikes could be used in the mix, providing all riders are competent (Shaun Nicole pers. comm.).

Gyrocopters, tracking collars, fixed-wing aircraft and helicopters can also help gather intelligence before the decision is made to commence mustering. Water lure methods and local intelligence gathering from community members can also affect the timing of operations, as well as reducing searching time. This information is essential in the decision to muster or otherwise, and few operators would consider a muster if there were less than 50 camels known to be in the general vicinity, say 20 km.

Variable costs

Clarke (2014) suggests mustering costs of between $50 and $100 per head in an area with high camel density (greater than 0.5 camels per square kilometre). However, using transport, wages, optional helicopter and vehicle costs, we were able to calculate more detailed operating costs for mustering and delivering camels to an abattoir (see Appendix C.1 and C.2 for a range of costs, depending on the scale of operation). This analysis suggests the variable costs to muster can range between $64 and $105 per camel most of the time (excluding calves on foot), depending on the number of camels available and the distance from tracks to muster them.
Wild camels may require yarding for up to a week before transporting long distances (Clarke 2014). He suggests holding yard costs could be $35 per head to cover feed, water and yard maintenance costs. This depends on the number of camels that can be held and bull partitioning. Internal property transport costs required to bring camels to a central collection point may be required in some circumstances. Our calculations include subsequent holding yard management, feed and watering.

Phil Gee and Shaun Nicole suggest that on average some 70% of all animals mustered are immediately suitable for transport to abattoir. Most of those animals which are not suitable could be held in paddocks (if available) and allowed to grow-out or improve their condition. This suggests that, at most, 30% may be suitable for farming, but this often depends on the ratio of males to females, temperament and age.

There is always a cost trade-off when searching for camels and mustering them at greater distances from tracks and roads, particularly when the need arises to maintain a chain of supply to market. Many operators we spoke with said that when mustering camels within 10 km of tracks, the cost of mustering camels is well under $100 per head. However, to keep chain of supply up, occasionally they may need to travel further out. On many occasions, good intelligence about camel movement is obtained by people travelling around the land. In dry conditions camels come to water, which greatly assists in reducing mustering costs. On Ngaanyatjarra, water points and yards are used to more to efficiently muster camels (Knight 2015).

The distance available wild camels are away from yards and tracks is of particular concern. For this study we needed to develop a formula that uses camel density (which relates to mob size) and the distance from tracks to determine cost, while remaining in the range of costs provided by industry representatives. Moreover, as the camel density reduces, the cost of mustering increases. The cost of mustering also increases with distance. These variables lead to an upper limit where a decision would be made not to muster. This formula (Figure 9) is a good fit of the information we obtained from a number of operators.

Figure 9 assumes the camels are pushed into winged muster yards using, on average, one helicopter, two vehicles and two motorbikes with ~5 personnel in different roles. From Figure 9 we estimate a cost of $30 per camel would be expected at a camel density of 0.45 camels per km², if all camels were within 5 km of a road or track. On average, this increases to over $90 per head 12 km out from a track and at a lower density of 0.3 camels per km². Clearly when camels are more than 12 km from tracks and in very low densities, the costs rise dramatically. Interestingly, these figures are generally lower than the figures quoted by Clarke (2014) but likely to be more precise because we have costed in wages, vehicles, camel density and distances to tracks.
Appendix D shows up-front costs associated with mustering operations. For this exercise we have assumed a worst case scenario, that is, a new operator starting with little or no infrastructure. When interviewing industry operators, there were variations in the capital equipment and infrastructure required. For example, some suggest permanent yards with winged panels, droppers and hessian are sufficient, while others have separate holding yards to mustering yards. This depends somewhat on the landscape (hills, natural corridors), existing infrastructure and if an operator needs to use separate portable yards for flexibility.

For each mustering yard, we used a price of $140 per panel at 200 panels for a yard, with additional costs for droppers, labour, the welding of gates, ramp construction, water infrastructure, used vehicles and motor bikes. This came to a total of ~$180,000. We acknowledge some of these systems have already been bought by current operators working in the region or combined with permanent yards, nevertheless, as a worst case scenario, we have included these costs.

Annual maintenance costs are in addition to this. These are highly dependent on the level of wear and tear, but we have assumed up to $12,500 per annum in our model.
**Transport**

Our model assumes the price paid by the abattoir is not farm gate but landed works (delivered). We used a figure of 19 adult camels per single deck, raised roof, 40 foot trailer. As previously mentioned, we contacted several transport operators who currently move camels. They provided a price that equates to 14 cents per camel per km.

**4.4 Current information on camel ecology**

The opportunity costs of mustering wild camels greatly depends on their ecology.

**Camel population growth rate**

The population increase of camels in Australia has been well publicised in the media. The figures generally quoted in public documents and the media stem from a study by Dörges and Heucke (1995), where they calculated annual population growth rates in the range 7.1% to 12.3%, with an average of 9.7%. However, this was derived over a relatively small area at New Haven (NT) and in a fenced area. Following the Australian Feral Camel Management Project (AFCMP), more up-to-date information has come to light which reveals that free-ranging camels in the broader landscape do not survive as well in drought.

Moreover, Lethbridge (*unpublished*) undertook a study of the population age structure of over 200 camel carcasses in the Simpson Desert in SA from the 2010 cull, and contracted an independent consultant to age the animals using cross-sections of incisor teeth (Figure 10). Assuming this was a stable age distribution, the population growth rate was estimated from these data to be 1.06 per annum for free ranging camels using a matrix model in PopTools (Hood 2010). In a separate study, Pople and McLeod (*unpublished*) used five estimates of the population between 1966 and 2001 and calculated a population growth rate of 1.05 for free-ranging camels.
Other supporting evidence that wild camels may exhibit a lower population growth rate than Dörges and Heucke (1995) study includes high levels of natural mortality of camels observed in the Great Victoria Desert and the Simpson Desert in the period 2011 to 2013 (Lethbridge et al. 2016). Here carcasses were counted from an NT aerial survey and it was estimated that there were more than 13,000 mortalities (Saalfeld & Edwards, unpublished data). This was twice the number culled in this region. These mortalities are thought to be the consequence of the combined effects of fire and low rainfall. In September and October 2011, a series of large fire fronts moved across much of the Simpson Desert, burning about 60% of the landscape. Fire and drought also occurred in this period in the Great Victoria Desert and Western Deserts of NT and APY Lands, and while no formal surveys of carcasses were conducted in these regions, further mortalities were observed in these areas.

For this study we have therefore assumed for a farmed or managed herd of camels, the population growth rate of 1.097 (10% increase per annum) from Dörges and Heucke (1995) is applicable but in the wild the average is more likely to be 1.06 (a 6% increase per annum).

**Camel movement**

Understanding camel movement is vitally important, and the opportunity costs of harvesting wild camels are heavily dependent on how camels move across the broader landscape and how they congregate. Lethbridge et al. (2010) satellite-tracked female camels in central Australia and found camel movement in Australia was not migratory, but instead was more akin to a combination of temporary home ranges and larger movement events between these monthly ranges, termed ‘ranging’. They calculated a mean monthly range of approximately 11,000 ha to 300,000 ha. Figure 11 is a schematic representation of these two movement modes.
Figure 11  Schematic representation of camel ranging (dashed lines) and home ranges (other coloured lines)

For most of the time, the camels ranged well under 100 km between these home range centres with several long-distance monthly movement events of more than 200 km. So over a 12 month period, camel movement is at a much broader scale than any one mustering operational area. Since the study by Lethbridge et al. (2010), data was obtained from a further 28 camels, most of which were satellite tracked for more than 12 months in the Gibson Desert and Simpson Desert, before, during and after AFCMP. Lethbridge et al. (2010) only published the results of seven females. In Figure 12, data from an additional three males are also included.

Figure 12  Monthly home ranges areas (converted to an equivalent average radius of activity - left) and ranging distance between home range centres (right)
All of the camels captured by Lethbridge et al. (2010) were in APY Lands. These camels were often travelling larger distances into NT and WA because they needed to move through corridors around mountain ranges. Large ranging events between home range centres in the Simpson Desert can be attributed to the larger north-south movement camels needed to range following the north-south dune system. These dunes substantially inhibited east-west movement and inflated north-south movement. As the dunes are 100-600 metres between peaks, this also accounts for the more contained monthly home ranges seen in the Simpson Desert when compared with the other areas.
Camel distribution

Large camel densities occur in three or four broad-scale hotspots within a 400 km radius of the tri-state border (Surveyor General’s corner – Figure 14 below). Interestingly, when Lethbridge (unpublished) analysed these changes over time at a broad scale, the general distribution of camels has not changed dramatically over the last decade. This shows camel movement is relatively non-random at the broad-scale. While not technically migratory, Lethbridge et al. (2010) found camels often move in cyclic fashion, which is no doubt related to memory of pasture and water held by cow-herd matriarchs. Similarly, older bulls would have a good memory of these locations.

In dry seasons, Lethbridge et al. (2010) also found camels regularly return to water in 3–10 day cycles, and camel operators who regularly harvesting camels in central Australia have observed the repeated return of camels to good pastures in swale systems and water points, using this to their advantage in harvest operations. This also means that repeatedly mustering camels from the same area will eventually create a vacuum effect. Knowing the magnitude of this effect (hence the timeline) is vitally important in terms of the cost and profit margins of mustering operations and importantly, the timing of the transition time to farmed camel operations to maintain a consistent supply.

In order to establish the link between camel movement/abundance at a broad scale and the viability of harvest operations across Central Australia, we developed a spatially-explicit stochastic simulation, similar to Lethbridge (2016). The commercial industry version of this model can be applied to a range of species including donkeys, goats, horses and kangaroos. The model provides a foundation for understanding the viability of mustering operations, their extent and the likely transition time to farmed camels, should landholders and governments adopt this option. The model accounts for changes in camel population growth rate, costs, and the number of animals able to be mustered, although for this progress report we have not yet included costs since more data is to be gathered.

Camel weights

Mr Phil Gee provided a range of weights for each age class of camels. We then used the age distribution data in Figure 10 (assuming it was indicative of all camels) and the percentage of camels in each age category (except calves and yearlings) to arrive at a weighted average of 524 kg. This is assumed to be an average across age classes and seasons. This weight was also used in the abattoir NPV calculations in the previous section.

4.5 Model description

The model predicts camel distribution, density, availability in muster areas and mustering costs over the next 20 years. This is a stochastic model. Stochastic models acknowledge there will be a range of variations in the way camels move and congregate. The model is based on the 2013 camel distribution map (Figures 14, 15; NintiOne 2013) and assumes there were about 350,000 camels in Australia at that time. Figure 13 is a schematic diagram of how the model operates. The model supports up to 10,000 repeated simulations. The entire Australian landscape is divided into grid cells.
At the commencement of each simulation the population is reinitialised and redistributed across the landscape according to the most current camel distribution map. In each annual time cycle, mobs of camels are moved according to the known home range and ranging limits described in Figure 12. The model also simulates mustering operations in the hypothetical areas of the landscape specified by the user.

Figure 13  Schematic diagram of the model's operation
4.6 Scenarios modelled

We first analysed the removal area marked in red in Figure 14. This may or may not approximate the harvest area over Nganyatjarra Aboriginal Lands. We then added further harvest areas (Figure 15). These areas pay little attention to land ownership and boundaries and are located approximately over the known camel hotspots rather than the fringe areas, where it is less likely harvest operations would be viable. While some may view the total area in red (281,900 km²) as ambitious, our intention is to understand how a fully supported, equitable and high capacity camel industry could work. Thus it seemed sensible to explore a scenario at the broader scale.

Analysis assumptions

We assume:

1. A starting population of 350,000 wild camels across Australia, and to keep our estimates conservative we assumed government agencies and industry will at least keep the population of ~350,000 from increasing across the broader landscape,
2. The population growth rate for farmed or managed camels is 10%,
3. Over the whole removal area (in red in Figure 15), three major operations or several equivalent minor operations could harvest camels,
4. However, for the area in Figure 14 over Nganyatjarra Aboriginal Lands in WA, there is assumed to be only one mustering team,
5. Each mustering operation requires an initial capital investment of $180,000 for vehicles, temporary yards etc. (following Appendix D). This is thought to be sufficient to install a single temporary winged yard or wings attached to a permanent holding yard per operation,
6. Annual fixed costs for maintenance and equipment upgrades are ~$12,500 per operation,
7. An export market could be grown over 3 – 5 years, doubling the current 6,800 per annum exported to ~14,000.
Figure 14  The 2013 camel distribution map from aerial surveys with a red square area approximating a harvest area over Ngaanyatjarra Aboriginal Lands.

Figure 15  The 2013 camel distribution map from aerial surveys with four hypothetical muster areas covering the main hotspots.
4.7 Results

We trialled a large range of hypothetical scenarios of which only a few are reported here. Obviously, depending on the timing of removals, if fewer than ~21,000 camels (6% of 350,000) are removed each year, harvesting does not abate the overall wild camel population growth rate. From Part A, we believe it is unlikely a market target of 21,000 can be achieved in the next 5 years. All of the following scenarios are independent of the processor. In other words, these scenarios are applicable to a Peterborough and/or Alice Springs processing operation.

To test the model, we first considered camel operations on Ngaanyatjarra Aboriginal Lands. According to Alex Knight, the eventual aim of the Ngaanyatjarra Camel Company (NCC) is to bring the wild herd under management and in the interim use holding paddocks to improve animal quality and maintain the chain of supply all year round (ABC Rural 2015; Knight and Mitchel 2015). However, it is also apparent from recent discussions at a March 2016 meeting in Alice Springs that the eventual farming of camels could be a necessity for the NCC in order to maintain a long-term chain of supply. Our model (Figure 16) in fact shows that if there were no transition to farming by the NCC, harvest operations over the Ngaanyatjarra Aboriginal Lands would eventually run low on camels after a few years because the population of available camels inside the harvest area reduces. Meanwhile, well outside of this area, camels would continue to increase at ~6% per annum if they were not removed.

![Figure 16](image.png)

**Figure 16**  Harvest operations in the Ngaanyatjarra Aboriginal Lands with no transition to farming
Scenario 1: Harvest area of 281,900 km², procuring camels up to 10 km from tracks

We simulated harvesting over the larger area in Figure 15. We assumed three major operations (although there could be many more) would try to repeatedly remove as many camels off the landscape, that were available up to 10 km out from tracks and roads. This starts at about 15,000 per annum. Of these we assume that only 70% of the camels go to slaughter, despite it still costing money to muster all of the camels to a holding yard. Of the 30% remaining we have assumed most could be put to paddock or farmed. The other limiting factor is the market. Here we assume that for the first two years the market can only absorb 6,800, thus more than 30% can in fact be tagged as stock.

In Figure 17, at year 3 there are enough stock camels (~20,000) to begin slaughtering 2,000 of these per annum. As the number of stock camels can only build slowly and wild harvested camels become increasingly difficult to find, there is only 9,000 per annum available for market between years 3 and 9, after which a target of 14,000 can finally be reached. We only show the profit from harvest only below. This is the total profit of three major mustering operations. The first two years of profit are lower because we assumed a 2 year pay-back for infrastructure investments. After year 4 the profit gradually declines and by year 20 the profit becomes marginal. This does not include vehicle or infrastructure replacement costs but does include an annual maintenance cost.

Farming operations are discussed in a later section. Interestingly, the population inside the harvest area will eventually increase as animals drift in over time, so opportunistic harvesting could still occur in parallel with farming.
Scenario 2: Harvest area of 281,900 km$^2$, procuring camels up to 25 km from tracks

In the previous scenario, the 10 km limit would improve profit margins because the cost of mustering is contained. However, there is a risk that not enough camels are being removed fast enough to build the stock capacity to a level to attain the 14,000 camel target to market in 3 years. In the following scenario, we accordingly increased the catchment area of camels out to ~25 km from roads, considering the increased cost penalty associated with mustering camels further out (Figure 18). So while the profit margins drop significantly, in this scenario more camels are being tagged and farmed sooner, thus ensuring a faster market growth capacity and attaining 14,000 camels to market by year 3.
Figure 18  Harvest operations over a larger area, extending out to 25 km from tracks
PART D
Farmed Camel Capacity
5.0 Farmed camel capacity

The financial return compared with other grazing activities with higher market price points is a barrier to the farming of camels on fenced pastoral lands (Clarke 2014). This is not to say in some parts of Australia, camels could be a smarter option than cattle. For example, in some areas camels may be useful for woody weed control. In other areas where the distance to watering points is greater than cattle are able to travel, camels may be useful. In the following, we also propose governments consider areas outside the current pastoral zone and not always consider traditional pastoral practices for camels.

5.1 Capacity requirements

Independent of where camels are processed, we have shown there must be a major transition to farming so there is less of a dependence on wild camels and a more continuous, profitable supply of camels to the market. Using the current export figure for camels of 6,800 per annum, in the absence of wild harvested camels, there would need to be ~68,000 camels managed as stock, if one assumes the ~10% population growth rate. For an export market of 14,000 (just over double 6,800), there would need to be ~140,000 camels managed as stock.

5.2 Camel density and Dry Sheep Equivalent (DSE)

To meet this capacity, an understanding of the likely stocking rate the landscape can support is critical. This desktop study should by no means be seen as having definitive figures on stocking rates because it will always be landsystem and climate dependent. For this exercise we only focus on the issue of Dry Sheep Equivalent (DSE) but acknowledge that palatable plant species and water points are often subject to heavier impacts.

As a rule of thumb, DSE densities of camels in Central Australia are likely to need to be lower than current wild camel densities because NRM agencies are unlikely to accept camels as stock if they are going to be at the same densities or more than the current numbers, particularly if they are in the same landscape as the wild camels. This suggests that behind-wire camel operations need to be more widely distributed across Australia to reduce impacts. This may also be useful for lowering the risk of supply deficiencies, because if drought takes place in one part of the country it may not elsewhere (ABC Rural 2015).

At this stage there is no official DSE for camels in Australia. We acknowledge the diet of camels is quite different from sheep, nevertheless, for the purpose of exploring likely farmed camel stocking rates, we calculate a DSE for camels by comparing other DSEs (i.e. for a range of species) in Australia with other international Livestock Units (LU), namely the UK, Sub-Saharan Africa (SSA), North America and the Tropical Unité de gros bétail (UBG), the adult bovine unit. To do this, we needed to use a set of common species/stock already cross-referenced by each unit to convert between overseas livestock units and the Australian DSE. Figure 19 shows these relationships and the DSE in Australia.
Only four regions world-wide had a sufficient number of measures comparable with Australia (including camels) to draw out any correlations.

![Graphs showing relationships between DSE and Livestock Units for different regions.]

**Figure 19** The Australian DSE relationship to four other regions where there were common units for the same species, including camels

Using these relationships, Table 5 shows the expected DSE for camels in Australia.

**Table 5** Expected camel DSE in Australia, using for OS regions

<table>
<thead>
<tr>
<th>Region</th>
<th>Expected Camel DSE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sub-Saharan Africa (SSA)</td>
<td>22.4</td>
</tr>
<tr>
<td>UK</td>
<td>11.8</td>
</tr>
<tr>
<td>North America (NA)</td>
<td>16.5</td>
</tr>
<tr>
<td>UGB (Tropical)</td>
<td>18.1</td>
</tr>
</tbody>
</table>

The UK estimate could probably be discounted because of the very different climate in the UK compared with Australia. From these figures, we suggest the DSE for camels in Australia may range between 16.5 and 22.4.

Bastin (2011) reported the ACRIS Livestock Density Update for the period 2009 to 2011, which also included the history of DSEs for pastoral rangeland bioregions (IBRAs) as far back as 1992. The stocking densities in 2011 are shown in Figure 20.
Figure 20  Stocking densities (as DSEs per km$^2$) for 2011 by pastoral rangeland bioregion (from Bastin 2011)

We also created a histogram of the yearly livestock densities (DSEs per km$^2$) for all pastoral rangeland bioregions (Figure 21) using Bastin’s (2011) published data.

Figure 21  Histogram of yearly livestock densities across all pastoral rangeland bioregions, calculated from Bastin’s (2011) published data.
This has a median of 16 DSE per km². However, excluding temperate and tropical regions, the remaining bioregions (some covering the wild camel hotspots) include Coolgardie, Murchison, Gascoyne, Nullabor, Channel Country, Finke, Simpson Strzelecki Dunefields, Stony Plains and Gawler. These regions, where camels may be more likely farmed, has a much lower median of 7.4 (see Figure 22 and 23). This is also closest to the mode (peak or most common stocking rate) in Figure 23.

Figure 22  Pastoral rangeland bioregions relevant to camel populations and operations
Using these semi-arid bioregions, and the expected camel DSE (from international conversions), median stocking rates of between 0.33 and 0.63 camels per km$^2$ could be expected for camels (Table 6).

### Table 6  Expected camel DSE (from international conversions)

<table>
<thead>
<tr>
<th>Region</th>
<th>Expected Camel DSE</th>
<th>Median Camels/km$^2$ (using 7.4 DSE /km$^2$)</th>
<th>Maximum Camels/km$^2$ (using 32 DSE /km$^2$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sub-Saharan Africa (SSA)</td>
<td>22.4</td>
<td>0.33</td>
<td>1.4</td>
</tr>
<tr>
<td>UK</td>
<td>11.8</td>
<td>0.63</td>
<td>2.7</td>
</tr>
<tr>
<td>North America (NA)</td>
<td>16.5</td>
<td>0.45</td>
<td>1.9</td>
</tr>
<tr>
<td>UGB (Tropical)</td>
<td>18.1</td>
<td>0.41</td>
<td>1.8</td>
</tr>
</tbody>
</table>

Interestingly, the CACIA engaged Dörges et al. (2003) to undertake an assessment of the stocking rates of camels in the NT. Depending on the vegetation type, they suggested 1-1.5 camels per km$^2$, but down to 0.5 per km$^2$ in drought. If these international conversions are correct, we suggest this is too high for semi-arid central Australia. Clearly, in wetter regions, much higher stocking rates could be expected.

Interestingly, more recently Brimbox et al. (2016) undertook a camel impact study for the AFCMP on water and palatable plant species. They suggest that when densities were under ~0.25 camels per km$^2$, fewer than 40% of trees and shrubs were browsed. Conversely, densities above 1 camel per km$^2$ showed severe impacts. However, total grazing pressure becomes significant around waterpoints, and close to water impact measures are often confounded by multiple species, making it difficult to
relate property-scale stocking rates to impact in these areas. Understanding how other species add to the impact on a landsystem (total grazing pressure) is also important.

It is also difficult to reconcile stocking rates for camels in temperate and tropical bioregions due to large land system variations and high rainfall events, and we have deliberately omitted any analysis in these areas. However, in the semi-arid regions of Australia it would appear that 0.33 – 0.63 camels per km² may be sustainably supported as stock, and during times of high rainfall > 1 camel per km² is possible. Importantly, this analysis does not consider the cultural context of impact or impacts on water points and highly palatable plant species.

Using the figure of 0.33 camels per km² as an example, a managed population of 68,000 farmed camels would require an area of 206,060 km² and a managed population of 140,000 farmed camels would require an area of 424,200 km² most of the time. In reality 5% - 10% fewer would need to be farmed because they are breeding constantly. There may also be some input into the supply chain from the wild herd. By way of context, currently, in the 290,000 km² hotspot of camels in Central Australia, there are ~0.41 camels per km².

5.3 Price points compared with cattle

Meat & Livestock Australia’s (MLA) latest cattle industry projections suggest Australian producers with cattle to sell should have confidence in the market over the long term. According to MLA, as of the 22 January 2016, a medium sized beef cow is A$2.17 per kg live weight (http://www.mla.com.au/Prices-markets/). While it often quoted that camel meat is high in protein and has less than half the fat of beef, thus a healthy alternative, price points for camel meat are incongruent with this suggestion.

While difficult to generalise across rainfall zones and land systems, translating the overseas units, the DSE for camels is between 11.8 (0.63 camels per km²) and 22.4 (0.33 camels per km²), whereas for beef it is approximately 10. So why would a cattle station move to camel operations when the price is lower and fewer camels can be held on the property? If this is correct, the only viable place to farm or manage camels is in areas where beef are unsuitable, fencing could be avoided or there is an ancillary role for camels (e.g. woody weed control). Co-grazing is another solution, but unfortunately this is less likely to be readily adopted by all government agencies.

5.4 Fencing versus managed herds

Fencing

For some time the ACIA has recognised the need for a “behind wire” solution to maintain a regular supply chain of camels to market. Our analysis in Part C (or Section 4) suggests this is imperative. However, there is some debate over the level of fencing required to manage a camel herd, and some concern with regard to policing of these fencing requirements near other pastoral operations (based on SA government’s Native Vegetation Council’s NVC Draft Guideline public feedback). Interestingly,
currently there are no fencing requirements for camels in either South Australia or the Northern Territory (P. Conradie, D. Casement, pers. comm.).

Some believe that a simple cattle strand-wire and/or barbed-wire fence will suffice. Ngaanyatjarra Council successfully hold camels with four strands of barbed wire (Knight and Mitchel 2015), while a cameleer at Beltana Station suggests a cattle fence where the top two strands of wire are barbed is adequate. Chris O’Hora (Calamunnda Camels P/L, a camel dairy operation) comments that the type of fencing required (and subsequently the cost) is largely dependent on a number of factors, including the type/temperament of the camels, the environment, the seasonal traits of the confined camels, and the end use of the camels. We also suggest the density of camels (i.e. feedlot, milking or open grazing) plays an important role in the level of fencing required. Well-constructed cattle infrastructure could be easily adaptable, but requires modification to suit the range of camel types (sex and ages) for safe management. For example, to confine and educate semi-wild camels, Chris O’Hora uses a five-strand wire fence (three electric wires, two neutral wires), approximately 1500-1700 mm in height. The fence is clear of vegetation for three metres either side to aid the camels in sighting the fence, and providing re-direction options. ‘Coacher camels’ further assist in domestication and training, location and introduction to new feed /water points and pathways for moment between farm layout.

In summary, fencing (if required at all) will depend on a number of factors;

1. where the camel herd is located – fenced camels within current wild camel distribution are likely to attract wild bull camels. Wild bull camels may show little to no respect for fencing, particularly during rut (ABC Rural 2015; Kamahl (Beltana Station) pers. comm.). If fenced camel herds are located outside of wild camel populations, perhaps any potential interference from wild camels will be negated,
2. the camels’ temperament – “camels are very trainable” (ABC Rural 2015). Yet the perceived proportion of wild camels suitable for farming varies widely. Some suggest 20% and others suggest a much higher proportion (Phil Gee pers. comm; Kamahl pers. comm.). Little effort is required for wild camels to adapt to captive conditions, particularly when under the guidance of personnel experienced in camel behaviour and husbandry (Kamahl pers. comm.),
3. water availability – as long as food and water is readily available within an enclosure, and this is more accessible than any food and water external to the enclosure, wild camels are likely to respect fencing,
4. fencing purpose – clearly, the fencing infrastructure required for intensive management, e.g. holding and transporting, needs to be more substantive.

Managed herds

Alternatively, the application of behavioural principles has been used to manage herds overseas without the requirement of fences (Lauren Brisbane pers. comm). Animals learn from social interactions with conspecifics and people, feedback from nutrients and toxins in plants, and interactions with their physical environment, such as the location of water. Once an animal’s behaviour is understood, the animal can be ‘trained’ to adjust this behaviour (BEHAVE 2015).
Following from this, we propose pilot testing a ‘managed herd’ system, particularly where camels are to be managed within the distribution of wild camel herds, and isolated from cattle operations. The expanding precision livestock management industry has seen a number of developments that allow for the management of livestock in remote areas and systems, such as app ‘iHerd’, allowing producers to track and monitor mobs of cattle via wireless sensor networks. Similarly, satellite collars allow for live-tracking of animals in remote environments, greatly reducing costs associated with mustering. Furthermore, the tracking of animals enables producers to determine which areas of the landscape are used by the animals, and how this might change with time of day or time of year. Moreover, virtual fencing or geofencing can be utilised to ensure animals stay within preferred boundary limits, and can notify land managers when the animals move beyond these perimeters.

At a more controlled level, Self-herding (and Self-Shepherding) allows managers to positively influence the decisions animals make on where to go, and how they interact with each other, land managers and the landscape. In fact Revell Science has demonstrated that not only are muster costs significantly reduced but more cleanskin cattle (who may leave the herd permanently) have joined the herd, thus increasing the number of stock.

The principles of Self-herding draw on animal behaviour, nutrition, physiology and ecology, with animals encouraged to move using a series of methods and cues (such as water availability, food or shiny objects). This differs from traditional approaches by not relying on exclusion and control (Maynard & Revell 2015). Managed (Self-herding) herds eliminate the risk of damage to infrastructure from wild camels. Furthermore, as the camel meat industry gains traction and the demand for quality meat increases, there is likely to be an increase in the control of wild camels to prevent poorer quality or unknown quality meat from entering the market. The Self Herding of cattle has been trialled and developed in the Western Australian rangelands, and could be equally suitable for the management of camels. Self-herding is conducive to the mode of camel movement, that is home range drifting, not migration (Dean Revell per comm; Lethbridge et al. 2010). Like cattle, camels can also be fitted with electronic identification tags (that record their presence at waterpoints or gates) and managed herd matriarchs and bulls can be fitted with satellite collars and proximity detectors (to others in the herd). These systems are now available for hundreds of dollars, not thousands of dollars.
5.4 Ownership and legislation

Feral, non-native animals are not legally owned by anybody (*ferae naturae*), until they are designated as a pest or declared animal. At this stage ownership is determined by common law as recognised in State or Territory legislation – no Commonwealth legislation exists. Feral camels then largely become the responsibility of the owners of the land upon which they occur (Carey et al. 2008, Garnett et al. 2010).

However, in the absence of a clear ownership regime in each jurisdiction, the question of access to land where feral camels exist is significant. As the control of access to land becomes a de-facto form of ownership despite there being little responsibility to control their numbers, ownership could be disputed depending on the exact circumstances under which the camels have been captured, on whose land and in which jurisdiction. Ha (2008) identified problems with the current law that may lead to ownership disputes:

1. The law may allow people to gain from trespass,
2. The law may not reward labour,
3. Legislation is inconsistent between the jurisdictions,
4. The common law and legislation regarding identification and ear-tags is problematic,
5. The doctrine of *ferae naturae* applies in an ambiguous manner.

In Australia, ownership rights fall into a number of categories. Camels that have been sufficiently domesticated may be *mansuetae naturae*. Whether a wild camel has been ‘sufficiently domesticated’ should be determined by factors including the type of enclosure, the length of time they have been confined, whether they are marked or tagged and whether they have been managed as livestock (Ha 2008).

To own a wild animal *per industriam* requires taming or confining the wild animal so it is under its owner’s control. If it escapes and pursuit is abandoned or impossible, it is no longer owned. Wild animals can be owned *propter impotentiam* if they are injured or too young to be independent. The final right is for the owner of land to kill or take wild animals on that land, at which point they become the absolute property of the landowner, although this is a by-product of landownership not a right of property in wild animals (Garnett et al. 2010).

Case law supports the superiority of *per industriam overratione soliso* that an animal chased continuously from another’s land becomes the property of the chaser once killed not the owner of the land on which it was killed (Blades v. Higgs 1865).

In 2007, a comprehensive draft review of over 570 pieces of legislation relating to feral camel management was produced. The review made it clear that the relevant legislation was inconsistent and unworkable (Ha 2008). To alleviate this situation, Ha (2008) recommended that the Crown claim ownership of wild camels. But issues with this resulted in a proposal that the relevant States and Territories enter into an agreement, similar to the Intergovernmental Agreement on the Murray-Darling Basin Reform of the Council of Australian Governments (Ha 2008).
**South Australia**

South Australian landholders are legally responsible for the managing the impact of pest animals under the Natural Resources Management Act 2004 (SA) s 181. The owner of the land is responsible for the control of any feral camel upon their land. A person must not release a feral animal in SA.

Under the Pastoral Land Management and Conservation Act, stock are “any animal on a pastoral lease that is part of a commercial enterprise under the lease.” Currently this covers cattle and sheep. Recently, the South Australian government released a draft document relating to the farming or pasture of camels. The ability to hold camels as stock in SA is subject to the tenure. On pastoral lease areas, camels constitute a change of livestock species (from the approved cattle and sheep). This change of livestock species constitutes a form of land clearance under the Native Vegetation Act, and therefore requires approval of the SA Pastoral Board and NRM Board. Camels can however, be run as livestock on Free Hold and Perpetual Lease areas subject to similar land management and livestock management requirements that apply to other livestock species. DEWNR and the SA Pastoral Board have, on at least two occasions, approved the domestic production of camels on pastoral lease areas, but in general most camels in rangeland areas are considered feral (D. Casement, pers. comm.).

Any owner of camels must have a Property Identification Code (PIC), and ‘managed’ camels would need to be marked and registered via NLIS, and held behind wire/fencing (D. Casement, pers. comm).

**Northern Territory**

Under the Territory Parks and Wildlife Conservation Act, a feral camel is classed as a ‘prohibited entrant’. The owner or occupier of the land is responsible for the management of the camels. The general rule is that a person cannot own or have property of a wild animal (*ferae naturae*). However, feral camels can become the property of someone when killed or taken, used and or domesticated by the person claiming title to the animal. The critical question that arises is whether a person has taken ‘possession’ or has the care and control of the camel. The taking of possession of the camel can occur by capturing it, confining it or killing of it and thus acquiring rights to the use of the animal. Under the Territory Parks and Wildlife Conservation Act 2006, a person must not release a feral animal in NT.

Under Pastoral Land Regulations (NT) r 6, ‘Stock’ includes camels that are not in a feral state, and under the Pastoral Land Act 1992 (NT) ss 3(1), the Minister may order removal of stock which can then either be sold or disposed of to a new owner. While permits are not required for the transport of camels into or out of the NT, properties must have a PIC, and waybills must be completed for camels (feral or farmed). No NLIS registration is currently required. The NT government has recently developed a guide relating to the farming, processing and export of donkey products (Corowa 2015). The definition for a husbanded donkey is one that is ‘adequately controlled behind fencing and managed by providing feed and water; donkeys may be branded for identification purposes’. It is likely that the definition of a husbanded camel would be similar; the branding of camels is not compulsory (Kluth 2015).
Discussion and Recommendations
6.0 Key findings

6.1 Markets

Our summary of the immediate market outlook for camel meat, including current markets, suggests there is capacity for growth to ~10,000 camels (Table 7). Further growth to ~15,000 camels per annum could be possible beyond 3 – 5 years, but this would require marketing support and vigorous overseas marketing. The market will also require a guaranteed supply.

Table 7 Market Status and outlook

The last column is indicative and assumes 28% of live weight is useable boxed meat with an average live weight of a camel = 524kg.

<table>
<thead>
<tr>
<th>Market</th>
<th>Comment on market status and outlook</th>
<th>Likely market demand (tonne/year)</th>
<th>Equivalent camels</th>
</tr>
</thead>
<tbody>
<tr>
<td>Australia</td>
<td>Viable market that will grow slowly over time</td>
<td>125</td>
<td>852</td>
</tr>
<tr>
<td>North America</td>
<td>Viable market willing to pay more than commodity prices</td>
<td>300</td>
<td>2045</td>
</tr>
<tr>
<td>Western Europe</td>
<td>Small game meat market with capacity to pay, some sales to the resident Muslim population</td>
<td>100</td>
<td>682</td>
</tr>
<tr>
<td>Eastern Europe</td>
<td>No established sales, longer term it may be prospective</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Middle East</td>
<td>Strong preference for local freshly killed camel meat</td>
<td>50</td>
<td>3410</td>
</tr>
<tr>
<td>North Africa</td>
<td>Stable mature market in Morocco</td>
<td>900</td>
<td>6134</td>
</tr>
<tr>
<td>Other Asia</td>
<td>Unlikely that Australia could meet regional ‘Malesia’ halal certification requirements. Small test market explored in Japan with high prices received</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>China</td>
<td>Potential market but legal market access and promotion required. Small sales into Hong Kong may be possible</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Total 10,053

More immediately, there appears to be only small markets for branded or processed meat in UAE, Saudi Arabia and Kuwait. Overall demand for processed camel meat appears to be weak in the Middle East and North Africa region, where there is a strong preference for local freshly killed camel meat. However, this market could be developed with strong marketing and by generating awareness, making the product available through sampling and pricing at a competitive level (DBERD 2005).

The game meat sector in Western Europe is small and easily flooded. This market is currently being ‘developed’ by distributors who are heavily discounting the product. More immediate targets appear
to be US and Canada, paying high prices (i.e. A$6.58/kg and A$8.68/kg - FAO data). The highest priced sales were Japan at A$11.86/kg for a modest 2 tonne, but the rest of the world is low priced commodity sold for around A$4.30/kg to A$4.50/kg, and sometimes lower than this.

6.2 Abattoirs

Our analysis has shown a domestic abattoir at Alice Springs, beyond Wamboden’s current opportunistic processing, is not feasible for camels alone and there would need to be domestic cattle processing at the very least. However, an export Tier 1 abattoir could be feasible only with a well-researched business plan and collaboration between investors interested in different species inputs. In other words, it can only be viable if it is multi-species and the majority of its income comes from non-camel products.

Unfortunately, to-date, most potential investors have (at times naively) focussed on a single species. Our preliminary analysis suggests it would be important to conduct a more rigorous market and supply chain analysis of donkeys and perhaps horses. Investors will also need to calculate the required markets volumes of cattle input as there would still be a shortfall in revenue after camels and donkeys.

To be viable, a Tier 1 export license abattoir would also need to operate on a two or three shift staff roster. However, this comes with new risks including the maintenance of a skilled labour force and higher running costs, particularly associated with delays associated with breakdowns and transport – see below.

6.3 Chain of supply and farming

The harvest of wild camels is both profitable and viable for a few years, after which there must be a transition to farmed camels to maintain the supply of camels to market and stay profitable. This is because there will be vacuum effect created through the repeated removal of wild camels from current hotspot areas.

We did not cost out farmed operations because the costs depend greatly on where camels can be farmed and if they are fenced or a managed herd. However, opinion was unified among industry representatives, who said that on pastoral properties, standard cattle fencing is largely adequate for camels, providing there is sufficient food and water. Rogue and unsettled wild camels can be sorted at harvest and put to slaughter, rather than turned in as stock. However, behind wire operations can be expensive and camels need to be selected so that they are more conducive to the higher-end markets demanding premium meat. There is no incentive for a pastoral operation currently managing cattle to changeover to camels.

To this end Lauren Brisbane, Chair of the ACIA also suggested a managed herd option should be considered by Primary Industries agencies. All of the rules regarding stocking rates and ear tagging would apply, but the camels are kept on a property with some or no fencing. This would not work in the pastoral region but we recommend trialling this well away from current cattle operations and
where the cost of perimeter fencing would be prohibitive. We believe, through careful waterpoint management, a self-herding model similar to that being trialled by Revell Science (Maynard & Revell 2015) on cattle in the Pilbara could be utilised. Lethbridge et al. (2010) found camels do not migrate in Australia, instead drifting from one home range to the next. This type of movement is conducive to Self-herding or Self-shepherding models (Revell pers. comm.). Self-herding has also been shown to save on mustering costs. Another impetus for this approach is that residual populations of wild camels, particularly wild bulls, can at times pose a risk to fencing, particularly when both cow herds and water are contained by fencing.

However, much work needs to be carried out on improving the DSE guidelines for camels. In principle we also support the Native Vegetation Guidelines in SA, where NRM agencies plan to monitor long-term biodiversity impacts for farmed camels on biodiversity assets, but caution that no methodology has yet been developed to do this. This poses a risk to the industry and no doubt NRM agencies will need to clarify how they propose to conduct this monitoring. Not surprisingly, the DSE per km² varies dramatically with rainfall. However, using overseas DSE equivalents of 16 - 22, and by analysing cattle stocking rates in the more semi-arid bioregions of central Australia, we found that most of the time 0.3 – 0.45 camels per km² is likely to be sustainable. This appears to be congruent with recent observations in the NT.

6.4 Recommendations

The Industry Investment Division (2005) listed eight critical success factors for a viable camel industry, based on McKinna (2005). Some of these are still relevant and we have used relevant headings to frame our recommendations, in addition to some additional headings we have added.

1. A well-funded and targeted market development program

Gary Marriot from SAMEX suggests this is where governments can best support the industry. To do this there needs to be significant support for marketing camel meat (perhaps alongside of other niche products). This could be in the form of development grants, government policy changes and federal/state facilitation in bringing niche products (perhaps badged as clean and healthy) into trade agreement and investment discussions. The market also requires a guaranteed supply.

2. Sustainable long-term supply of camels at economic prices

A vacuum effect will occur. The increasing cost to find camels further away from tracks is also part of the problem. To maximise returns, a transition to farming needs to be immediate and involve removing as many feral camels as fast possible. We recommend trialling unfenced managed herds where it has community support and does not affect cattle operations. A ‘fence less’ option provides incentives for camel farmers to remove feral camels from the landscape, as over time wild camels will compromise high quality meat products that come from a farmed operation. The demand for high quality product may also be able to use its higher profitability to afford the cost of removal of potential interruption to the achievement of a high quality herd, the sort of quality control required for consistent product supply to international markets. Moreover, we encourage NRM agencies to
become involved with this pilot study rather than be caught up in conservative, and often subjective, views without any evidence this will be detrimental to the landscape.

3. **An economically viable Halal and export accredited slaughter and boning facility**

We do not recommend governments provide investment incentives for an Alice Springs abattoir, instead leaving the decision wholly to the commercial sector. As previously mentioned, such an abattoir is only viable if investors, historically interested in single species, partnered. However, a staged development approach might work where the abattoir starts out as a smaller domestic concern. We warn that running costs will be high and maintaining a skilled labour force and a veterinarian will be challenging. These are some of the issues bedevilling AACo’s abattoir near Darwin.

4. **Business operators prepared to run the meatworks and/or the marketing/trading company**

McKinna (2005) proposed the role of CACIA would be to facilitate livestock trade and to be represented on market and industry development committees. He suggested the need for an independent advocate as champion and to encourage cooperation. We agree. Industry Investment Division (2005) suggested two optional operating models, both of which showed the CACIA as the agents or gatekeepers in the chain of supply. However it would be unusual for an industry association to become directly involved in the supply chain, delivery or trading of camel meat. It is equally unhealthy for a single business operator to run meatworks and all of the marketing/trading. Currently, one monopoly regulates the chain of supply, for good business reasons. But despite these good reasons (i.e. for quality control and frequency of supply), continuing this model in the same way may ultimately divide the industry.

We recommend co-investment, perhaps using seed grants and investment from indigenous communities, processor(s) and the private sector, in an independent organisation (with marketing and/or supply agents) that has sufficient separation from the industry body and the current chain of supply. However, SAMEX and the Ngaanyatjarra Camel Company also need the opportunity to become involved, particularly given their successes already in securing a small economy from camel meat. Their preclusion would fragment the industry further.

5. **A cohesive camel industry association**

We applaud the initiatives of the current ACIA and the past CACIA. Despite beginning to gain some traction, funding for a CACIA executive officer position was not continued. This should be reconsidered, but now for ACIA.

Industry unity and cooperation are paramount for successful agri-business in Australia. For example, in 1996, the Australian wine sector published Strategy 2025, in which they aimed for “an unprecedented level of knowledge sharing and cooperation between the various wine and grape growing organisations” (Wine Australia 2007). This was despite stiff competition between companies
in the premium wine sector and disturbing “grape and wine supply and demand fluctuations within Australia.”

A good allied model is the Goat Industry Council of Australia (GICA). GICA represents the interests of producers and property managers selling either farmed or rangeland goats to market. Rangeland goats are part of this and account for about 90% of total goat meat production. The market levy from goat meat sales is: Meat and Livestock Australia (MLA) marketing 10.5 cents; MLA research and development 16.7 cents (matched by the Australian Government); Animal Health Australia (AHA) 4.5 cents and National Residue Survey (NRS) 6 cents, in total collecting 37.7 cents per head.

However, GICA is only responsible for managing and making recommendations to the Minister for the distribution of the goat transaction levy income and does not engage in trading. This is in contrast to the past CAICA model. CAICA was established in 1995. ‘Camels Australia Export’ was a registered business name of the CACIA, and the closely aligned (and privately owned) company Camel Exports Pty Ltd, set up in 2006 remains a registered company. While this was a well thought-out model, we suggest it would not work today because agents or trading companies need to be clearly separated from their industry association. We recommend the ACIA as a start point for rebuilding and that the industry considers a framework similar to GICA.

6. **A champion to bring all this together**

There needs to be several champions (not one) that have an interest in developing the industry beyond their own immediate gain. There also needs to be state and federal government (public servants and politician) champions that commit to this support.

7. **NRM agency support**

We have detected unwarranted negativity from NRM agencies towards the camel industry. But no one we have spoken to in the industry wants to see camels negatively impact on the landscape. Importantly, few people are able to recognise there can be long-term (imperceptible) impacts even at moderate camel densities, which does require carefully measurement.

Industry representatives and the media have also been vocal about culling. We believe culling needs to remain in the mix of strategies, particularly when traditional owners and landholders specifically want this action to be taken. The decision to muster or cull must always remain with the landholder or traditional owner, providing their voice is being properly heard.

These two issues have polarised public perception and we recommend NRM agencies work more closely with industry in future, making them the first port of call, not the last. On the other hand the industry needs to acknowledge at times, culling may be necessary. This understanding by both parties and the concerted cooperation between NRM agencies and the industry was not apparent under the AFCMP.
Despite the ground-breaking work of Brimbox et al. (2016), where they quantify the difference between camel damage and true impact (leading to long-term plant mortality), the density/impact relationship in their study was only surmised. And while it is broadly acknowledged that high feral herbivore densities negatively impact on the landscape, apart from some rare exceptions, ecologists to-date have never drawn a direct correlation between feral herbivore densities and their associated impacts in order to properly justify NRM budgets. This also hinders the traction of the camel industry and broadly marginalises the NRM sector from the majority of the rural sector. NRM agencies must therefore demonstrate through evidence what density of camels in these land systems is acceptable and be clearer about what constitutes temporary damage versus long-term impact. This gives everyone a clear understanding of objectives and target thresholds. As a start-point, we recommend NT and SA NRM agencies at least formulate and clearly communicate a methodology. Further research is required but we do not recommend waiting 10 years for its outcome. Research can run parallel with industry development and NRM monitoring.

Camel removal on co-managed and/or public reserves has some merit with some NRM staff suggesting it could happen where mustering precedes culling. This reduces the potential conflict of interest for the Minister and Indigenous co-managers but also paves the way for a genuine collaboration with industry. We recommend NT and SA NRM agencies explore this policy option in discussion with the industry.

8. **Stocking rates**

As the research will take many years, governments need to formulate a DSE for the industry with a fixed review period to allow for industry certainty. This clearly links to 7. above.

9. **Wild camel crisis?**

Using the more conservative 6% camel population growth rate and current 350,000 population estimate, there will be more than 1 million camels in Australia in the next 20 years, if they are left uncontrolled. Removal operations by government on reserves in small pockets of the landscape on (now) limited budgets will do nothing more than create a vacuum effect, in the meanwhile leaving camels to breed up in other (more remote) areas. So it is clear that post-AFCMP, NRM and Primary Industries agencies cannot maintain lower camel densities on their own, particularly now the public purse is smaller. Conversely, based on our market research, fewer than 21,000 can be absorbed by the industry, thus also having little effect on reducing the camel population in Australia. We suggest the rhetoric from both industry and government about the other must cease and if anything can be learnt from AFCMP, it is now the need for government, rural communities and commercial operators to work more closely together.

**Final comments about Indigenous opportunities**

We have not lost sight of the fact that empowerment of Indigenous Australians must come with lateral thinking. This is no more evident than on the Ngaanyatjarra Aboriginal Community, where First Peoples Australia empowerment takes the form of a business co-ownership model, a strong
determination and sound enterprise business development. As an example to all, the Ngaanyatjarra Camel Company is already moving a large number of camels to SAMEX and plans are in place for the community to locally butcher camels and possibly produce other by-products including milk.

Our study has focussed on the prospects of a broader camel industry and its place in the meat industry, and we make it clear that its success largely relies mainly on the growth of the overseas market. However, given governments have to-date been largely unsuccessful in supporting First Peoples Australia, and finance has rarely been available through commercial banks, we urge small businesses to partner rather than employ, and capital investment companies to consider risk distributed grass-roots investment models rather than always look for large scale models. All should realise there are already successful Indigenous entrepreneurs in Australia and many more are in these communities.
7.0 References


BEHAVE 2015, ‘Applying behavioural principles’, Utah State University, viewed 09/02/16, http://extension.usu.edu/behave/htm/application


Industry Investment Division 2005. ‘Analysis and Recommendations on the future of the camel meat industry in the Northern Territory.’ Department of Business, Economic and Regional Development.


UNIDO 2011 http://www.unido.org/unido-united-nations-industrial-development-organization.html


Appendix A  Miscellaneous data to inform supply chain analysis

- Keeling (2008): $3.60/kg to $4.00/kg for SAMEX to source, process and box manufacturing beef (camel meat substitute)
- Zeng and McGregor (2008): abattoir price (ex-works) of $4.00/kg for camel for human consumption
- Foster (2014): $4.26/kg ex works for camel in Peterborough or Caboolture
- Gary Dann (pers. comm. 2015): $4.50/kg ex-works for boxed bone in camel primals Alice Springs
- Mike Eathorne (pers. comm. 2015): $4.50/kg to $5.00/kg ex-works is possible/profitable
- Keeling (2008) $0.20/kg freight for Kimberley abattoir to reach southern markets
- Mike Eathorne (pers. comm. 2015): $0.25/kg for freight Alice Springs to southern port
- Mike Eathorne (pers. comm. 2015): $0.25/kg for sea freight Aust to most export markets
- Warfield and Tume (2000) say $5.10/kg wholesale price for camel meat
- Produce Marketing Australia – work on double from wholesale to retail
- AgEconPlus (2015) $15/kg retail Halal butcher in Punchbowl
- Mike Eathorne (2013) sales of boneless camel primal delivered Philadelphia profitable at $US6.80/kg

All prices in A$. 
### Appendix B  Option 2, a new export standard Tier 2 abattoir at Alice Springs

<table>
<thead>
<tr>
<th>Year</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Camels</td>
<td>14000</td>
<td>14000</td>
<td>14000</td>
<td>14000</td>
<td>14000</td>
<td>14000</td>
<td>14000</td>
<td>14000</td>
</tr>
</tbody>
</table>

**Costs**

- **Capital investment (to upgrade)**: $35,000,000
- **Fixed (e.g. upgrades)**: $100,000
- **Variable**:
  - Year 1: $7,982,783
  - Year 2: $8,222,266
  - Year 3: $8,468,934
  - Year 4: $8,723,002
  - Year 5: $8,984,692
  - Year 6: $9,254,233
  - Year 7: $9,531,860
  - Year 8: $9,817,816
- **Total**:
  - Year 1: $7,982,783
  - Year 2: $8,222,266
  - Year 3: $8,468,934
  - Year 4: $8,723,002
  - Year 5: $8,984,692
  - Year 6: $9,254,233
  - Year 7: $9,531,860
  - Year 8: $9,817,816

**Revenue**

- Year 1: $9,013,584
- Year 2: $9,283,991
- Year 3: $9,562,511
- Year 4: $9,849,386
- Year 5: $10,144,868
- Year 6: $10,449,214
- Year 7: $10,762,691
- Year 8: $11,085,571

**Nett Revenue**

- Year 1: $1,030,801
- Year 2: $1,061,725
- Year 3: $1,093,577
- Year 4: $1,026,384
- Year 5: $1,160,176
- Year 6: $1,194,981
- Year 7: $1,230,830
- Year 8: $1,267,755

**Present Value Factors**

- Year 1: 0.926
- Year 2: 0.857
- Year 3: 0.794
- Year 4: 0.735
- Year 5: 0.681
- Year 6: 0.630
- Year 7: 0.583
- Year 8: 0.540

**Present Value of Cash Flows**

- Year 1: $883,746
- Year 2: $842,832
- Year 3: $803,812
- Year 4: $698,540
- Year 5: $731,108
- Year 6: $697,260
- Year 7: $664,979
- Year 8: $646,979

**Net Present Value**

- -$28,485,018

**Average processing cost per camel**

- Year 1: $345.22
- Year 2: $270.20
- Year 3: $287.30
- Year 4: $304.92
- Year 5: $330.21
- Year 6: $341.76
- Year 7: $361.02
- Year 8: $380.85
## Appendix C.1

### Variable costs for camel mustering operations – smaller operation

<table>
<thead>
<tr>
<th></th>
<th>Hours</th>
<th>Rate - Dry</th>
<th>Totals</th>
</tr>
</thead>
<tbody>
<tr>
<td>R44 Ferry</td>
<td>3</td>
<td>$330.00</td>
<td>$990</td>
</tr>
<tr>
<td>R44 search/Muster</td>
<td>5</td>
<td>$330.00</td>
<td>$1,650</td>
</tr>
<tr>
<td>Avgas</td>
<td>8</td>
<td>30</td>
<td>$2.90</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Hours</th>
<th>Rate (inc maintenance)</th>
<th>Totals</th>
</tr>
</thead>
<tbody>
<tr>
<td>4WDs nudge vehicles</td>
<td>2</td>
<td>50</td>
<td>0.75</td>
</tr>
<tr>
<td>People</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Labour</td>
<td>3</td>
<td>$40.00</td>
<td>16</td>
</tr>
<tr>
<td>Labour - yard setup</td>
<td>3</td>
<td>$40.00</td>
<td>8</td>
</tr>
<tr>
<td>Labour - yard manage</td>
<td>1</td>
<td>$40.00</td>
<td>48</td>
</tr>
<tr>
<td>Labour - loading</td>
<td>3</td>
<td>$40.00</td>
<td>8</td>
</tr>
<tr>
<td>Hessian</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Total $ 9,971

Hypothetical target number of camels per muster: 150 $ 64 per camel
### Appendix C.2  
**Variable costs for camel mustering operations – larger operation**

<table>
<thead>
<tr>
<th>Hours</th>
<th>Rate - Dry</th>
<th>Totals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aircraft Ferry (x 2)</td>
<td>6</td>
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<tr>
<td>Aircraft search/Muster (x 2)</td>
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<tr>
<td>Avgas</td>
<td>16</td>
<td>30</td>
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</table>

**4WDs**

<table>
<thead>
<tr>
<th>Hours</th>
<th>Rate (inc maintenance)</th>
<th>Totals</th>
</tr>
</thead>
<tbody>
<tr>
<td>4WD nudge vehicles</td>
<td>2</td>
<td>125</td>
</tr>
<tr>
<td>Motorbikes</td>
<td>3</td>
<td>125</td>
</tr>
</tbody>
</table>

**People**

<table>
<thead>
<tr>
<th>Hours</th>
<th>Rate (inc overheads)</th>
<th>Totals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Labour</td>
<td>5</td>
<td>$40.00</td>
</tr>
<tr>
<td>Truck (carrying yards)</td>
<td>1</td>
<td>$60.00</td>
</tr>
<tr>
<td>Labour - yard setup</td>
<td>3</td>
<td>$40.00</td>
</tr>
<tr>
<td>Labour - yard management after</td>
<td>1</td>
<td>$40.00</td>
</tr>
<tr>
<td>Labour - loading (over time)</td>
<td>3</td>
<td>$40.00</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Hours</th>
<th>Rate (inc maintenance)</th>
<th>Totals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hessian</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Total: $15,707

Hypothetical target number of camels per muster:  **150**  
$105 per camel
Appendix D  Highest fixed up-front costs for a new camel mustering operation – 1 yard

<table>
<thead>
<tr>
<th>Item</th>
<th>Quantity</th>
<th>Unit</th>
<th>Cost</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yard panel costs</td>
<td>200</td>
<td>$</td>
<td>140</td>
<td>28,000</td>
</tr>
<tr>
<td>Gate construction (labour/materials)</td>
<td></td>
<td>$</td>
<td></td>
<td>6,000</td>
</tr>
<tr>
<td>Water troughs</td>
<td>3</td>
<td>$</td>
<td>1,000</td>
<td>3,000</td>
</tr>
<tr>
<td>Satellite phone</td>
<td>2</td>
<td>$</td>
<td>2,000</td>
<td>4,000</td>
</tr>
<tr>
<td>UHF Radios etc</td>
<td>6</td>
<td>$</td>
<td>400</td>
<td>2,400</td>
</tr>
<tr>
<td>Nudge wagon 4WD (used)</td>
<td>2</td>
<td>$</td>
<td>25,000</td>
<td>50,000</td>
</tr>
<tr>
<td>Motorbikes (new)</td>
<td>4</td>
<td>$</td>
<td>6,500</td>
<td>26,000</td>
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<tr>
<td>Water tanker</td>
<td>1</td>
<td>$</td>
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<tr>
<td>Water pump</td>
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<td>Permanent yard upgrade</td>
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TOTAL $ 183,050