Farm animal genetic resources: second national report—Australia

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Summary

This is Australia’s second country report on animal genetic resources for food and agriculture. It will contribute to preparation of the progress report on implementation of the Global Plan of Action for Animal Genetic Resources being prepared by the Food and Agriculture Organization of the United Nations (FAO) for the Commission of Genetic Resources for Food and Agriculture. This report will also contribute to an update of the State of the World’s Animal Genetic Resources. The information in this report has been entered into the FAO’s Domestic Animal Diversity Information System (DAD-IS), meaning that current Australian data will be considered in future analyses of the global status of livestock breeds.

This report summarises Australia’s livestock industries and the role of diversity of breeds used in animal production systems. It also examines the changing demands on livestock production, and discusses Australia’s capacities and priorities for conserving, developing and using animal genetic resources.

Animal genetic resources are the collection of existing genetic diversity in all livestock species and are most easily recognised as different breeds of livestock. This diversity is the result of thousands of years of animal husbandry and controlled breeding, combined with the effects of natural selection in the environments where the populations developed. Animal genetic resources can be conserved using either in situ or ex situ methods. In situ conservation maintains live animal populations through active breeding programs. Ex situ conservation involves storage of genetic material, such as semen, embryos, cells or tissues external to the living animal, in an artificial environment and usually under cryogenic conditions. In situ conservation is considered the most effective and efficient way of conserving farm animal genetic diversity.

A large proportion of the Australian livestock industry relies on a few exotic species. Although based on imported breeds, long-term selection has resulted in animals adapted to the Australian environment. Cattle, sheep, pigs and chickens are the main livestock species in Australia, and use of their animal genetic resources is advanced and effective. However, there is a focus on only several breeds within each species and, in some cases, crossbreeds dominate production. These arrangements underpin productivity growth, profitability and consequently conservation and enhancement of the genetic resources of a restricted group of breeds. Most farm animal genetic diversity is kept by small-scale farmers and enthusiasts/hobbyists. Agricultural societies, breed societies, clubs and other non-government organisations play an important role in conserving rarer and less numerous breeds, where some of these organisations have specific genetic resources conservation goals. Most conservation of animal genetic resources occurs in situ on-farm, but an active artificial insemination industry for cattle, horses, pigs and sheep could be considered a potential ex situ conservation activity.

Australia’s livestock industries are supported by agricultural research and innovation systems that have facilitated use of the latest breeding technologies to improve performance of major commercial breeds. Government policies on innovation, biosecurity and agricultural productivity have resulted in a competitive environment with a favourable biosecurity status that allows farmers and others to keep livestock species for commercial or other reasons. High quality genetics coupled with a favourable disease status have also contributed to development
of a breeding animal export industry in addition to trade in reproductive material (sperm, eggs and embryos). Conversely, the costs of quarantine can make it difficult to import genetic resources of breeds that have little current commercial value.

Effective management of animal genetic diversity is essential for the Australian livestock industry to meet emerging challenges (such as, new animal diseases and a changing climate) while increasing production to meet rising Asian demand and becoming more environmentally sustainable. Many breeds have unique characteristics or combinations of characteristics (like disease resistance, tolerance of climatic extremes or supply of specialised products) that may provide production benefits or underlie development of new export industries. However, evidence suggests ongoing and probably accelerating erosion of the global genetic resource base across many agriculturally relevant species. Australia is no different in that some breeds of farm animals have been lost.

The FAO's DAD-IS covers 33 species/groups of animals, but some are not present, not kept as farmed animals or are harvested from the wild in Australia. In addition to mainstream livestock breeds, breeds of animals that have agricultural utility, such as dogs and horses, are included in this report. Some native animals, such as kangaroos, crocodiles and emus, which are used in commercial food production, are also discussed, along with an endangered Australian species, the Southern Cassowary, which is not used for food or agriculture in Australia but is relevant in the context of international animal genetic resources conservation.
1 State of farm animal biodiversity in the agricultural sector

This chapter provides an overview of the agricultural sector in Australia. It focuses on animal production systems, use of farm animal genetic diversity and conservation status of agriculturally important species.

Overview of Australian agriculture

This overview of Australia’s agriculture provides general information, such as geography, climate and population; governance and trade; as well as agricultural sector information such as land use, climate, regional variations, employment, productivity and innovation.

General information

Geography, climate and population

Australia is located in the Southern Hemisphere and has seven external territories including the Australian Antarctic Territory. In land area, Australia is the world’s sixth largest nation, covering a total land area of 768 million hectares. The continent has an overall flat land surface, with relatively low precipitation and runoff rates. Mountain ranges in the southeast are often snow covered in winter, but Australia generally experiences mild winters and hot summers.

Australia’s climate ranges from tropical monsoon in the north, Mediterranean in the south, to temperate in Tasmania, with a vast, arid region in the interior (Map 1). Australia’s climate is highly variable, with high year-to-year rainfall variability and drought being recurring climatic features over most of the continent.

Map 1 Climate classification of Australia

Source: Australian Government Bureau of Meteorology
Australia’s population is just over 22 million people, with a density of about 2.9 people per square kilometre (ABS 2012b). The population is projected to increase to between 30.9 and 42.5 million by 2056 and to reach between 33.7 and 62.2 million by 2101 (ABS 2012b).

**Governance**

Australia has a federal system of government, where powers are divided between the Australian Government and the governments of the six states and two territories. Both levels of government are involved in policies and measures affecting the agricultural sector. Research and development (R&D) has proven essential in maintaining the international competitiveness of Australia’s agriculture and food industries. Expenditure on R&D is seen as a partnership between government and industry.

The Australian Government provides funding for rural innovation through R&D corporations (RDCs). RDCs are created as partnerships between government and industry to share funding and strategic direction setting for primary industry R&D, investment in R&D and subsequent adoption of R&D outputs (DAFF 2011a). The Australian Government also provides funding for research, including agricultural research, through a national competitive research grants system and funding to the Commonwealth Scientific and Industrial Research Organisation (CSIRO). State and territory governments provide significant resources for rural innovation mainly through their respective agriculture agencies.

The Council of Australian Governments is Australia’s peak intergovernmental forum that discusses and develops nationally consistent policy reforms. It comprises the political leaders of the Australian and state and territory governments and can initiate, develop and monitor implementation of reforms of national significance, particularly those that require cooperation by governments, such as in health, education, microeconomic reform, climate change, and energy and water. These issues may have arisen from Ministerial Council deliberations. Ministerial Councils play a key role in initiating, developing and monitoring policy reform, implementing nationally consistent policies and programs, and facilitating cooperation and consultation between the Australian governments in specific policy areas, which include matters concerning animals, such as animal welfare.

**Trade**

Multilateral processes—in particular the World Trade Organization (WTO) Doha Round and various bilateral or multi-party free trade agreements—are being emphasised to promote stronger trade and commercial ties between Australia and its trading partners. Free trade agreements facilitate access to new markets and can provide new opportunities and reduce barriers in existing markets for Australian exporters.

Over the past 40 years the Australian economy has grown and diversified. There has been significant investment in export-oriented mining and energy industries; and diversification and modernisation of the agricultural sector.

**Agricultural sector information**

The agricultural sector is influenced by land use, climate, regional variations, employment, productivity and innovation.

**Land use**

Agriculture dominates land use in Australia; around 59 per cent of total land area is used for agriculture (DAFF 2012; Map 2). Most agricultural land (88 per cent) is used for grazing. Of this, 15 per cent is improved pastures and 73 per cent is other agricultural land.
About 8 per cent of agricultural land is used for cropping and about 2 per cent of land is reserved for conservation (ABS 2010; ABS 2011). Some Australian farms practice both grazing and cropping in rotation.

**Map 2 National-scale land use of Australia, version 4, 2005-06**

Data source: ABARES

**Climate**

The pattern of Australian agriculture is largely influenced by climate. Low rainfall and high evaporation are common characteristics in many areas. Soil quality is also a common limiting factor in Australian agriculture. Australian soils are generally highly weathered, shallow, have low fertility, and are deficient in phosphorus and/or nitrogen. As a result, nitrogen and phosphate based fertilisers are used extensively. Significant parts of the continent also have salt occurring in association with groundwater, and trapped in rocks of marine origin. Consequently saline soils are a relatively common constraint to primary production.

Areas used for crop and pasture production in Australia tend to receive between five and nine months of effective rainfall (where precipitation exceeds evaporation) per year. Areas receiving more than nine months of effective rainfall generally grow higher value crops or tropical crops and fruits. In areas receiving periods of effective rainfall of less than five months, cropping is usually restricted to areas that are irrigated.

**Regional variations**

Australia can be broadly divided in three agricultural zones (Map 3). The northern tropical regions are suited to grazing (mainly cattle), intensive horticulture and sugarcane. In the more temperate regions, grain cropping and livestock production with low density grazing is found. In the south, the Murray–Darling Basin (geographical area including the Darling and Murray river systems) supports intensive agriculture, such as vegetable, fruit, rice, cotton, grape and dairy production.
Around 70 per cent of Australia’s land area is rangelands, where livestock grazing on native vegetation is the dominant land use (ABS 2010). The rangelands carry about half the country’s cattle and about 10 per cent of the sheep flock. Australian rangelands comprise a diverse array of environments and ecosystems shaped by strong climatic and geological forces. The climate is unpredictable and the scale of management is immense compared with European agricultural systems. The rangelands are also significant to Indigenous communities and contain nationally and internationally significant conservation areas.

The pastoral zone includes most of the northern tropical areas and the arid and semiarid regions of Australia. Agricultural land use in this zone is characterised by extensive grazing of native pastures. Although some cropping is undertaken, it is impractical on most farms due to inadequate rainfall.

The climate and topography in the wheat–sheep belt generally allow regular cropping of grains in addition to grazing of sheep and beef cattle in a more intensive way than in the pastoral zone. Rainfall is generally adequate for producing a variety of pasture species, usually as part of a crop–grazing rotation. Farms are, on average, smaller in this area than those in the pastoral zone.

The high rainfall zone forms the greater part of the coastal belt and adjacent tablelands of the three eastern mainland states, small areas in southeast South Australia and southwest Western Australia, and the whole of Tasmania. Higher rainfall, steeper topography, more adequate surface water and greater humidity make the high rainfall zone less suitable than the wheat–sheep zone for grains-based cropping but more suitable for grazing and producing other crops.

**Employment**

About 3.3 per cent of Australia’s population is employed in agriculture, fisheries or forestry. Australia supports about 136 000 farms; of these, almost 121 000 are solely dedicated to agricultural production. Families own and manage most farms; about 6 per cent of commercially operated farms have a corporate structure (ABS 2012b).
Productivity

The gross value of Australian farm production in 2010–11 was estimated at $52.1 billion (Figure 1), approximately 21 per cent more than the previous year. The long and widespread droughts in 2002–03, 2006–07 and 2008–09 and the lower than average rainfall in intervening years had a significant adverse effect on agricultural productivity (DAFF 2012).

Figure 1 Gross value of agriculture, fisheries and forestry production, 2010–11

Australian agriculture is strongly export-oriented, with about 60 per cent of agricultural production exported annually. In 2010–11, the value of agricultural exports was $32 billion. Over the past 20 years, the focus of Australian agriculture shifted from European to Asian markets. Major agricultural exports include grains, wool, beef, sugar, dairy products and cotton (Figure 2). A summary of farm economic data for 2007–08 to 2010–11 is shown in (Table 1).

Figure 2 Australian agricultural exports, 2010–11
Agricultural innovation

The Australian rural innovation system is characterised by a number of funding organisations purchasing a range of R&D services from a diverse group of providers. In 2008–09, funding for Australian rural R&D was estimated at $1.5 billion, with about 75 per cent provided by the Australian and state and territory governments, and the remainder by the private sector (Productivity Commission 2011). The research providers are the Commonwealth Scientific and Industrial Research Organisation, state and territory agriculture departments, universities and some private sector organisations. Most research capability focuses on national priorities through the National Primary Industries Research Development and Extension Framework which recognises the benefits of reducing duplication and fragmentation among research providers.

Table 1 Farm sector indicators in Australia, 2007–08 to 2010–11

<table>
<thead>
<tr>
<th></th>
<th></th>
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</thead>
<tbody>
<tr>
<td><strong>Gross value of farm production</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Crops $m</td>
<td>24 237</td>
<td>22 769</td>
<td>21 119</td>
<td>27 106</td>
</tr>
<tr>
<td>Livestock $m</td>
<td>19 516</td>
<td>19 149</td>
<td>18 537</td>
<td>21 057</td>
</tr>
<tr>
<td>Total $m</td>
<td>43 752</td>
<td>41 918</td>
<td>39 656</td>
<td>48 162</td>
</tr>
<tr>
<td><strong>Net value of farm production</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$m</td>
<td>6 615</td>
<td>5 287</td>
<td>5 173</td>
<td>11 370</td>
</tr>
<tr>
<td><strong>Value of farm exports</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Crops $m</td>
<td>13 070</td>
<td>17 001</td>
<td>15 231</td>
<td>17 621</td>
</tr>
<tr>
<td>Livestock $m</td>
<td>14 500</td>
<td>15 147</td>
<td>13 318</td>
<td>14 823</td>
</tr>
<tr>
<td>Total $m</td>
<td>27 570</td>
<td>32 148</td>
<td>28 550</td>
<td>32 444</td>
</tr>
<tr>
<td><strong>Crop area and livestock numbers</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grains and oilseeds area '000 ha</td>
<td>23 204</td>
<td>24 084</td>
<td>23 793</td>
<td>24 112</td>
</tr>
<tr>
<td>Sheep million</td>
<td>77</td>
<td>73</td>
<td>68</td>
<td>74</td>
</tr>
<tr>
<td>Cattle million</td>
<td>27</td>
<td>28</td>
<td>27</td>
<td>29</td>
</tr>
<tr>
<td><strong>Employment</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Agriculture '000</td>
<td>302</td>
<td>322</td>
<td>235</td>
<td>307</td>
</tr>
<tr>
<td>Forestry and logging '000</td>
<td>8</td>
<td>8</td>
<td>7</td>
<td>6</td>
</tr>
<tr>
<td>Commercial fishing '000</td>
<td>14</td>
<td>9</td>
<td>11</td>
<td>12</td>
</tr>
<tr>
<td>Total portfolio, including services '000</td>
<td>354</td>
<td>362</td>
<td>369</td>
<td>351</td>
</tr>
<tr>
<td><strong>Total Australia</strong></td>
<td>10 684</td>
<td>10 892</td>
<td>11 027</td>
<td>11 355</td>
</tr>
</tbody>
</table>

Source: DAFF 2012

Animal production

In Australia, much of the livestock industry’s R&D is coordinated by statutory and industry owned R&D corporations: Meat and Livestock Australia, Australian Chicken Meat Federation, Dairy Australia, Australian Wool Innovation, Australian Pork Ltd and the Rural Industries Research and Development Corporation.

The Rare Breeds Trust of Australia is one of a number of organisations that play an important role in ensuring preservation and survival of all rare breeds. It is a charitable trust and has links with many breed societies and registration authorities across all livestock species groups. Its main objectives are to encourage genetic diversity among all species of domestic farm livestock, and to protect and encourage conservation and breeding of endangered domestic farm livestock. Similarly, Heritage Sheep Australia is an organisation representing sheep breeders, which aims to protect, promote and secure the future of the breeds that played an important role in the foundation of the sheep and wool industry in Australia. While the Rare Breed Trust and Heritage
Sheep Australia play important roles in identifying breeds at risk and encouraging their conservation, they do not in themselves hold genetic resources.

In Australia, most beef and sheep meat comes from animals that are extensively grazed on natural pastures or in rotational cropping systems. Cattle and sheep are also finished in feedlots to increase their final weight and condition. Pigs are usually raised in relatively intensive farming systems using grain or prepared feeds, although there is a recent increasing trend for free range pork production. Chickens are also raised in intensive farming systems but free range chicken meat and egg production is increasing (Glatz & Ru 2004).

The following sections outline the various livestock industries sectors in Australia, including the mainstream, minor and emerging animal production industries.

Cattle
The beef and dairy industries are major contributors to the Australian economy. They support more than 70 different breeds of cattle. Purebred cattle make up the majority in both beef and dairy enterprises, although about one-third of the recognised breeds are stabilised composites of two or more other breeds (RBTA 2006).

Beef sector
Farms with beef cattle and sheep occupy about 56 per cent of Australia’s land mass (DAFF 2012). The beef industry specifically makes up 50 per cent of all farms with agricultural activity (ABS 2010; NFF 2011). Around 74 237 beef cattle farms in Australia collectively had 25.9 million head of cattle in 2010–11, about 8 per cent higher than the previous year (Table 2; Map 4). The largest populations of beef cattle are in Queensland (12.4 million) followed by New South Wales (5.4 million), Victoria (2.3 million) and the Northern Territory (2.2 million) (ABS 2011).

Table 2 Distribution of broadacre beef cattle farms in Australia, by number of cattle (average between 2006–09 and 2010–11)

<table>
<thead>
<tr>
<th>Farm size (ha)</th>
<th>Farms no.</th>
<th>Share of farms (%)</th>
<th>Share of beef cattle (%)</th>
<th>Share of sales value (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;100</td>
<td>9317</td>
<td>27.7</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>100–200</td>
<td>7422</td>
<td>22.1</td>
<td>5</td>
<td>7</td>
</tr>
<tr>
<td>200–400</td>
<td>7379</td>
<td>22.0</td>
<td>10</td>
<td>13</td>
</tr>
<tr>
<td>400–800</td>
<td>4571</td>
<td>13.6</td>
<td>13</td>
<td>14</td>
</tr>
<tr>
<td>800–1 600</td>
<td>2660</td>
<td>7.9</td>
<td>15</td>
<td>16</td>
</tr>
<tr>
<td>1 600–5 400</td>
<td>1813</td>
<td>5.4</td>
<td>24</td>
<td>23</td>
</tr>
<tr>
<td>&gt;5 400</td>
<td>445</td>
<td>1.3</td>
<td>30</td>
<td>22</td>
</tr>
<tr>
<td>Total</td>
<td>33 606</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>

Data source: ABARES

The beef industry is the single most important rural industry to Australia’s economy, with a gross value of $7.4 billion in 2010–11, including live cattle exports of around $499 million. Australia is the second largest exporter of beef in the world after Brazil. Approximately 63 per cent of Australia’s total beef and veal production was exported in 2009–10, valued at $4.3 billion (ABARES 2011).
Map 4 Distribution of meat cattle in Australia in 2006

Data source: Australian Bureau of Statistics

Dairy sector

The Australian dairy industry is largely pasture-based in southeast Australia due to the region’s favourable climate and natural resources. In normal seasonal conditions about 70 to 75 per cent of the feed requirements come from grazing, resulting in efficient high-quality milk production. Most dairy production occurs in coastal areas where pasture growth depends on natural rainfall (Map 5). Use of supplementary feed (hay, silage and grain) is common and increased in recent seasons with drier conditions prevailing in many regions (Dairy Australia 2011).

Since 2000, Australian dairy farmers have been operating in a deregulated and open market, with the government only involved in administering food standards and food safety assurance systems. Consequently, the price farmers receive for milk is largely determined by national and international markets.

The national dairy herd size increased in 2010–11 by 1 per cent to 2.6 million head. Tasmania experienced the largest percentage increase of all states with an increase of 16 per cent to 223,000. Victoria reported the highest number of dairy cattle (1.6 million head) which was 62 per cent of the national herd, while New South Wales reported a 6 per cent decrease of dairy cattle compared with the previous year (ABS 2011). The national dairy herd size includes one-year-old to two-year-old heifers, heifers over two years old; as well as calves, bulls and bull calves.

The dairy industry is Australia’s third most important rural industry, valued at $3.9 billion at the farm gate in 2010–11 (ABARES 2011). Although Australia produces only around 2 per cent of the world’s milk—in terms of dairy trade—it accounted for 8 per cent of world dairy product exports at a value of $2.29 billion in 2011–12. Close to half of the milk produced on Australian dairy farms is exported (Dairy Australia 2012; ABARES 2011).
Dairy farms in Australia are generally owner-operated with corporate farms making up just 2 per cent of the total. Farmer cooperatives account for about 35 per cent of milk production. Over the past 30 years the number of farms has fallen dramatically from 22,000 in 1980 to just under 7000 in mid-2010. This has coincided with an average increase in herd size from 85 cows per farm in 1980 to an estimated 230 cows currently. A trend is emerging of very large farm operations with more than 1000 cows. In 2010–11, just over 11 per cent of dairy farms had herds of more than 500 cows and these accounted for 33 per cent of total milk production. Conversely, 26 per cent of farms had fewer than 150 cows and produced just 8 per cent of total milk (Dairy Australia 2011; National Dairy Farmer Survey 2012b).

Sheep

All Australian states and mainland territories have sheep farms (Map 6). Australia has the world’s second largest national flock after China. According to the Rare Breeds Trust of Australia (RBTA 2006), most of Australia’s sheep are purebred Merino (85 per cent) used for wool production, or first-cross sheep (11 per cent) used for prime lamb production. The remaining 4 per cent of sheep consist of more than 40 distinct breeds.

The Australian wool industry dates back to European colonisation of Australia in the 1770s. Australia remains the world’s largest wool producer even though wool production is at its lowest level since 1925 (New Merino 2011). In 2010–11 Australia produced 429 million kilograms of greasy wool from about 68 million sheep. It is estimated that wool production in 2012–13 will increase to 438 million kilograms, with sheep numbers estimated at 78 million head (ABARES 2011; ABARES 2012b).

In the past 15 years selective breeding has considerably reduced the average fibre diameter of the Australian wool clip. In 1993–94, only 8 per cent of the wool clip was 19 micron or finer; this increased to 32.4 per cent in 2005–06 and 36 per cent in 2008–09 (RBTA 2006; AWI 2011).
The sheep-milk industry is a relatively small but emerging industry. In 2006–07, eight commercial dairy sheep farms had a total of 4000 (mainly crossbred) sheep and produced 500,000 litres of milk, with an estimated gross value of $4 million. One farm (Meredith Dairy) accounted for 40 per cent of production. Most of the milk (60 per cent) was used for yoghurt production; the remainder to make cheese (NRIA 2011).

**Pigs**

All Australian states have pig producing farms (Map 7) that are generally located within or close to grain-growing regions because of their feed requirements. Most pig farms are intensive production systems, with about 70 per cent of pork producers being small-scale farmers. The pig industry is moving toward using confinement-free systems for sows (DAFF 2009).

The number of pig producers in Australia dropped dramatically from more than 40,000 in the 1960s to about 1350 in 2009. At the same time, the herd size, based on sows per herd, increased from an average of less than 10 in the 1960s to an average of around 179 in 2009 (Australian Pork Limited 2010). In 2007, the Australian pig industry had almost 900 specialist pig producers, with a total herd size of 2.18 million pigs (DAFF 2009).

The Australian pig industry is affected by fluctuating world grain prices, changing herd size and productivity, increased imports of frozen pig meat and domestic consumption patterns of fresh pork (especially competition from poultry, beef and lamb). In 2007–08, the estimated gross value of production was $880 million, down from previous years. This decrease was attributed to the drought, which caused an increase in feed grain prices. Around 80 per cent of pork produced in Australia is consumed domestically; 40 per cent is consumed as fresh meat and the remainder as processed pork. While about 20 per cent of pork is exported, pork imports are increasing. Following changes to Australia’s quarantine regulations, pork imports have been...
approved from selected countries complying with relevant conditions. Most imports are in the form of uncooked, frozen, boneless meat, which is further processed in Australia (DAFF 2009).

Map 7 Distribution of pigs in Australia in 2006

Data source: Australian Bureau of Statistics

**Poultry**

The poultry industry in Australia provides meat and eggs and is dominated by the chicken industry, with a small amount of turkey and other poultry produced.

**Chicken meat industry**

The Australian chicken meat industry is highly integrated and dominated by two large privately owned companies which supply almost 70 per cent of meat chickens in Australia. These companies also control many stages of the supply chain, including breeding and multiplication farms, hatcheries, chicken growing, feed mills, processing and further processing plants. Five other companies—all of which are partially if not fully vertically integrated—supply a further 25 per cent of Australia’s meat chickens.

Most chicken production and processing facilities are found near capital cities and regional centres, close to markets and labour sources (Map 8). Chicken meat consumption has steadily increased over the past 50 years, from 6 kilograms per person in 1965 to 44 kilograms per person in 2011. Chicken is now the most popular meat in Australia. Lower prices for chicken meat may be a reason for this shift in consumer preference. Lower prices can be attributed to improved production efficiency, in particular use of chicken breeds that have superior feed conversion efficiency, automation of poultry plants, better nutrition, and improved health management and husbandry. While most production is in modern intensive farms, about 10 to 15 per cent of chicken meat is produced under free-range conditions, and this sector is growing (ACMF 2011).
In 2011, close to 1.015 million tonnes of poultry meat was produced. Chicken meat accounts for about 96 per cent of all poultry meat produced in Australia; the remainder is mostly turkey. The gross value of production of the poultry industry in 2010–11 was estimated to be $1.9 billion and chicken production is projected to increase 3 per cent per year to 2016 (DAFF 2011b).

In 2009–10, Australia exported about 37 000 tonnes of poultry meat with a value of $36 million. The major export markets are located within the Australasian region. The volume of chicken meat imported is low. Since 2009, importation of chicken meat has been permitted from any country under strict import conditions, which has meant very little has been imported (DAFF 2011b).

**Chicken egg industry**

Retail egg sales increased steadily between 2000 and 2010. Over 80 per cent of total egg production comes from New South Wales, Victoria and Queensland (Map 9). In 2009–10, the total number of chickens in egg production was 15 million. The egg industry’s gross value of production in 2010 was $427 million (ABS 2011).

In 2003, the Australian Egg Corporation Limited was established. It is a producer-owned company that raises funds through production levies and directs a portion toward R&D activities. It works with the Australian Government to ensure appropriate standards for quality assurance, food safety, animal health and welfare, and labelling.

Egg production in Australia is based on intensive caged, barn-raised and free range systems. In caged systems, birds are housed continuously in cages within a shed. In barn systems the birds are free to roam within a shed. The floor of the barn may be litter and/or other material, such as slats or wire mesh. In free range systems the birds are housed in sheds and have access to an outdoor range.
About 400 commercial egg producers operate in Australia. Around 60 per cent of production comes from caged systems. Eggs from barns, organic and free-range farms make up the remaining 40 per cent (AECL 2010).

**Ducks and turkeys**

Compared with the chicken meat industry, the duck meat industry is small. In 2010, more than 8 million ducks worth about $100 million were produced. Duck meat production is increasing at a rate of about 5 per cent a year (APCRC n.d.). Marketing of specialist cuts, ready-to-cook and cooked products has made consumption of duck meat more convenient and increased economic returns to the industry. The duck egg industry is very small, comprising mainly small operators producing for small and specialist outlets.

The first European settlers brought turkeys in the 1770s and they became an integral part of Australia’s traditional Christmas fare. The Australian turkey meat sector is small, but growing to meet an increasing niche market. In 2001–02 about 4.7 million birds were produced with a value of $200 million (DAFF 2010b). The industry is estimated to have grown by between 5 and 9 per cent since 2002. Australia does not have a commercial turkey egg industry (DAFF 2010a).

**Quail**

The quail farming industry, which started in Australia in the early 1970s, produces meat and eggs. An estimated 6.5 million quail were produced in 2003 and similar numbers were produced in the three years to 2009. However, the number of independent producers in all Australian states has generally declined over the past two decades. In 2005, there were 13 independent producers (including one large integrated New South Wales company) located across all states except Western Australia and the Northern Territory (DAFF 2010b).
Australian quail rank among the world's top meat-producers, with an average live weight at five weeks of 240 grams. Most quail products are sold in the domestic market (DAFF 2010b).

**Geese**

Australia does not have a structured goose industry. Geese are farmed in backyard operations and are mainly kept for their aesthetic value. Demand for goose meat for human consumption is very low, while there is some limited demand for goose feathers (Scott et al. 2009).

**Game birds**

Commercial game farming started in Australia in the 1960s. Although the industry has grown, the rate of growth has been slow. In 2003, the annual value of the industry was about $7.8 million (Scott et al. 2009).

**Goats**

The goat industry in Australia is relatively new; goats are grown for meat, fibre (cashmere and mohair) and milk. Australia has about 155 000 Angora goats and 2000 Cashmere goats. Dairy goats are estimated at about 25 000 (MLA 2012).

Boer goats or Boer crosses are predominantly used for meat production. It is estimated that Australia has up to 200 000 Boer goats. The domestic farmed goat population is currently around 400 000. This, in combination with the estimated feral goat population, makes the total Australian goat herd between 3 million and 4.4 million head (MLA 2012).

**Goat meat**

While most (90 per cent) of Australia’s goat meat is produced from feral populations grazing in rangeland habitats, some higher rainfall areas support small intensive goat meat farming enterprises. Goat meat is also obtained from the goat fibre and dairy industries, where meat is considered a by-product. In 2006–07 the gross value of production from meat goats was just over $57 million. Domestic consumption of goat meat is generally increasing as a result of changes in Australia’s ethnic makeup (NRIA 2011).

Around 95 per cent of goat meat is exported. In 2009–10 about 1.8 million goats were slaughtered. Australia is the world’s largest exporter of goat meat and live goats, its main markets are the United States and Southeast Asia (GICA 2011). Increased domestic slaughter, combined with prolonged drought and its effect on feral goat populations, resulted in reduced live exports (NRIA 2011).

**Goat milk**

While Australia’s dairy goat industry is an emerging one, it exists in all states. Interest and demand for milk and cheese products other than those derived from dairy cattle is increasing. About 12 000 goats were milked in 2006 generating 6 million litres of milk; about 60 per cent was processed into cheese and about 35 per cent was consumed as milk or yoghurt. There is an export market for stud dairy goats (GICA 2011). In 2006–07, 65 dairy goat holdings had a gross production value of $6 million (NRIA 2011).

**Goat fibre**

In Australia goats are used to produce mohair and cashmere fibre. In 2006–07, the cashmere industry consisted of about 75 farms shearing about 13 000 goats; one farm in the New South Wales Riverina region had almost two-thirds of these. In 2001, about 500 Angora goat farms in...
Australia, had an estimated 60,000 goats. Angora goat numbers have declined significantly since then as a result of severe drought. In 2006–07, the goat fibre industry's gross value of production was just over $2.2 million for mohair and $87,000 for cashmere (NRIA 2011).

**Minor and emerging animal industries**

Several minor and emerging industries in Australia are based on farming or wild collection of animals such as deer, camelids (camels, alpacas and llamas), rabbits, water buffalo and ratites (emus and ostriches) (Map 10). Their products generally include meat, milk, fibre, skins and fat. In 2006–07 the estimated annual average value of these relatively new animal industries was $270 million. This value was lower than expected due to the severe drought of 2006–07, which affected production of all emerging animal industries in Australia. More than half the products Australia’s emerging animal industries generate are exported. Australia's favourable disease status is an important factor in accessing export markets (RIRDC 2009).

**Map 10 Distribution of new and emerging animal industries in Australia**

Some emerging animal industries have grown in response to changes in Australia's ethnic makeup, rising demand for healthy products, and changing consumer preferences associated with increasing incomes. For example, domestic demand for meat and dairy products from emerging animal industries is increasing because many people consider them healthier options than traditional animal products. Leather products made from crocodile, kangaroo and ostrich skins are also important for emerging animal industries. Other products, such as emu oil and deer velvet, are increasingly used in health products (RIRDCA 2009).
A large proportion (40 per cent) of Australia’s emerging animal industries is based on harvesting from the wild, including kangaroos, wallabies, wild pigs, feral goats and camels. These animals are seen as pests in some areas, so harvesting helps reduce adverse effects on agricultural production and the environment (RIRDC 2009).

A small proportion (6 per cent) of Australia’s emerging animal industries is based around commercial farming of native animals, such as crocodiles and emus, where it is illegal to harvest them from the wild (NRIA 2011). The Appendix outlines some of these industries.

Native animals farmed or harvested from the wild are subject to conservation management plans to ensure ongoing survival of native species. These plans are part of Australia’s obligations under the Convention on International Trade in Endangered Species of Wild Fauna and Flora. While products from native animals can be exported with appropriate approvals, export of live animals and reproductive material is restricted to specialised, non-commercial uses.

**Other animals important to the livestock industry**

Other animals important to Australia’s livestock industry are horses and dogs.

**Horses**

Horses were brought to Australia in the early stages of European settlement; there are now about 1.2 million. Of these, about 400 000 are feral and about 316 000 are on agricultural properties (DSEWPAC 2011b). Within the agricultural context, horses are used in livestock mustering (known as stock horses) as well as for a small horsemeat industry. Over time, the ownership and use of horses has changed from one of a necessary asset used to work the land, to one for sports and pleasure. Horses ridden for leisure and sporting activities are of a different type to horses ridden for working the land. As a result, many of the older types, especially the heavy breeds, are being lost (RBTA 2006).

The horsemeat industry is directed toward the export market, as horsemeat is not widely consumed in Australia. Close to 40 000 horses are processed for human and pet consumption each year; around 20 per cent of these are feral. Export-directed horsemeat can only be processed in export-accredited abattoirs of which only two currently operate in Australia. Horses destined for the domestic pet food market can be processed in one of 33 licensed knackeries. Australia exported about 2320 tonnes of horsemeat in 2006–07 with a value of $10.3 million. Most was exported to Russia and Europe (DAFF 2011c).

Most of the feral horse and donkey populations occur in the cattle-producing regions of central and northern Australia. Smaller populations are scattered within the alpine and subalpine regions of south-eastern Australia. Populations of feral donkeys occur mainly in the central arid region, the Kimberley region in Western Australia and the north of the Northern Territory. An estimated 400 000 feral horses roam the extensive cattle production areas of the Northern Territory, Queensland and some parts of Western Australia and South Australia; and as many as 5 million feral donkeys roam arid central Australia, the Kimberley in Western Australia and the Top End in the Northern Territory (DSEWPAC 2011b).

**Dogs**

In Australia, dogs are used in agriculture for herding and as guardians. Herding dogs work with farmers to gather and move livestock. Livestock tend to move away from herding dogs thus allowing farmers to control herd movement by controlling the dog’s movements. Guardian dogs, on the other hand, have been bred to protect livestock, such as sheep, goats and poultry, from
predator attack, such as from feral dogs, foxes and dingoes. Guardian dogs integrate with livestock and live among them, unsupervised (van Bommel 2010).

**Livestock use for landscape and environmental management**

Using livestock to manage the landscape, as opposed to managing the impact livestock has on the landscape, is relatively uncommon in Australia. However, several grazing strategies have been used to meet different farm and/or environmental objectives, these include:

- set stocking—livestock grazing in the same paddock for an extended period
- rotational grazing—rotating livestock through several paddocks to allow pasture regrowth
- tactical grazing—designed to meet specific objectives (MLA 2011a).

Set stocking is partly used to control weeds on some farms. Low levels of grazing may also be beneficial as a weed control measure in forests. However, native vegetation and remnant forests generally need to be protected from overgrazing by livestock. Livestock numbers need to be carefully monitored as increased stocking rate can result in environmental degradation, such as erosion, soil compaction and increased weed abundance.

Debate on the effect of cattle grazing in national parks in Australia has been significant. Grazing was permitted in the Victorian Alps to reduce the fuel load and manage the intensity of bush fires. However, this strategy was shown to have no scientific validation (Williams et al. 2006); to adversely affect biodiversity due to livestock damaging fragile subalpine and alpine vegetation communities; and, in turn, to threaten endangered species (Wahren et al. 1994).

The Australian Government Department of Sustainability, Environment, Water, Population and Communities subsequently rejected a proposal to reintroduce cattle to the national heritage listed Alpine National Park in Victoria.

**Conservation status of important agricultural species**

This section outlines the status of genetic resources for agriculturally important animals in Australia. The information is largely based on data from the respective livestock associations and the Rare Breeds Trust of Australia, which conducts regular surveys across the animal industry to obtain information on numbers and trends of agricultural breeds. Accurate numbers for minor breeds can be difficult to obtain, as most animals are not formally registered and tend to be maintained in an ad hoc way by enthusiasts. The data the Rare Breeds Trust of Australia obtained generally corroborate that obtained by other research institutes, whose numbers are based on formally registered animals.

The common species of farm livestock in Australia are cattle, sheep, pigs, poultry, goats and horses. Other small populations within the emerging animal production industries include deer, camels, rabbits, water buffalo and farmed ratites. This report does not focus on native animals or animals kept as pets. In Australia dogs, horses and guinea pigs are kept as pets and not used as a food source. Stock horses and herding and guarding dogs have agricultural uses and are therefore covered in this report. Most breeding and genetic variation in native animals is undertaken for environmental and conservation reasons. Apart from kangaroos and emus, most native animals are not considered to have any substantial agricultural use.
Overview of animal genetic resources

Australia’s farm animals are based on breeds introduced from other countries (in particular Europe) and as a result few livestock breeds are unique to Australia. No native ancestral relatives of Australia’s common domestic stock ever existed, but feral populations of introduced goats, buffaloes, camels and pigs are common. Feral animals cause environmental damage (competing with and destroying native species’ habitats) and agricultural productivity losses (damaging crops, eroding soil and spreading disease) (DSEWPAC 2007; 2011b). Harvesting feral animals for food is part of Australia’s emerging animal industries (see ‘Minor and emerging animal industries’).

Mainstream breeds

In Australia, international genotypes influence mainstream breeds. Importation of genetic material over extended periods means many Australian livestock breeds are effectively part of the international population. This is particularly so for poultry and cattle (especially dairy), but also for sheep, goats and pigs. An overview of numbers of animals in registered mainstream breeds (including some minor breeds) of sheep, cattle and pigs is in the Appendix.

Cattle

More than 70 cattle breeds exist across both the beef and dairy industries, with recognised registration bodies for most. Purebred cattle are used in most beef and dairy enterprises; however, about 30 per cent of the recognised breeds are stabilised composites of two or more other breeds. Over the past 100 years, around 12 composite breeds have been developed, stabilised and locally adapted to Australian conditions. Some of these breeds have been highly successful and now have large populations (RBTA 2006).

The three main beef cattle breed types in Australia are the British (including Australian derivatives), tropical and European breeds. Their distributions vary due to wide climatic differences between Australia’s north and south. The British breeds originated from Bos taurus and are common in the temperate southern states, while the tropical breeds were derived from Bos indicus and Bos taurus africanus subspecies and occur in the sub-tropical and tropical northern states and territories. Other European breeds have often been used in cross breeding and as terminal sires primarily in the temperate regions.

In 2010 the Australian Registered Cattle Breeders’ Association had registered 135,053 beef cattle; a decrease of 1.0 per cent from 2009. British breeds comprised around 54 per cent, tropical breeds around 26 per cent, European breeds around 18 per cent and the remaining 2.5 per cent was other breeds (ARCBA 2010).

Over the past decade the beef industry has become dominated by the Angus breed in temperate areas (although the Hereford was previously the largest beef breed in Australia) and the Brahman in tropical areas. The Angus is a British breed while the Brahman is a tropical breed. In the European breed category, the Charolais overtook the Limousin as the dominant breed in 2003 (Appendix). In 2005, 22 other cattle breeds were identified as unregistered, so their number and genetic status was unable to be determined (RBTA 2006).

In Australia, 15 dairy breeds are known to exist and of these the dominant breed is the Friesian Holstein, which makes up about around 70 per cent of all dairy cattle.

A number of Australia’s mainstream cattle breeds are thought to have undergone substantial cross-breeding and are thus considered by some as breeds at risk of being endangered. These
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include traditional Angus and Hereford, and the dairy and beef Shorthorn breed, as well as the Holstein dairy and Ayshire (RBTA 2006).

Feral populations of cattle roam the rangelands in northern Australia and cause substantial environmental damage in national parks and in grazing leases with inadequate fencing. Some feral herds of Bali banteng (Bos javanicus) roam northern Australia. The banteng population has risen from about 1070 in 1978 to between 7000 and 9000 in 2007. The wild banteng is endangered in Southeast Asia and it has been suggested that Australia’s feral population has high conservation value. Australia’s banteng are descended from domesticated stock brought from Bali or Timor in 1849. These domesticated types are apparently still common in Southeast Asia and hence the genetic variability of Australia’s feral populations is not seen as having high conservation value (DSEWPAC 2007).

The domestic and wild forms of yak (Bos grunniens) have not been recorded in Australia (ALA 2011).

**Sheep**

Sheep in Australia support substantial wool and meat industries and a small, but growing, sheep milk industry. About 95 per cent of Australia’s national flock are either purebred Merino (around 85 per cent) used for wool production, or Merino first-cross breeds used for producing prime meat lambs (around 11 per cent). The remaining 4 per cent of the national flock represents most of the genetic diversity, with 40 distinctively different breeds (RBTA 2006). A number of first-cross sheep breeds have been developed from the Merino (Table 3).

**Table 3 Breeds of sheep derived from Merino**

<table>
<thead>
<tr>
<th>Breed</th>
<th>% Merino</th>
<th>Developed in</th>
<th>Parent breed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bond</td>
<td>50</td>
<td>Australia</td>
<td>Imported Lincoln rams X Peppin Strain Merino</td>
</tr>
<tr>
<td>Border–Merino</td>
<td>50</td>
<td>na</td>
<td>Border Leicester ram over Merino ewe</td>
</tr>
<tr>
<td>Comeback</td>
<td>75</td>
<td>Tasmania and Victoria</td>
<td>Merino X Corriedale and Polwarth</td>
</tr>
<tr>
<td>Cormo</td>
<td>75</td>
<td>Tasmania, Australia</td>
<td>Corriedale ram over Saxton Merino ewes</td>
</tr>
<tr>
<td>Corriedale</td>
<td>50</td>
<td>Australia and New Zealand</td>
<td>Lincoln X Merino</td>
</tr>
<tr>
<td>Polwarth</td>
<td>75</td>
<td>Western district of Victoria, Australia</td>
<td>Merino crossed with Lincoln X Merino 1st Cross</td>
</tr>
<tr>
<td>Zenith</td>
<td>na</td>
<td>Victorian sheep–wheat belt</td>
<td>Lincoln and Merino</td>
</tr>
</tbody>
</table>

na = not available
Source: RBTA 2006

Nearly 98 per cent of the diversity in sheep breeds (42 out of 43 breeds) in Australia is represented in less than 15 per cent of the national flock, including Merino first-cross animals. However, if only the pure-bred genetics are considered, most of Australia’s sheep breed diversity is found in only a small percentage of the national flock (RBTA 2006). Within this group, the Border–Leicester, Suffolk, Wiltshire–Horn and Southdown breeds represent the highest number of registered ewe joinings. Registered ewe joinings, sheep flocks and trends are shown in the Appendix.

The total sheep population has declined steadily over past 20 years and it appears the herd size of pure breeds is also declining. The Australian Society of Breeders of British Sheep Ltd indicates a declining trend across more than a dozen sheep breeds. Moreover, more than 90 per cent of the recorded breeds are showing a rapid decline in the number of stud breeders and breeding ewe numbers. In 2006 the Rare Breeds Trust of Australia attributed this decline to:
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- a change from pedigree breeding to those based on objective measurement, such as calculation of estimated breeding values (for example, LAMBPLAN)
- a move away from purebred genetics to crossbred genetics as a means of increasing productivity and profitability
- ageing of breeders who raised particular breeds and subsequent dispersal or loss of their flocks.

Breeds now lost from Australia include the large framed fleece breeds (such as the Cotswold, North Devon and Teeswater) which contributed to development of the Australian sheep industry. Close to half the remaining sheep breeds are believed to be in danger of disappearing from Australia (RBTA 2006).

**Pigs**

The Australian pig industry has undergone extensive structural change over the past 60 years from an industry with many small producers associated with dairy farms and using skim milk as a major feed source, to large-scale vertically-integrated operations using grain-based feeds. From 1960 to 2004, the number of pork producers fell from almost 50,000 to fewer than 2000. Although the number of breeding sows in the national herd rose between 1960 and 1972, the numbers remained fairly stable over the next 30 years, varying between 300,000 and 356,000 sows. The average herd has grown from 4.3 sows per producer in 1960 to 159 sows per producer in 2004. However, at the same time the Australian Pig Breeders Association recorded a fall in the number of registered sows indicating a shift from producing purebred animals to that of commercial crossbreeding (RBTA 2006).

A number of pig breeds—such as the Large White, Landrace and Duroc—have dramatically decreased in numbers in the past decade. As these breeds are not deemed endangered elsewhere, they have not been considered endangered or rare in Australia.

A number of breeds have been lost in Australia, including the Gloucester Old Spots, the Middle Yorkshire White and most recently the Welsh (the last were registered in 1995). Other breeds are in danger of being lost as their characteristics are not attractive in the current commercial environment. These include the Wessex Saddleback, the Large Black, the Tamworth and the Berkshire and they are also in decline in their country of origin (England). Of particular note is the Wessex Saddleback which differs significantly from the British saddleback. The Wessex Saddleback no longer exists in its country of origin, potentially making the Australian population of this breed important in conservation terms.

Some evidence exists of significant levels of inbreeding within the remaining lines of the more threatened breeds. Some of the effects attributed to inbreeding include loss of size and loss of reproductive performance (infertility, anoestrus, reduced litter sizes, poor motility in semen of boars). With the small number of suitable animals in these breeds in Australia, breeders will be challenged to find new gene pools for maintaining sufficient diversity and preventing the adverse effects of inbreeding (RBTA 2006).

Feral pigs roam most of the northern and eastern states of Australia, with the total population estimated at up to 24 million across about 45 per cent of Australia (Invasive Animals CRC & ABARES 2011). Feral pigs cause environmental damage and their annual cost to agriculture is estimated at $100 million. Despite its size, the relative genetic value or diversity significance of feral populations has not been assessed (Invasive Animals CRC & ABARES 2011; RBTA 2006).
Poultry

Hybrid crossbred chickens currently dominate Australia’s commercial egg laying and meat chicken production systems. Accurate statistics for purebred poultry and waterfowl numbers in Australia are not available and a breed registry that holds accurate information for any poultry breed does not yet exist. In 2006 the Rare Breeds Trust of Australia started developing Australia’s first poultry registration system to address the issue of inadequate identification of purebred poultry breeds.

The chicken, duck and turkey industries use global genetics by importing fertilised eggs from international breeding companies. Most poultry enterprises farm only one species. The game bird, quail and speciality poultry operators are the most likely sectors to farm a variety of species (Scott et al. 2009).

According to the Rare Breeds Trust of Australia (2006), 95 per cent of Australia’s egg and chicken production comes from about eight commercial hybrid breeds, and less than 5 per cent is produced from about 100 different breeds (Appendix). In 2000, backyard egg producers accounted for 0.1 per cent of total egg production, and some of this would be from minor breeds. These producers keep the vast majority of the diversity of poultry genetics in Australia. However, there is a concern that lack of sufficient monitoring programs to record trends may threaten the ongoing Australian presence of some breeds (RBTA 2006).

In the early days of the commercial industry, most chickens were purebreds or varieties. Today, most chickens in commercial egg and meat industries are various synthetic or hybrid lines. These are usually known by the name of the breeding company and a code that identifies its strain, such as ’Cobb 500’, ’Ross 308’ and ’Lohmann 97’. In 2006 the Victorian chicken meat industry used two major genotypes—the Ross bird and the Cobb bird—which were derived from stock imported from the United Kingdom and the United States, respectively (RBTA 2006).

Over time, the size of a number of breeds has been reduced by traditional selective breeding techniques so they are represented as bantams—smaller versions of the original breed. However, some breeds such as the Japanese, Seabright and Rosecomb exist naturally as bantams and have no larger counterparts.

Australia has created four poultry breeds—the Australorp, Australian Game, Australian Pit Game breeds of chicken and the Elizabeth duck—some of which are regarded as rare. Apart from the Australorp, these breeds exist in low numbers (RBTA 2006).

Some larger geese, such as the Embden and Toulouse, may increase in number as there appears to be a trend to introduce these birds to restaurant menus. Similarly, the listing of turkeys, such as the Bourbon Red, on the Slow Food Initiative, Ark of Taste, has increased the interest in these non-commercial varieties in Australia (RBTA 2006).

A factor favouring ongoing maintenance of chicken and waterfowl breeds is their relatively small size and ease of care. Enthusiasts are able to keep and breed poultry in most Australian environments, including suburban backyards. The Rare Breeds Trust of Australia (RBTA 2006) considers this a significant conservation activity to secure the diversity of poultry and waterfowl breeds in Australia.

Goats

While on a global scale Australia is a small producer of goat meat, it is the world’s largest exporter; around 27,842 tonnes of goat meat (valued at $104 million) was exported in 2009–10.
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Australia supports around 10 breeds of goats: three fleece breeds, two meat breeds and six dairy breeds (Appendix).

The Australian Heritage Angora is Australia’s most significant endangered goat breed, with less than 150 purebred animals held by three breeders. It has a unique genetic heritage which is different to the Texan Angora from the United States and the South African Angora, which has dominated the Australian mohair industry for two decades. The Australian Heritage Angora ancestry dates back to one of Australia’s first registered Angora studs.

Australia’s feral goat population has no registration history. However, its success in the Australian environment suggests the animals are well-adapted to it. A breed called the Australian Rangeland goat, which developed as a feral type, now forms a large part of the goat meat industry (GICA 2011) not only through wild harvest but also through selection and breeding by farmers.

Other animals important to the livestock industry

Other animals important to Australia’s livestock industry are horses and dogs.

Horses

In 2001, the Rural Industries Research and Development Corporation estimated the number of horses in Australia ranged from 900 000 to 1.8 million (RBTA 2006). A wide variety of horse breeds, such as the Arabian, Quarterhorse, Australian Stockhorse, and various unregistered offspring or crosses thereof, are used on-farm for stock work. Many breeds are represented in Australia by only small populations, but they are not rare in their countries of origin. Others are rare in both Australia and their countries of origin. Australia’s low incidence of equine diseases makes the genetic resources ideal for export to other countries due to their positive health status and associated favourable quarantine requirements. This means Australian horses have a relatively high utility for overseas conservation efforts (RBTA 2006).

Dogs

Records or databases for dogs in the agricultural context, that are comparable with those used by farmers for their stock, do not exist for ‘true’ working dogs. Instead, breed information stored in databases tends to be based on dogs used for showing. Dogs used for showing would not have been selected for their stock herding abilities but rather for qualities related to the physical appearance of their breed (Noreen Clark 2011, pers. comm.) Nevertheless, breeding for herding ability is undertaken and breeders use results from herding skill competitions to indentify appropriate animals. Universities have started research projects to look for molecular markers associated with favourable working-dog traits. Improved selection of positive traits is seen as a way to increase farm productivity through improving dog performance and associated reductions in labour costs (Hasham 2012).

Minor and emerging breeds

Information on several minor and emerging breeds that contribute to Australia’s farm animal genetic diversity is shown in the Appendix. These breeds contribute only minor amounts to the gross value of Australian agricultural production. However, they are being used in new niche industries that may provide benefits to producers through diversification of income streams.

Yak, guanaco, vicuna, nandu and Chilean tinamou, which are listed in the Domestic Animal Diversity Information System (DAD-IS), have not been recorded in Australia and are therefore not covered in this report. Other creatures (such as pigeons and swallows) which are not used
for agricultural purposes are similarly not covered in this report. While pigeons are kept in Australia, they are mostly pets or hobby birds; few are used as a food source.

**Conservation status of animal genetic resources**

Only when animal production systems are efficient and profitable is Australia able to maintain viable populations of livestock and other farm animal breeds. This is because most of Australia’s livestock does not have free-living wild counterparts or ancestral breeds, so their continued existence relies on farming profitability. Genetic maintenance efforts have therefore generally focused on economically important breeds. Australia has developed some breeds suitable to the environment while maintaining their productive potential. In addition, Australia’s quarantine system has kept it free of many major livestock diseases, meaning that Australia is able to export genotypes bred and adapted to its environment with relatively few biosecurity impediments in receiving countries. Conversely, importation into Australia of live animals or reproductive material may not be allowed for some species, and for other species, the costs may be prohibitive for keepers of rare breeds.

A few examples of successful targeted breeding efforts are:

- Approximately 12 composite breeds have been developed over 100 years and have resulted in stable, locally-adapted breeds suitable to varying Australian environments. Some have performed well and are present today. For example, the Murray Grey cattle breed is popular in Australia and has been exported to a number of countries (RBTA 2006).

- Many traditional *Bos taurus* breeds were found unsuitable for North Queensland’s environment. The Droughtmaster was developed from crossing imported *Bos indicus* and *Bos taurus* breeds to create a breed well adapted to tropical environments; it is heat and drought tolerant and cattle-tick resistant. Development of commercially viable herds is a major means of conserving genotypes that have immediate application to agricultural production (Droughtmaster Australia n.d.).

- The Illawarra dairy breed was developed from the late 1890s by interbreeding the Jersey, Guernsey, Kerri Dexter, Friesian, Shorthorn and Ayrshire bloodlines. Physical characteristics, such as dark pigmentation and hooves, protect the animal from sunburn and skin cancer. The breed is also recognised for high milk production, ease of calving, adaptability and longevity. The breed has been introduced to many countries, including Japan, Korea, Indonesia, New Zealand, Central America, the United States, the United Kingdom and the Middle East (Illawarras Australia n.d.).

- The Australian Merino descends from Spanish and French Merinos and is made up of several ‘strains’ or sub-breeds of Merino. The Merino breed developed in Australia is diverse, highly resilient and able to adapt to a wide range of climatic conditions and management practices. It displays regional variation, with a number of genotypes adapted to environments ranging from southern temperate systems through Mediterranean-like systems to arid inland systems. Development of commercially viable and environmentally adapted lines of Merinos allowed profitable farming in these areas (Merino Australia n.d.).

Australia does not have a history of directly conserving or using ancestral landrace animals for agricultural purposes. Instead, all significant agricultural species have been imported, in particular from Europe. Some sheep breeds, such as the Wiltshire Horn, are more abundant in Australia than their parent breed in Britain (AWHSA n.d.). Similarly, the Wessex Saddleback pig is no longer present in its country of origin; however, their numbers are increasing slightly in Australia. Finding a niche market for these animals has been pivotal in increasing their
population. Some genotypes are also conserved for historical reasons rather than for agricultural purposes; for example, the nineteenth century ‘Macarthur’ Merinos (RBTA 2006).

Without extensive genetic analysis it is not possible to clearly determine how current Australian breeds compare with parent breeds. For instance, it is difficult to determine whether they are sub-populations of a breed or if they have diverged significantly from it. As a consequence the impact of the loss of any rare breed in Australia is hard to assess.

Conservation of rare breeds in Australia is almost totally conducted by private breeders and breed societies, or non-government organisations such as the Rare Breeds Trust of Australia. Through these groups, the on-farm conservation of breeds is supported. Breeding companies and conservation non-government organisations support off-site conservation by maintaining gene banks.

The Rare Breeds Trust of Australia produced a number of Status of Rare Breeds in Australia reports. Its stated aim is ‘to protect and encourage the conservation and breeding of endangered domestic farm livestock in Australia to ensure their survival worldwide’. These reports are a valuable resource on the status of Australia’s animal genetic resources for agriculture. A list of rare breeds in Australia, derived from the database of the Australian Rare Breeds Trust, is in the Appendix (RBTA 2006).

Breed societies and non-government organisations such as the Rare Breeds Trust of Australia usually assess the risk status of breeds. The status of a breed is in general determined by the number of registered females of breeding age. This is a conservative estimate as there may be additional unregistered animals. For example, ‘critical’ status is assigned to sheep when there are 500 or fewer ewes, ‘rare’ status is assigned when there are between 500 and 1500 ewes, and ‘vulnerable’ when there are between 1500 and 5000 ewes.

Most work relating to native animals is undertaken within an environmental conservation context.

**Use of characterisation and information systems**

In Australia, pure livestock breeds are recorded in registration systems usually maintained by breed societies, industry based organisations or large commercial companies. A number of performance recordings and genetic evaluation programs, such as Best Linear Unbiased Prediction (BLUP) analyses, are carried out by industry organisations or breed societies. Funding for this is generally sourced through RDCs which are supported by government through matching producer levies collected for industry R&D.

Breed analyses (pedigree, production characteristics of a large number of stud and commercial animals) are usually maintained in databases in a cooperative arrangement between farmer groups, breed societies, RDCs and scientific institutions. These databases include extensive information on pedigree and production characteristics of stud and commercial animals. This data is supported by additional detailed information obtained from research programs.

The characterisation of Australian cattle, sheep and pigs is extensive, accurate and is used to inform many genetic selection schemes. Molecular marker technologies have facilitated use of DNA markers and genes that are directly related to traits associated with production parameters. They are used to underpin pedigree studies, phenotypic characterisation and selection strategies. These new technologies, together with an extensive knowledge of tropical and subtropical production systems, place Australia in a unique position to be able to facilitate characterisation, conservation and use of animal genetic resources in developing countries.
Conservation and use of animal genetic resources is promoted through a number of institutional arrangements with groups such as the Association for the Advancement of Animal Breeding and Genetics and the Australian Society of Animal Production. These groups include professional scientists, breeders and producers.

**Beef industry**

About 40 breeds of beef cattle are formally registered with breed societies. The Australian beef industry uses modern genetic evaluation systems such as BREEDPLAN to aid genetic selection. BREEDPLAN uses BLUP technology and produces estimated breeding values for a range of traits commercially available for testing in selected breeds (Table 4). Calculation of estimated breeding values includes the animal’s own performance, the performance of known relatives, the heritability of each trait and the relationship between the different traits.

**Table 4 Production traits estimated for expected performance in BREEDPLAN**

<table>
<thead>
<tr>
<th>Weight</th>
<th>Fertility</th>
<th>Carcase</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight</td>
<td>Fertility</td>
<td>Carcase</td>
<td>Docility</td>
</tr>
<tr>
<td>Birth weight</td>
<td>Scrotal size</td>
<td>Carcase weight</td>
<td>Net feed intake (residual feed intake)*</td>
</tr>
<tr>
<td>200-day milk</td>
<td>Days to calving</td>
<td>Eye muscle area</td>
<td>Flight time*</td>
</tr>
<tr>
<td>200, 400 and 600-day weights</td>
<td>Gestation length</td>
<td>Fat depth</td>
<td>Shear force*</td>
</tr>
<tr>
<td>Mature cow weight</td>
<td>Calving ease</td>
<td>Retail beef yield</td>
<td>Structural soundness</td>
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<tr>
<td></td>
<td></td>
<td>Intramuscular fat</td>
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<tr>
<td></td>
<td></td>
<td>Marbling</td>
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</tbody>
</table>

*Trial estimated breeding values

Source: Breedplan 2012

A number of molecular markers have been developed for the beef industry. For example, markers for tenderness have been validated and are included in BREEDPLAN estimated breeding values. The genetic marker for the poll gene (no horns) can be used to identify polled or horned genetic attributes. The molecular marker has shown close to 90 per cent success rate in Brahmans. The marker has also been shown to work well with Hereford and Droughtmaster breeds and shows potential for use in Charolais, Santa Gertrudis, Shorthorn, Simmental and Tropical composite breeds (Beef CRC 2011). The test was developed through a collaborative effort between government, industry and universities in response to animal welfare concerns in relation to dehorning.

Meat and Livestock Australia and relevant breed societies have developed Beef Information Nucleus (BIN) herds. Use of DNA markers is somewhat breed dependent and using marker tests across breeds does not give the same results as within breeds. BIN herds allow calibration of markers within a breed which facilitates benchmarking of individual animals of that breed for a given trait.

In northern Australia, reproductive potential is an important driver of profit, and understanding female reproduction in this context has been a key research focus. Traits related to reproduction include age of maturity, age of first conception and weaning age. Traits relating to improved reproductive performance result in higher profitability and productivity, but are also influenced by nutrition and management practices. Maximising profit is therefore dependent on management and genetics.

**Dairy industry**

Dairy cow genetic selection is achieved mainly through the Australian Dairy Herd Improvement Scheme, which is responsible for determining Australian breeding values for dairy traits and maintaining a national database of performance and pedigree information for individual dairy animals, collected by milk-recording organisations and breed societies. The database is used to...
aid genetic improvement in the dairy industry by artificial insemination companies and dairy farmers. Genetic evaluation is conducted with an animal model for yield, conformation, workability and survival traits. The Australian Dairy Herd Improvement Scheme also participates in international evaluations with Interbull and releases Australian breeding values for foreign bulls. Australian breeding values estimated with genomic data have also been developed (ADHIS 2010).

Over the past 30 years the average annual milk yield per cow has increased from 2850 litres to about 6571 litres as a result of improved herd genetics, pasture management and feeding regimes (Dairy Australia 2011; National Dairy Farmer Survey 2012b). Breeding technologies such as artificial insemination have delivered benefits including production gains and the ability to import genetic diversity. However, concern has been raised about inbreeding in the Holstein-Friesian breed in many countries, including Australia (Man et al. 2001; Man 2004; RBTA 2006) with some suggesting that the practice of artificial insemination using sperm from a limited number of high performing bulls being a major contributing factor. In contrast, Zenger and colleagues (2006) found no significant inbreeding in the Australian Holstein-Friesian population; but where individual inbreeding was detected they argue that it is not high enough to affect population inbreeding.

Sheep industry

The Australian Stud Sheep Breeders Association and the Australian Association of Stud Merino Breeders collect data on registered animals. The sheep industry employs LAMBPLAN and MERINOSELECT to help determine breeding values for sheep and for traits related to meat and wool production, respectively. The two systems provide programs that allow breeders to benchmark their animals and track improvement in their herd's genetic make-up (MLA & AWI 2009a; 2009b).

Pig industry

The pig industry employs a genetic evaluation system known as PIGBLUP. Traits analysed include production, reproduction and carcass traits. This, in combination with improved artificial insemination techniques, has enhanced the use of purchased fresh semen from high-performing boars that were selected based on their estimated breeding values (EBV). Another advantage is that breeders can reduce the number of boars in their herd. However, this poses a risk of narrowing the genetic pool (RBTA 2006).

State of use of farm animal diversity

Australia has a successful record of developing breeds adapted to its environmental conditions. Recent commitments to R&D have led to development of a range of world-class selection tools for livestock industries. For instance, traditional European breeds are generally unable to withstand the hot conditions and the poorer nutritional quality of some native grasses, but genetic improvements in Australian stocks of these breeds have increased their tolerance.

The breeding selection process primarily aims to increase productivity and improve health and fitness, which in turn contribute to animal welfare. The latter is necessary because of Australia’s unique environment. For example, the northern Australian cattle industry has focused on developing breeds tolerant to heat and ticks.

Mainstream breeds

Research has focused on selecting the most efficient and profitable animal populations from the gene pools available in Australia through use of sophisticated genetic selection schemes.
Cattle
Cattle include beasts for both meat and dairy production.

Meat cattle

The Brahman, Angus and Hereford breeds are the main breeds used for commercial meat production in Australia. Breed societies generally maintain purebred cattle and use sophisticated selection schemes and performance testing for production traits.

Systematic crossbreeding, based on a range of recognised breeds, is used regularly, and includes a range of rotational and terminal crossbreeding strategies. This practice is employed to achieve a number of objectives including meat quality, temperament, environmental adaptability and traits resulting from hybrid vigour (such as, feed conversion, physical structure, improved weight gain, disease and pest resistance and improved fertility). Examples of these crosses include the Simmental–Angus, Hereford–Angus, Santa Gertrudis–Hereford, Tuli–Murray Grey–Brahman–Charolais, Simmental–Gelbvieh and Droughtmaster–Charolais–Limousin. A reliable source of the respective purebred parental lines is essential to facilitate current and future crossbreeding strategies.

Dairy cattle

The Fresian–Holstein is the dominant dairy breed in Australia (70 per cent of dairy cattle). Other important dairy breeds include the Jersey (about 14 per cent of dairy cattle), and Australia’s own breed, the Illawarra, and the Guernsey and Ayrshire.

Artificial insemination and widespread use of a small selection of high performing sires have been linked to increasing levels of inbreeding in the Holstein–Friesian breed in Australia. Although inbreeding rates in Australia are lower than in Canada and the United States, Australian breeders are concerned that US Holstein genetics have been used in Australian herds for a decade. Consequently, the top five Australian Holstein sires are US-bred which could mean restricted diversity in this breed in Australia (RBTA 2006).

Sheep

The sheep meat industry is dominated by the Merino, the Border Leicester (as a maternal sire) and breeds such as the Poll Dorset (as the terminal sire) selected for carcase qualities. The wool-producing sheep are classified according to their fleece quality.

Systematic crossbreeding, based on recognised breeds, is normal in the meat sheep industry and includes a range of rotational and terminal crossbreeding strategies. Producers and breeders undertake extensive performance recording and selection for those animals that most efficiently meet current market needs for carcases and wool type.

Pigs

In Australia, pork is largely produced from pigs housed in a densely populated environment. Hybrid pigs specifically bred for such conditions are used in these systems because they offer maximum vigour and improved productivity. Use of intensive housing systems in the pig industry led to use of the Landrace breed in crossbreeding programs with the Large White. These crosses are also frequently used as the maternal line in commercial herds, with breeds such as Duroc or Hampshire as the terminal sire. The Australian Pig Breeders Association recorded a fall in the number of registered sows, which may be indicative of a shift from producing purebred animals to that of commercial crossbreeds (RBTA 2006).
A number of breeds are used in the expanding free-range pork industry. These include the Wessex Saddleback, Large Black, Tamworth and Berkshire pigs, all of which are endangered globally and in their country of origin. Remaining populations in Australia have a high vulnerability status. There is some indication that breeds, such as the Wessex Saddleback, Hampshire and Large Black, are increasing but their numbers remain low overall (RBTA 2006).

The commercial pig industry is focused on production from hybrids based upon lines or breeds of global importance. Nucleus breeding stocks of improved purebred populations supply multiplier units where parent hybrids are produced. Use of breeds in the industry has changed from almost exclusive dependence on the Large White and Landrace to greater use of the Duroc. Genetic selection tools, such as PIGBLUP, are used to accelerate the genetic progress of nucleus herds, thereby increasing sustainability and profitability of commercial production. PIGBLUP uses best linear unbiased prediction analysis and is used in both large and small pig herds.

Vertical integration and industry consolidation has led to several companies dominating pork production in Australia. Three genetics firms (Hyfarm Pty Ltd, PIC Australia and Cefn Genetics) dominate supply of commercial crossbred breeding pigs to the Australian industry. While these major companies supply almost all boars to the pig industry they maintain their diversity by sourcing their genetic resources from large pig populations.

**Poultry**

Poultry includes chickens, ducks, turkeys, quail, geese and game birds.

*Chickens*

Before the 1990s, chicken strains for meat production (broilers) were all of Australian origin and had variable performance and carcass quality. Liveability (survival expectancy) in growing stock was generally acceptable when farmers maintained their breeding stock free of disease agents such as *Mycoplasma gallisepticum*. However, by international standards, fertile egg production and day-old production was generally poor. New genetic material in the form of fertilised eggs imported through South Australia’s Torrens Island Quarantine Station gave the industry an opportunity to upgrade the genetics of the Australian broiler bird (Scott et al. 2009).

The important characteristics in broilers are growth rate, feed conversion and carcass processing properties. The modern commercial broiler strains are capable of achieving live weights of 2.8 kilograms at 49 days of age with feed conversion of less than 1.9 kilograms of feed per kilogram of live weight (RBTA 2006). Most meat chickens used in commercial breeding programs were developed from pure breeds, such as the New Hampshire, White Plymouth Rock, Cornish or Indian Game, Barred Plymouth Rock, Light Sussex, Australorp and Rhode Island Red. Australia has developed some breeds through crossing Asian and breeds of other origin. Examples of these include the Australian Australorp and Australian Langhorne (Scott et al. 2009).

Like the chicken meat industry, the egg layer industry imported four new strains of layers in the late 1980s and early 1990s to ensure the international competitiveness of the Australian industry (Scott et al. 2009). The Australian egg industry currently uses four major breeds of birds—the Hisex Brown, ISA Brown and Lohmann Brown (all European birds); and the Hy-Line Brown (from the United States). These breeds account for about 98 per cent of all egg layers in Australia and, as a result of consumer preference, all are brown-egg layers. Benefits from these imported breeds include superior feed conversion, and early and large egg production (RBTA 2006). Backyard egg production is common in Australia but only accounts for around 0.1 per
cent of eggs produced. Backyard breeders are the main resource of genetic diversity in poultry (RBTA 2006).

**Ducks**

The major duck breeds available for meat production in Australia before importation of genetic material in the 1990s were the Muscovy, Aylesbury, Pekin and Rouen and crosses of these breeds. The Pekin–Aylesbury cross was the major breed type. New strains based on Cherry Valley strains of the Pekin were imported and are now widespread in the meat industry. The Grimaud strain was imported from France to increase genetic production capacity (Scott et al. 2009).

The Khaki Campbell and Indian Runner used to be the main egg producing breeds but were difficult to maintain in large flocks due to their nervousness and uneconomical egg production. Consequently, the modern Pekin duck is now used for egg production. The Pekin are good layers and naturally gregarious, making them suitable for intensive housing. They are also used in free range egg production systems (Scott et al. 2009).

**Turkeys**

The turkey industry in Australia mainly uses two breeds—the Nicholas from the United States and the Hybrid from Canada. A number of small producers may maintain lines of rare breeds, such as the King Island Turkey, or traditional Australian genetic stock (commercial white, bronze wing) (Scott et al. 2009).

**Quail**

Japanese Quail (*Corturnix Corturnix japonica*) is the most common species used in the Australian quail producing industry (Scott et al. 2009).

**Geese**

Goose breeds available in Australia are the Embden, Toulouse and Chinese varieties. The Toulouse is the largest and can weigh up to 15 kilograms and lay 30 eggs per season in spring. Embden geese have a pure white plumage which favours their dressed carcass but are slow to mature and lay only about 30 eggs per season. Chinese geese come in two colours—white and brown—and are good layers, averaging 60 to 70 eggs per season (Scott et al. 2009).

**Game birds**

The Mongolian Ringneck Pheasant is exclusively farmed in commercial game bird operations in Australia. Other breeds of pheasant are generally bred for ornamental purposes only. The Indian Chukar Partridge breed is used exclusively in the commercial partridge industry and is considered to be easily raised in captivity. The helmeted Guinea Fowl, which originates from Africa, is also a popular game-bird species in Australia (Scott et al. 2009).

**Goats**

Australia is the world’s largest exporter of goat meat, with most exports derived from feral goat populations. Feral goats have become locally adapted over 200 years in Australia and are sometimes known as the Australian Rangelands goat. Goats were introduced from England with the First Fleet, serving as a source of meat, milk and fibre. Cashmere and Angora breeds were subsequently introduced for fibre production and the Boer and Kalahari Red breeds were
introduced recently as specialty meat breeds and to help improve the carcass composition of the Australian Rangelands goat.

**Meat goats**

Goats in Australia are mainly used for meat. The Boer and Australian Rangelands goats are used for meat production, and the Cashmere and Angora for fibre production.

The goat meat industry in Australia is generally constrained by inconsistent supply and quality characteristics. The irregularity in the quality is mostly derived from the wild harvesting operations which are less discerning than processors of farmed goats. Recent imports of the Boer and Kalahari Red are expected to provide genetics that will improve carcass composition, shape and overall quality.

**Dairy goats**

The Dairy Goat Society of Australia recognises six breeds of dairy goat—the Saanen, Toggenburg, British Alpine, Anglo Nubian, Australian Melaan and the Australian Brown.

The Australian Brown and the Australian Melaan have been developed in Australia and the Dairy Goat Society of Australia now recognises them as genuine breeds. The Australian Brown originated from all-brown goats with Saanen, Toggenburg and British Alpine backgrounds which appeared in flocks from time to time. In the early 1990s, several breeders kept and used some *all brown* goats to establish a separate breed, and sufficient numbers were later found in three states to allow exchange of stock and initiation of a breeding program. The Dairy Goat Society of Australia developed an *all brown* standard and in 2006 they were accepted as the Australian Brown breed (DGSA 2011).

The Australian Melaan is a black goat thought to originate from a Saanen buck imported in 1943. Black kids used to be bred back into existing breeds, such as the Alpine, or destroyed. The pathway to a separate breed was established when the Dairy Goat Society of Australia initiated an experimental listing for all black goats. They were accepted as an experimental breed in 1995 and recognised as a true breed in 2000. They are well suited to Australia’s variable weather conditions, from the tropics in the north through to the temperate south (DGSA 2011).

**Fibre goats**

Fibre goats are used for mohair and cashmere fibre production in Australia.

Feral goats, whose heritage dates back to the late 1700s, have been used to breed the Australian Cashmere goat. Introduction of Cashmere breeding goats has resulted in further improvements.

Angora goats were purchased from South Africa and Texas and imported to Australia. These goats were subsequently crossed with a breed derived from the feral goat, the Australian Angora. Through selective breeding a new type of Angora has been developed that is suited to the Australian environment (GICA 2011).

**Other animals important to the livestock industry**

Other animals important to Australia’s livestock industry are horses and dogs.

**Horses**

The stock horse has evolved through selected breeding from imported horses. Mechanisation of agriculture and transport over a century has shifted the focus of the equine industry from one of
necessity and demand to one of pleasure and sport. The shift in focus has resulted in loss of many heavy breeds used for draft power and increase in the types that are ridden (RBTA 2006). The heavy horse and pony are not used in modern agriculture. Instead, they are maintained for aesthetic and historical reasons, and according to the Rare Breeds Trust of Australia are considered threatened. Dedicated breeders and enthusiasts keep small populations of British and European pony breeds.

**Dogs**

Herding dogs are used to manage a range of livestock including cattle, sheep and goats. Key characteristics include responsiveness to training, obedience and stamina. Herding breeds in Australia include the Kelpie, the Cattle dog and the Border Collie. The Working Kelpie, as it exists today, is the result of intermixing progeny from three pairs of Working Collies originally imported by early landholders.

The Cattle dog is an Australian-developed breed and is also known in Australia as the Blue Heeler, Red Heeler, Australian Heeler or Queensland Blue. It originates from drover breeds introduced in the 1800s, which were subsequently crossed with dingoes (indigenous dogs) (Clark 2003). The Border Collie is a British breed originating from the border regions of England, Scotland and Wales.

Guardian dogs are medium to large sized dogs and include the Maremma, Pyrenean Mountain dog, and Anatolian Shepherd breeds (van Bommel 2010). Guardian dogs are not used to the extent that herding dogs are used.

**Minor and emerging breeds**

At this time, several minor and emerging breeds are primarily maintained in hobby farms in Australia (Appendix). They are often used in agricultural shows, other exhibitions and competitions where they are judged according to ‘type’ and ‘breed standards’. Genetic selection in these breeds generally serves these ends and is often familial within the breed.

**Identifying major features and critical areas of animal genetic resource conservation and use**

Breeding programs mainly target functionality, improved productivity and environmental adaptation of farm animals; these areas are therefore considered when conserving and using animal genetic resources in Australia.

Modern technologies (such as identification markers) and global exchange of breeding stock have resulted in intense selection pressure for high yield in mainstream breeds and strains.

Although globally there have been occasional instances of such intensive selection leading to a loss of functional characteristics (such as animals unable to maintain normal posture or walk moderate distances), these issues are not common in Australia as they tend to raise animal welfare issues, reduce product quality and incur extra costs.

Australia’s farm animal husbandry systems have to meet high animal welfare standards which are valued in the community.

Functional characteristics, such as general health, conformation and fitness, are essential in order to maintain high levels of productivity, health and welfare. Australian pastoral genotypes in the cattle and sheep industries are particularly noted for their hardiness and high level of
adaptation to their environments. These characteristics are therefore seen as important and are not considered at risk within these industries.

A number of breeds are under threat of extinction in their country of origin, but remain in Australia; there are attempts to establish programs to ensure survival of these breeds in Australia. However, the population sizes of these breeds are small and finding the right gene pool for breeding, while preventing inbreeding, is a challenge in Australia.

Key factors for animal genetic resources conservation and use in Australia are:

- A reduction in genetic diversity within and between breeds in domestic farm livestock in Australia. This is despite, or because, Australia is a major exporter of agricultural animal products such as beef, wool, sheep meat and goat meat. Industries such as dairy are also narrowing genetic diversity through practices such as artificial insemination with limited lines (RBTA 2006).

- A trend of some industries (such as pig industries) is to move from purebred animals to hybrid crossbreeds. While important for the newer crossbred production systems, fewer breeders are in the business of keeping purebreds. Some breeders are preserving rare breeds, but most are doing so at their own expense and/or as a hobby; this may not be enough to conserve rare breeds in Australia (RBTA 2006).

- Minimising unmanaged mating between breeds and also reducing loss of genetic variability within each breed is needed to conserve at-risk breeds.

- Australia's isolation as an island continent coupled with its strict quarantine system makes it a valuable store for global conservation of animal genetic resources and makes it difficult to introduce live animals or reproductive material of some species.

- The declining number of farming families in all states and territories (ABS 2006), an aging farming population, and a decrease in entry of young people into farming industries are issues facing agriculture in Australia. Maintaining sufficient skills in the agricultural labour force is not only critical for Australia’s productivity in this sector, but also for managing its animal genetic resources.
2 Changing demand on livestock production and implications for national animal genetic resource policies, strategies and programs

Reviewing past policies, strategies, programs and management practices

Australian rural industries are relatively young compared with many countries that have a long history of agriculture. European settlement history resulted in Australia’s main breeds being derived from imported exotic genetic material especially those from North America and Europe. Consequently, Australia has few unique domestic breeds. All breeds in Australia have undergone selection in the context of production characteristics in Australian conditions and so are most probably genetically different to their modern or ancestral counterparts in Europe and North America.

Australian agriculture has undergone considerable change over the past 60 years. Of note is the significant intensification and continual productivity improvements leading to increased production capacity. These changes were largely driven by the need to increase international competitiveness. A possible consequence of these changes is an overall decrease in diversity of breeds across the livestock sector, especially in the more intensive pork and poultry industries. While the sheep and cattle industries still have breed diversity, the poultry, pig and dairy sectors have a limited number of breeds and/or strains.

Animal genetic resource conservation and management in Australia is conducted primarily by private corporations and industry organisations, commercial breeding programs and individual breed associations. Commercial breeding programs tend to focus on mainstream breeds of importance to their industries, whereas breed associations generally manage remaining breeds to varying degrees. Two policy considerations relevant to animal genetic resources conservation relate to export of Merino sheep and Australian native animals from Australia.

In 2009, the Australian Government Department of Agriculture, Fisheries and Forestry reviewed the merino export policy—Livestock Export (Merino) Orders 1990—which prohibited export of merino rams, ewes, and reproductive material unless an exemption was obtained from the department. Following consultations with Australian sheep and wool industries, the restrictive policy was revoked to free up trade and support growth of a global Merino industry. The Livestock Export (Merino) Repeal Order 2009 took effect on 1 January 2010.

Export of Australian native wildlife is regulated under the Environment Protection and Biodiversity Conservation Act 1999 which allows commercial export of live native invertebrates and fish from a source approved under the Act. However, export of live Australian native mammals, birds, reptiles and amphibians (including their reproductive material) is prohibited for commercial purposes and is possible only for specific non-commercial purposes, such as exhibition (zoos), research and conservation breeding.
Analysing future demands and trends

Australia’s livestock industries will be largely influenced by prevailing international and market forces, animal health and welfare regulations, as well as various social and environmental factors. The factors expected to shape animal genetic resources use and conservation in Australia are:

- economic pressure on the livestock industry to compete internationally
- increase in international and domestic demand for (and specific characteristics in) meat, wool and dairy products
- increasing environmental regulation and accountability
- domestic pressure to improve regulations on animal welfare
- increasing demand for free range, organic or biodynamic meat products
- challenge to remain free of livestock diseases
- effect of imported livestock products on domestic industries
- increased policy focus on climate change mitigation and adaptation in the agricultural sector; for example, addressing demands for breeds with lower greenhouse gas emissions or breeds that are better able to adapt to predicted climate changes.

Some of these factors and trends are further discussed below. Together, they will drive the choice of traits sought in livestock production and consequently, use and conservation of animal genetic resources.

Livestock sector-specific trends

Variability in seasonal conditions, price signals and demand are the main factors affecting Australian livestock industries. Cattle numbers fell over much of Australia in 2002–03 due to dry conditions, but improved conditions in some regions in the following three years resulted in the national herd reaching a 30-year high of 28 million in 2005–06. Cattle numbers declined again with a return to drier conditions; Australian cattle herd numbers reached 26 million by June 2010 (ABS 2012b).

Beef production and cattle numbers differed between northern and southern Australia due to variability in seasonal conditions. Northern Australia was favoured by improved seasonal conditions in 2009–10 leading to an increase in the number of cows mated and calving whereas much of southern Australia was affected by adverse conditions between 2002–03 and 2007–08 due to prolonged drought. Branding rates of cattle in southern Australia increased to 87 per cent in 2010–11, the highest since 2000–01 (ABARES 2012a).

The dairy herd size fell after the 2002–03 drought (ADHIS 2010), but operating conditions improved dramatically in 2010–11 and remained reasonably positive through 2011–12.

There is regional variation across the country, with pricing signals reflecting a weakening export market in southern states (Dairy Australia 2011; 2012). The number of dairy farms decreased, although with a compensatory rise in average herd sizes. This trend is likely to continue as producers will need to increase productivity to remain competitive on world markets.

Recent changes in the Australian pig industry resulted in smaller producers leaving the industry and remaining producers increasing the size of their operations in order to remain viable (ABS
2012b). In particular, the industry is experiencing difficulties competing with imports and is experiencing pressure to improve productivity and competitiveness.

Recently sheep numbers declined, as adult and lamb numbers fell to their lowest level in 88 years in 2009–10 due to falling demand for wool, higher lamb prices and the effects of previous drought. Since the 2009 lows, total sheep numbers have increased and are likely to continue to do so because of increased demand and more favourable production conditions.

**Animal welfare standards**

The Australian community expects a high level of animal welfare and this is reflected in Australia’s animal husbandry systems and regulations. Each state and territory government is responsible for its own animal production and welfare legislation. The Australian Government is working with state and territory governments, industry and welfare organisations to develop a series of nationally agreed animal welfare standards and guidelines. These standards will be legislated by the states and territories.

Industry has also taken voluntary actions to address animal welfare concerns. For example, the pork industry has implemented confinement-free systems to improve the welfare of sows and piglets without compromising production efficiency (Pork CRC n.d.).

Following an independent review of Australia’s livestock export trade by Mr Bill Farmer AO (the Farmer Review), Australia introduced a strict new framework for livestock exports. This framework aims to ensure animals are handled in accordance with World Organisation for Animal Health (OIE) guidelines for animal welfare through to point of slaughter. The framework is being phased in, with all markets to be covered by the end of 2012. In 2012–13 the Australian Government is also reviewing the Australian Standards for the Export of Livestock.

**Domestic demand and consumption trends**

Food consumption and spending patterns on food in Australia have changed dramatically over the past 60 years. The notable changes in consumption are:

- a fall in consumption of red meat and meat products, namely beef, veal, lamb and mutton (decreased by 41 per cent between 1970 and 2010; ABARES 2011)
- an increase in consumption of poultry (400%) and pig meat (90%) from 1970 to 2010 (ABARES 2011)
- a fall in consumption of eggs (137 eggs per person in 1998–99 compared with 255 in the 1940s), although consumption is increasing again (192 eggs per person in 2012; Victoria DPI 2012)
- an increase in consumption of fruit and fruit products (56.1 per cent increase since 1960s to 135 kg per person in 1998–99; ABS 2000)
- an increase in consumption of vegetables (up 38.3 per cent from the 1950s to 162 kilograms per person in 1998–99; ABS 2000).

Furthermore, the types of food and food products consumed have changed towards a more multicultural diet, driven by the effects of immigration (for example, Mediterranean and Asian cooking influences). This has resulted in Australians now consuming a greater variety of foods.

Spending on packaged and pre-processed food has also increased, driven by population (for example, higher overall disposable consumer incomes), technology (for example, new food processing and distribution systems) and social change (for example, preference for reduced
A recent social trend has seen consumers preferring locally sourced, healthy and/or gourmet foods. Regional farmers markets and the ‘Slow Food’ and ‘foodie’ movements are becoming popular and creating shifts in demand for less mass-produced foods. Such shifts in consumer preferences can influence breeding policies across all major meat animal species; for example, by favouring production systems that increase flavour and tenderness rather than only maximising feed conversion rates for producer efficiencies. These social trends are expected to see consumers continuing to increase demand for organic, free range and specialty meat products by being willing to pay premium prices for them.

**Global demand and consumption trends**

Increasing affluence and wealth in Asian economies is expected to result in increased demand for livestock products from Australia. Australian producers are expected to use domestic breeding programs and importation of exotic genetic material to expand production and remain internationally competitive. Growth of the Asian and Middle Eastern markets is likely to maintain demand for live export of sheep and cattle and, increasingly, goats and camels.

**Climate change adaptation and mitigation**

Most of Australia’s productive land is likely to experience temperature increases due to global warming. However, rainfall trends are uncertain and selected regions are predicted to experience reduced annual precipitation. This is expected to affect Australia’s animal genetic resources through selection of breed traits that can tolerate conditions expected under a changing climate, while maintaining productive capacity. For example, traits for drought and/or heat tolerance and the ability to resist new parasites may become most important.

Another affect from climate change may be a shift toward alternative livestock species more suited to expected environmental conditions. Similarly, the spatial distribution of current livestock species may change considerably in future climates and this will affect animal genetic resources needs and conservation. For example, in some areas sheep may replace cattle and in others goats may replace sheep because of their superior browsing abilities and resilience under harsh conditions.

While many avenues for reducing greenhouse gas emissions from agriculture are available, some research is showing an interest in approaches involving genetic resources. These include genetic changes in feeds and in the bacterial rumen fauna so overall emissions are reduced. Of relevance to this report is the search for genetic variability in greenhouse gas emissions of ruminant livestock. While it may be possible to reduce overall emissions from ruminants through selection of animals, increasing the greenhouse gas efficiency of production (more live weight per unit greenhouse gas output) may be a more achievable target as it revolves primarily around increased feed conversion.

**Alternative strategies in conserving, using and developing animal genetic resources**

Australia’s commercial farm animals are derived from foreign breeds, and mostly survive in the countries from which they originated. Therefore, Australian populations of most livestock breeds could be replaced from existing stock in other countries. Conversely, Australia could serve as a resource for reintroducing breeds to other countries, should circumstances require. Australia is already exporting breeding stock to countries that value the characteristics of Australian breeds, including their relatively disease-free biosecurity status.
Australia’s animal genetic resources can easily be divided into two groups based on the status of conservation effectiveness:

- Breeds across agriculturally important species that form the basis of most commercial production. These include the several major beef and dairy breeds, Merino sheep, a few pig breeds and crossbred chicken strains. While commercial forces will maintain these few groups that from a production perspective represent premium genetics, they constitute only a small part of the diversity of their species in Australia.

- Breeds that do not play a large role in Australian agricultural commodity production. These breeds are kept by small-scale commercial farmers or enthusiasts and from a conservation perspective represent most of the genetic diversity of their species in Australia. While breed societies exist for most mammalian breeds, non-government organisations, such as poultry associations, the Rare Breeds Trust of Australia and Heritage Sheep Australia, keep lists of mammalian and avian breeds and monitor their populations.

Most animal genetic resources conservation occurs in situ on farm, but there is an active artificial insemination industry for cattle, horses, pigs and sheep which could be seen as a potential ex situ conservation activity. However, these are commercial operations and would keep material of commercial value, which is most likely to be the major breed types listed in the first group described above.

Australian beef and sheep breeds still have a degree of genetic input from international sources through importation of animals or their reproductive material. Australia is also a contributor of animal genetic resources to the international community, mainly through breeding and development of unique Australian breeds (such as Merino sheep) or high quality examples of international breeds. Several sheep and cattle breeds are no longer commercially important and may reach sufficiently low levels as to be considered threatened; they are maintained by enthusiasts.

Commercial poultry industries regularly import fertilised eggs to improve production potential of their hybrid lines. However, the quarantine process is expensive and not an option for most poultry fanciers. Some small-scale poultry breeders are trying to coordinate simultaneous imports to reduce costs. Poultry fanciers mostly hold the genetic diversity of poultry in Australia and these groups keep many breeds (Appendix). Attempts to develop a breed registry system for poultry are underway.

One or two breeds dominate the genetics of the pig industry, which uses sperm from a limited number of boars. While production in these herds is competitive, the industry is concerned about inbreeding. This is because of limited diversity among boars and inability to import pigs and porcine reproductive material into Australia. These issues also affect the rarer breeds of pigs. However, Australia’s large feral pig population offers a potential store of diversity but not in a form of particular use for maintaining purebreds.

Breeding organisations and non-government organisations generally support in situ and on-farm conservation of breeds. These groups also support ex situ conservation, with breeding groups using cryopreservation to maintain gene banks for commercial use. Cryopreservation methods that may be applicable to ex situ conservation are mainly used for commercial activities like artificial insemination. Cryopreservation is also used for transfer of reproductive material between countries or continents as it is more efficient and practical, and perhaps more amenable to biosecurity requirements, than transport of live animals.
Australian agricultural industries will continue to genetically improve the major breeds for increased productivity and adaptation to Australian production conditions. Breeding may continue to focus on welfare traits and respond to changes in demand for quality characteristics. Even where sectors are using crossbred hybrid animals to maximise production, underlying genetic resources in the major breeds will be conserved to serve as resources for developing crossbreeds. The breeds not used for mainstream commercial production are those that hold most genetic diversity. These are conserved by small-scale farmers, breed societies and non-government organisations.

The FAO’s work, in particular provision of national breed abundance data through the DAD-IS, will allow breed keepers to assess the global status of their breeds. This will also allow Australian breeders and governments to assess the need for alternative strategies for conserving, using and developing animal genetic resources in a global context. In the absence of global information, breeders would find little strategic value in examining new or alternative strategies for conserving, using and developing animal genetic resources in this country.

Policy, strategy and management plans for conserving, using and developing animal genetic resources

Australian Government policy on conserving animal genetic resources is to create the enabling environment to allow both owners and users of animal genetic resources to establish breeding and conservation programs for their respective industries. Industry–government partnerships collaborate through R&D activities to determine future priorities for these industries, and through these, the appropriate conservation, use and development of animal genetic resources.

In addition, Australia’s Biodiversity Conservation Strategy, which provides a broad national framework for conserving the nation’s biodiversity, also contains guiding principles applicable to the food and agriculture sectors (DSEWPAC 2010).
3 Capacities and future capacity building needs

Assessing national capacities

This assessment of Australia’s national capacities includes discussion of the relevant institutions and programs; research, education and human resources; information systems and communication; performance recording, genetic evaluation and genetic improvement; and capacity building requirements for the future.

Relevant institutions and programs

Commercial companies and industry-owned organisations largely manage animal genetic resources of mainstream and agriculturally important breeds in Australia. In many cases government and industry funds are used collaboratively for R&D. A number of industry bodies support livestock producers by providing industry-breeder coordination, breed standards and R&D funding. These bodies include Meat and Livestock Australia, the Australian Chicken Meat Federation, Dairy Australia, Australian Wool Innovation, Australian Pork Ltd, the Rural Industries Research and Development Corporation, the New Rural Industries Association and other smaller industry bodies representing specialised producers supplying niche markets.

Less commercially important and rarer breeds are primarily conserved by smaller-scale producers, private breeders and/or enthusiasts, breed societies or non-government organisations, which are essential in ensuring preservation of such breeds. The Rare Breeds Trust of Australia is one such non-government organisation and has links to many breed societies and registration authorities across the various livestock groups.

Individual breed societies, producer groups and non-government organisations maintain herd, flock and stud books (Appendix) in order to monitor the status of livestock breeds and advocate actions for conservation or improvement of a particular breed.

Australia maintains a national database of domestic animals through the five-yearly Australian Bureau of Statistics detailed census of economically important livestock species, supported by smaller surveys in the intervening years. Information is collected from commercial farms and includes basic data of numbers of breeding males and females of each species.

The National Livestock Identification Scheme was introduced in 1999 to meet the European Union’s traceability requirements for imported cattle and their products. The scheme provides a whole-of-life record of animal movement and ownership to allow cattle, sheep and goats to be traced for biosecurity, meat safety, product integrity and market access. It could be linked to pedigree data, production performance, and analysis of DNA samples taken at slaughter. However, to work to its full potential, the scheme requires close cooperation between breed and industry bodies, and intensive training and extension (MLA 2011b). Electronic identification through the National Livestock Identification Scheme is mandatory for cattle in Australia and similar arrangements for sheep and managed goats are being considered within the Council of Australian Governments.

Research, education and human resources

The Australian Government is a major contributor to R&D, and provides funding for rural innovation mainly through a system of industry-based RDCs, the Commonwealth Scientific and
Industrial Research Organisation, state and territory research agencies and universities. This funding allows relevant research agencies and industry producers, processors, exporters and retailers to work in partnership to build robust and self-reliant industries.

Australia has a major asset in its research and education system and the human resource base involved in agricultural R&D. The sector is recognised as world-class across a wide range of agricultural sciences and contributes significantly to national and international activities. However, there is a need to increase the number of Australians being trained in agricultural sciences in order to service future needs.

Industry organisations, research institutions and professional societies, such as the Association for the Advancement of Animal Breeding and Genetics and the Australian Association for Animal Production, play a vital role in information exchange. They provide an avenue for discussing issues facing Australian livestock industries and for raising their profile. These institutions provide policy and technical advice and recommendations to industry stakeholders and governments. Livestock industries associations and research institutes also play an important role in addressing issues of national importance concerning the livestock industry.

Australia provides training to overseas scientists and helps other countries develop their agricultural systems through the Australian Centre for International Agricultural Research, AusAID and other privately and publicly funded programs. Although Australia is involved in training and R&D projects around the world, it focuses on near neighbours in the Pacific and Southeast Asian region.

Australia is a developed nation with large areas of agricultural lands in the tropics. It is, therefore, in a unique position to deliver modern agricultural science knowledge to developing countries in tropical regions. Australia already exports semen and embryos from cattle and sheep, and live cattle for breeding to a number of countries and regions, including China, Indonesia, the Middle East and Russia.

Information systems and communication

Australia does not have a dedicated information or communication system for animal genetic resources. However, it has high-quality information and communications technology infrastructure that facilitates electronic communication and storage of information about animal genetics. Almost all mammalian breed societies have an online presence as do scientific organisations and companies involved in livestock research. Initiatives to develop a system for collating and storing poultry breed information have been discussed above and would almost certainly involve an internet-based system allowing information to be shared with interested parties domestically and internationally.

Performance recording and genetic evaluation and improvement

Australia has world-class genetic evaluation programs for many industries and breeds. A large proportion of breeders, including those with unregistered herds and flocks, use these programs and computerised performance records have facilitated their widespread uptake. Natural mating and artificial insemination on the basis of estimated breeding values is quite effective in improving the productivity and flow of genetic material through industries. Genetic trends and goals are available and reviewed regularly to meet breeder and market objectives.

A large number of traits are recorded in the performance recording schemes to allow breeds and strains of breeds to be defined at the phenotype level, and increasingly at the genotype level. This is valuable when matching genotypes to particular environmental and production system
niches. Genetic evaluation programs in Australia have mainly been delivered through collaboration of relevant RDCs, industry associations, universities and government agencies; and in some cases, breed societies, producer groups and non-government organisations.

A brief description of the major genetic evaluation programs was given in Chapter 1 ‘Conservation status of important agricultural species’. More detailed information is available from:

- Agricultural Business Research Unit at abri.une.edu.au
- Animal Genetics and Breeding Unit at agbu.une.edu.au
- Australian Dairy Herd Improvement Scheme at adhis.com.au
- Australian Pork Limited at apl.au.com
- Breedplan at breedplan.une.edu.au
- Dairy Australia at dairyaustralia.com.au
- Meat and Livestock Australia at mla.com.au
- Sheep Genetics at sheepgenetics.org.au.

Interest in genetic resistance to parasites and disease is growing. Discovery of a worm-resistant sheep (known as the ‘Golden Ram’ project) identified resistance to gastrointestinal worms as a trait determined by a recognisable gene. Genetic resistance to ticks is a trait selected for in cattle breeds for tropical environments, where ticks are prevalent.

DNA marker technology, such as quantitative trait loci (QTL) and single nucleotide polymorphisms (SNP) are being applied to animal breeding in Australia. SNPs are being incorporated into ‘SNPchips’, and can be used to screen animals to look for assemblages of selected traits. This can have a significant effect on the ability to rapidly screen animals for specific traits. Similarly, whole genome sequencing will facilitate analysis of underlying variation within and between breeds.

Both the beef and sheep industries have established research populations, where an extensive range of phenotypes have been collected and animals genotyped using SNPs. This information has been used to generate genomic predictions of breeding values, with varying degrees of reliability. The genomic information has to some degree been integrated into breeding programs. As the number of animals genotyped and the density of markers increases the predictive value of this approach is expected to improve. Genomic selection also has the potential to increase the accuracy of selection of traits that are difficult or expensive to measure (Swan et al. 2011).

The Australian Dairy Herd Improvement Scheme has performed genetic evaluations for both Australian and international dairy cattle since the early 1980s. In 2010 the scheme began incorporating genomic information in its estimated breeding values.

Future capacity-building needs

The future presents both challenges and opportunities for Australia’s livestock sectors. To respond effectively, Australia will need to make full use of its innovation and R&D capabilities. Some existing R&D programs are described here.
Sustainable and robust animal production systems
Future capacity-building needs will depend largely on the sustainability and robustness of the current animal production systems. Variation in market demand, availability of new technology and other factors will drive innovation and changes within production systems. While these changes will occur partly due to existing capacity, development of new capacity is also needed. Investment in scientific research is necessary to safeguard Australia’s capability to meet future production needs while improving sustainability and environmental accountability of livestock production systems.

Australian agriculture is expected to continue improving production through advances in animal production systems, for example:

- The pig and poultry industry will remain highly reliant on grain feeding systems, but housing and husbandry systems are changing to allow for more ‘natural’ behaviours (such as allocating more space per animal and/or environmental enrichment) and to improve efficiency of production.

- The beef industry is predominantly pastoral with the breeding herd almost exclusively reliant on pasture. About 30 per cent of cattle in the beef industry are finished in feedlots. Feedlot rations are generally based on grain with harvested forage contributing to roughage requirements. The feedlot industry is implementing quality assurance programs to ensure domestic and international consumers’ food safety, traceability and welfare expectations are met.

- The dairy industry will continue to be predominantly pasture-based with some supplementary feeding of harvested forage and grain-based feeds to maintain high feed intakes and compensate for seasonal deficiencies in pasture quality. Genetic programs to select animals for this production environment are expected to continue. A few dairies are highly reliant on grain feeding where pasture production is not a viable option; the number may increase depending on seasonal conditions and grain prices.

- The sheep industry also relies on pastures in addition to grazing in cropping enterprises. A trend to increase use of improved pastures in areas with sufficient rainfall is emerging. With appropriate grazing management, the carrying capacity in these areas can be significantly and sustainably increased. This type of pastoral intensification is particularly relevant to the sheep meat industry. Few feedlots finish sheep, as most meat sheep are finished at pasture.

Natural resource management
Creating sustainable farming systems for both productivity and natural resource management objectives is becoming an important focus in Australian agriculture. In this context, integrated farming practices that use innovative forage systems are likely to become more common. For example, forage systems using leucaena, a leguminous tree imported from South America, and other shrubs have been developed to broaden the plant base available for grazing and browsing.

In another example, the South Australian Research and Development Institute's research under the Future Farm Industries project, ‘Enrich’, is investigating the potential of Australian native shrub species for use as forage in grazing systems. Besides providing out-of-season feed, a large number of these native shrub species can contribute to protein and mineral nutrition, and improve digestion efficiency of livestock, help control gut parasites, and provide shelter and shade. The potential to provide several natural resource benefits exist in combating dryland salinity, reducing wind erosion and improving biodiversity. Consumption of a number of perennial Australian shrubs has also been shown to reduce methane production in animals and
about 40 per cent of shrubs tested were shown to reduce in-gut parasite development (Future Farm Industries CRC n.d.).

**Genomic selection**

Genomic selection is anticipated to play an increasingly important role as it can hasten selective breeding. In cattle, improved productivity through testing for desirable traits (for example, associated with age to weaning, fertility, number of offspring per year, reduced greenhouse gas emissions, improved feed conversion and milk production) will be industry targets.

As well, improved productivity through relevant traits can reduce the environmental footprint of the livestock industry and contribute to sustainable livestock production. Traits relating to drought tolerance in sheep are being investigated; for example, sheep that lose less weight during summer when feed quality is lowest and temperatures highest. Other traits being investigated relate to carcass quality, lifetime wool quality, reproduction and resilience (Sheep CRC 2011).

**Climate change**

Climate change is expected to affect livestock performance through changes in the quantity and quality of both water and feed. Climate change policies will influence changes within the livestock industry and may lead to new production environments or use of animal genetic resources. Improving environmental accountability is expected to lead to improvements in production efficiencies through breeding and optimisation of resources. Some targets include improving feed conversion efficiency using feed additives; and improving traits of pasture used for animal feed, such as improved nutrient content and use, water use efficiency of pastures, and improved pasture digestibility.

The National Livestock Identification Scheme system of registration could also be extended for potential use in greenhouse gas accounting systems (Arthur et al. 2010).
4 Identifying national priorities for conserving and using animal genetic resources

Under Australia’s federal system of government, states and territories have primary responsibility in agriculture and natural resource management. The Australian Government plays a facilitating role in addressing issues that require a national response. Ministerial councils and R&D corporations are the main national coordination mechanisms that address national crosscutting issues involving animal genetic resources.

Recognised national priorities for conserving, developing and using animal genetic resources are:

- Improving the monitoring and information infrastructure through recording schemes and suitably linked databases in order to address the increasingly complex livestock objectives necessary to meet social and commercial needs. Not-for-profit organisations currently maintain databases and collect animal genetic resource information at irregular intervals. It is difficult to determine the conservation status of a number of breeds owing to lack of data.
- Providing sufficient training in genetic management and operation of livestock conservation and improvement schemes.
- Ensuring effective technology transfer between groups. For example, Dairy Australia, Meat and Livestock Australia and Australian Wool Innovation, in collaboration with breeding companies and research organisations, fund information programs for all animal producers.
- Increasing the availability of information on performance standards for breeds and whole-of-chain marketing.
- Funding individual research programs, in collaboration with breeding companies and research institutes, into genetic management and selection techniques for livestock improvement programs and developing state-of-the-art technologies and/or approaches for effective and sustainable management of animal genetic resources.
- Developing animal genetic resources programs to align with environmental and climate change priorities; for example, through improving the sustainability and adaptability of livestock production systems.
- Preserving genetic variability through cryopreservation of genetic material. Some bull and pig breeding companies and several non-government organisations maintain gene banks.

Commercial returns to farmers are crucial to ensuring survival of rare breeds. Preservation of breeds is therefore highly dependent on their successful marketing and use. Niche markets are being created that promote the meat quality of selected breeds in specialty and boutique markets. Initiatives are also underway to establish rare breed farms to ensure a secure supply of meat from several rare breeds in order to promote products from these animals and preserve their numbers. Organisations like the Rare Breeds Trust of Australia and Heritage Sheep Australia play a pivotal role.
5 Formulating recommendations for enhanced cooperation in farm animal biodiversity

Australia participates in a range of international and regional fora concerned with genetic resources. This includes providing extensive assistance to international development and capacity building programs under bilateral arrangements, as well as contributing to the FAO and other multilateral organisations.

International cooperation in preservation of animal genetic resources also occurs through publicly and privately funded programs; for example, to provide training to overseas scientists and assistance to other countries to improve productivity of their agricultural systems. Australian researchers and industry have considerable expertise in managing and using animal genetic resources for food and agriculture. This allows them to participate in technology transfer and capacity building activities with developing countries. Australia is involved regionally in Southeast Asia with a number of projects and more recently in Africa. This usually occurs through partnership programs that include funding from AusAID and the Australian Centre for International Agricultural Research.

Australia has a number of breeds with very low population numbers, or that have reached critical levels elsewhere, including in their country of origin. Australia’s position as an island continent and with a favourable biosecurity status makes its animal genetic resources a potentially valuable resource for global conservation efforts. However, quarantine systems that underpin Australia’s favourable biosecurity status also impede introduction of some genetic resources into Australia. Regulatory arrangements prevent introduction of some species and the introduction of genetic resources for rare or non-commercial breeds is also uncommon because of the high costs of quarantine.

Australian technical capacity in animal genetic resources management is well developed, with world-class genetic evaluation techniques used in all commercial livestock sectors and in creating locally adapted breeds suited to Australia’s environment. Relevant practices include genetic selection programs and adaptive breeding, optimising selection, and incorporation of genomic selection tools. Australia’s capacity in agricultural knowledge and technologies could contribute to animal genetic resources conservation and use in other countries.
Appendix: Breed composition of Australian animal industries

Mainstream breeds

Information in this section was sourced from the Rare Breeds Trust of Australia (RBTA 2006) unless otherwise stated. The mainstream breed population data is also available in spreadsheet format from Australia’s National Coordinator for Animal Genetic Resources by emailing PGRFA-focalpoint@daff.gov.au.

The list of breeds below has been entered into DAD-IS. Detailed breed information is also available from the Rare Breeds Trust of Australia’s report, Status of Rare Breeds of Domestic Farm Livestock in Australia (pdf 1.19mb), and sources specified below.

Note: Large numbers of unregistered animals for some breeds have not been included in the Australian input into DAD-IS.

Beef and dairy cattle

The 73 breeds of beef and dairy cattle recorded in Australia are:

Adapteur (Belmont Adapteur)  Brangus  Jersey
Africander (Afrikaner)  Braunvieh  Limousin  Senepol
Angus (Aberdeen Angus)  British White  Lincoln Red  Shorthorn
Australian Friesian Sahiwal  Brown Swiss  Lowline  Simbrah
Australian Milking Zebu (AMZ)  Charbray  Luining  Simmental
Australian Red Dairy Breed (Aussie Red)  Charolais  Maine Anjou  Sindhi
Ayrshire  Chianina  Mandalong Specials  South Devon
Bazadaise  Dairy Shorthorn  Meuse-Rhine-Issel (Dutch Red and White)  Speckle Park
Beefmaker  Devon  Miniature Hereford  Square Meaters
Beef Shorthorn  Dexter  Murray Grey  Sussex
Belgian Blue  Droughtmaster  Nguni  Tuli
Belmont Red  English Longhorn  Piedmontese  Texas Longhorns
Belted Galloway  Galloway  Pinzgauer  Wagyu
Blonde d’Aquitaine (Blondes)  Gelbvieh  Poll Hereford  Welsh Black
Bonsmara  Greyman  Red Angus  White Park
Boran  Guernsey  Red Poll  Zebu
Braford  Hereford  Romagnola
Brahman  Highland Cattle  Sahiwal

Source: RBTA 2006
List of rare breeds

The Rare Breeds Trust of Australia developed the following list of dairy and beef cattle breeds in Australia that fit their criteria for being listed as rare.

<table>
<thead>
<tr>
<th>Status (criteria)</th>
<th>Breed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Critical (&lt;25 annual female registrations)</td>
<td>White Park</td>
</tr>
<tr>
<td></td>
<td>British White</td>
</tr>
<tr>
<td></td>
<td>Australian Milking Zebu</td>
</tr>
<tr>
<td></td>
<td>Belmont Adapteur</td>
</tr>
<tr>
<td>Endangered (&lt;75 annual female registrations)</td>
<td>Traditional Hereford</td>
</tr>
<tr>
<td></td>
<td>Traditional Angus</td>
</tr>
<tr>
<td></td>
<td>Traditional Dairy Shorthorn</td>
</tr>
<tr>
<td>Vulnerable (&lt;250 annual female registrations)</td>
<td>English Longhorn</td>
</tr>
<tr>
<td></td>
<td>Australian Friesian Sahiwal</td>
</tr>
<tr>
<td>At risk (&lt;750 annual female registrations)</td>
<td>Devon (548 registered in 2003)</td>
</tr>
<tr>
<td></td>
<td>Galloway (313 registered in 2003)</td>
</tr>
<tr>
<td></td>
<td>Beef Shorthorn (255 registered in 2003)</td>
</tr>
<tr>
<td></td>
<td>Belmont Red (580 registered in 2003)</td>
</tr>
<tr>
<td></td>
<td>Red Poll (877 total registered in 2003)</td>
</tr>
</tbody>
</table>

### Population data

Figures A1 to A3 show beef cattle registrations between 1999 and 2010. The data refer to cattle registered in the breed society’s herd book, which could represent about 70 per cent of breeding animals. The data do not include the number of animals used for breeding—these are recorded by breed societies but not entered in their herd book (pers. comm. 2012, Steven Skinner).

In 2007, Herefords Australia Ltd undertook Hereford and Poll Hereford registrations. Since that time, while both Hereford and Poll Hereford registered animals have been counted under Poll Hereford, the society still considers them two distinct breeds (pers. comm. 2012, Herefords Australia Ltd).

Figure A1 Beef cattle registrations, British breeds and Australian derivatives

Data source: Australian Registered Cattle Breeders’ Association and various breed societies
Figure A2 Beef cattle registrations, tropical breeds

Note: The Greyman Beef Cattle Society has been wound up and Greyman are now registered as an appendix in the Murray Grey Society.

Data source: Australian Registered Cattle Breeders’ Association (ARCBA) and various breed societies.

Figure A3 Beef cattle registrations, European breeds and Australian derivatives

Data source: Australian Registered Cattle Breeders’ Association and various breed societies

Figure A4 shows dairy cattle registrations between 1999 and 2010.
**Sheep**

**List of breeds**

The 43 breeds of sheep recorded in Australia, including 10 strains of Merino are:

**WOOL SHEEP BREEDS**
- Merino–Peppin Strain (Medium wool)
- Merino–Saxon Strain (Superfine & fine wool)
- Merino–South Australian Strain (Strong wool)
- Merino–Camden Strain
- Merino–Spanish Strain
- Poll Merino (strain)
- Booroola Merino (strain)

**MERINO-BASED BREEDS**
- Dohne Merino (strain)
- Fonthill Merino (strain)
- South African Mutton Merino (South African Meat Merino) (strain)
- Bond Corriedale
- Comeback
- Cormo
- Corriedale
- Hyfer
- Polwarth (Polled and Horned)

**MEAT SHEEP BREEDS—SHORT WOOL**
- Coolalee
- Dorset Down
- Dorset Horn
- East Friesian
- Finnsheep
- Hampshire Down
- Poll Dorset
- Ryeland
- Shropshire
- South Dorset Down
- Southdown
- South Suffolk
- Suffolk
- Texel
- White Suffolk
- Border Leicester
- Cheviot
- Coopworth

**FAT TAIL SHEEP**
- Awassi
- Karakul
- Damara

**CARPET WOOL BREEDS**
- Carpetmaster
- Elliottdale
- Drysdale
- Tukidale

**WOOL-SHEDDING SHEEP BREEDS**
- Dorper
- Wiltipoll
- Wiltshire Horn

*Source: RBTA 2006*
List of rare breeds
The Rare Breeds Trust of Australia developed the following list of sheep breeds in Australia that fit their criteria for being listed as rare.

<table>
<thead>
<tr>
<th>Status (criteria)</th>
<th>Breed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lost or extinct from Australia</td>
<td>Cotswold</td>
</tr>
<tr>
<td></td>
<td>North Devon</td>
</tr>
<tr>
<td>Critical (&lt;300 breeding ewes)</td>
<td>Horned Polwarth (Australia only)</td>
</tr>
<tr>
<td></td>
<td>Camden Merino (Australia only)</td>
</tr>
<tr>
<td></td>
<td>Carpetmaster (New Zealand, Australia)</td>
</tr>
<tr>
<td></td>
<td>Booroola Merino (Australia only)</td>
</tr>
<tr>
<td></td>
<td>Zenith (Aust only)</td>
</tr>
<tr>
<td>Critical (&lt;300 breeding females)</td>
<td>Lincoln</td>
</tr>
<tr>
<td></td>
<td>English Leicester</td>
</tr>
<tr>
<td></td>
<td>Ryeland</td>
</tr>
<tr>
<td>Endangered (&lt;500 breeding ewes)</td>
<td>Shropshire</td>
</tr>
<tr>
<td></td>
<td>Drysdale (estimate only)</td>
</tr>
<tr>
<td>Endangered (&lt;500 breeding females)</td>
<td>Lincoln</td>
</tr>
<tr>
<td></td>
<td>English Leicester</td>
</tr>
<tr>
<td></td>
<td>Ryeland</td>
</tr>
<tr>
<td>Vulnerable (&lt;900 breeding ewes)</td>
<td>Cheviot</td>
</tr>
<tr>
<td></td>
<td>Dorset Down</td>
</tr>
<tr>
<td>At risk (&lt;1500 breeding ewes)</td>
<td>Romney</td>
</tr>
</tbody>
</table>

Source: Rare Breeds Trust of Australia

Population data
Table A1 and Figure A5 show sheep registrations (ewe joining and flocks). These data do not include all sheep breeds in Australia, but breeds currently registered by the Australian Stud Sheep Breeders Association Ltd and the Australian Association of Stud Merino Breeders Limited. For Merinos in particular, these data do not include information about commercial breeders. The number of registered sheep flocks does not include Aussiedown, Australian Finnsheep, Border Leicester, Southdown, Suffolk, Suffolk or Wiltipoll.

Table A1 Total number of registered adult ewes (national)

<table>
<thead>
<tr>
<th>Breed description</th>
<th>2003</th>
<th>2005</th>
<th>2007</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aussiedown</td>
<td>279</td>
<td>183</td>
<td>250</td>
<td>136</td>
<td>125</td>
<td>166</td>
</tr>
<tr>
<td>Australian Finnsheep</td>
<td>206</td>
<td>144</td>
<td>112</td>
<td>119</td>
<td>90</td>
<td>79</td>
</tr>
<tr>
<td>Border Leicester</td>
<td>30 945</td>
<td>35 370</td>
<td>40 467</td>
<td>32 052</td>
<td>30 989</td>
<td>33 142</td>
</tr>
<tr>
<td>Cheviot</td>
<td>860</td>
<td>777</td>
<td>487</td>
<td>533</td>
<td>536</td>
<td>588</td>
</tr>
<tr>
<td>Dorset Down</td>
<td>191</td>
<td>193</td>
<td>202</td>
<td>257</td>
<td>259</td>
<td>262</td>
</tr>
<tr>
<td>Dorset Horn</td>
<td>721</td>
<td>666</td>
<td>615</td>
<td>506</td>
<td>564</td>
<td>522</td>
</tr>
<tr>
<td>East Friesian</td>
<td>437</td>
<td>284</td>
<td>261</td>
<td>260</td>
<td>361</td>
<td>423</td>
</tr>
<tr>
<td>English Leicester</td>
<td>585</td>
<td>499</td>
<td>471</td>
<td>435</td>
<td>440</td>
<td>446</td>
</tr>
<tr>
<td>Hampshire Down</td>
<td>977</td>
<td>1104</td>
<td>968</td>
<td>1 130</td>
<td>1 232</td>
<td>1 427</td>
</tr>
<tr>
<td>Lincoln</td>
<td>581</td>
<td>450</td>
<td>415</td>
<td>462</td>
<td>445</td>
<td>608</td>
</tr>
<tr>
<td>Merino</td>
<td>101 325</td>
<td>892 542</td>
<td>783 555</td>
<td>670 316</td>
<td>630 642</td>
<td>na</td>
</tr>
<tr>
<td>Romney</td>
<td>1 376</td>
<td>1 363</td>
<td>1 276</td>
<td>1 149</td>
<td>1 222</td>
<td>1 087</td>
</tr>
<tr>
<td>Ryeland</td>
<td>540</td>
<td>623</td>
<td>617</td>
<td>664</td>
<td>654</td>
<td>682</td>
</tr>
<tr>
<td>Shropshire</td>
<td>232</td>
<td>230</td>
<td>276</td>
<td>276</td>
<td>314</td>
<td>335</td>
</tr>
<tr>
<td>South Suffolk</td>
<td>1 905</td>
<td>1 925</td>
<td>1 669</td>
<td>1 294</td>
<td>1 262</td>
<td>1 315</td>
</tr>
<tr>
<td>Southdown</td>
<td>2 346</td>
<td>2 547</td>
<td>2 068</td>
<td>1 858</td>
<td>2 145</td>
<td>2 360</td>
</tr>
<tr>
<td>Suffolk</td>
<td>5 130</td>
<td>5 114</td>
<td>4 807</td>
<td>5 244</td>
<td>5 663</td>
<td>6 295</td>
</tr>
<tr>
<td>Wiltipoll</td>
<td>189</td>
<td>666</td>
<td>987</td>
<td>881</td>
<td>603</td>
<td>714</td>
</tr>
<tr>
<td>Wiltshire Horn</td>
<td>2 821</td>
<td>3 083</td>
<td>3 177</td>
<td>3 367</td>
<td>2 668</td>
<td>2 892</td>
</tr>
</tbody>
</table>

Source: Australian Stud Sheep Breeders Association Ltd Flock Register and the Australian Association of Stud Merino Breeders Limited
Figure A5 Registered sheep flocks (Merino flocks not presented)

Data source: Australian Stud Sheep Breeders Association Ltd Flock Register

**Pigs**

**List of breeds**

The nine breeds of pig recorded in Australia are:

- Berkshire
- Duroc
- Hampshire
- Landrace
- Large Black
- Large White
- Tamworth
- Welsh
- Wessex Saddleback

Source: RBTA 2006

**Population data**

Figures A6 and A7 show the rare pig registrations (number of animals and studs) since 2000.
Figure A6 Rare breed pig registrations in Australia

Data source: Australian Pig Breeders Association Herd Book

Figure A7 Pig breed studs in Australia

Data source: Australian Pig Breeders Association Herd Book
Poultry and waterfowl

List of breeds

There are recognised physical differences (in size, colour and feather type) within poultry and waterfowl breeds which are not important to genetic diversity. A few additional poultry breeds, as listed by the Poultry Stud Breeders and Exhibitors Victoria were added in the DAD-IS database. These were Legbar, Marans, Scots Grey, Sicilian Buttercup and Pit Game poultry breeds.

HEAVY BREED—HARD FEATHERED
Full size:
Australian Game
Australian Pit Game
Indian Game
Jungle Fowl
Malay
Modern Game
Old English Game
Bantam size:
Australian Game
Australian Pit Game
Indian Game
Jubilee Game
Malay
Modern Game
Old English Game

HEAVY BREED—SOFT FEATHERED
Full size:
Australorp
Barnevelder
Brahma
Cochin
Dorking
Faverolles
Frizzle
Crood Langshan
Australian Langshan
New Hampshire
Orpington
Plymouth Rock
Rhode Island
Sussex
Transylvanian Naked Neck
Wyandotte
Bantam size:
Antwerp
Australorp
Barnevelder
Brahma
Cochin
Dorking
Faverolles
Frizzle
Australian Langshan
New Hampshire
Orpington
Plymouth Rock
Pekin
Rhode Island
Sussex
Transylvanian Naked Neck
Wyandotte
LIGHT BREED—SOFT FEATHERED
Full size:
Ancona
Andalusian
Aracana
Barnevelder
Campine
Hamburg
Houdan
Leghorn
Minorca
Polish
Silkie
Spanish
Welsummer
Bantam size:
Ancona
Andalusian
Aracana
Barnevelder
Belgian Barbu d’Anvers
Belgian Barbu d’Uccles
Campine
Hamburg
Houdan
Leghorn
Minorca
Polish
Silkie
Spanish
Welsummer

Ducks—LARGE
Full size:
Aylesbury

DUCKS—LARGE
Full size:
Aylesbury

DUCKS—LARGE
Full size:
Aylesbury

Source: RBTA 2006
List of rare breeds

The Rare Breeds Trust of Australia developed the following list of poultry and waterfowl breeds in Australia that and fit their criteria for being listed as rare.

<table>
<thead>
<tr>
<th>Status (criteria)</th>
<th>Breed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Critical (&lt;100 purebred breeding pairs)</td>
<td>Turkey breeds</td>
</tr>
<tr>
<td></td>
<td>Black</td>
</tr>
<tr>
<td></td>
<td>Narragansett</td>
</tr>
<tr>
<td></td>
<td>Royal Palm</td>
</tr>
<tr>
<td></td>
<td>Geese breeds</td>
</tr>
<tr>
<td></td>
<td>African</td>
</tr>
<tr>
<td></td>
<td>Chinese (white)</td>
</tr>
<tr>
<td></td>
<td>Crested Roman</td>
</tr>
<tr>
<td></td>
<td>Geese breeds</td>
</tr>
<tr>
<td></td>
<td>African</td>
</tr>
<tr>
<td></td>
<td>Chinese (white)</td>
</tr>
<tr>
<td></td>
<td>Crested Roman</td>
</tr>
<tr>
<td></td>
<td>Duck breeds</td>
</tr>
<tr>
<td></td>
<td>Aylesbury</td>
</tr>
<tr>
<td></td>
<td>Black East Indian</td>
</tr>
<tr>
<td></td>
<td>Campbell (dark)</td>
</tr>
<tr>
<td></td>
<td>Crested</td>
</tr>
<tr>
<td></td>
<td>Poultry breeds/strains not known to be &gt;40 years*</td>
</tr>
<tr>
<td></td>
<td>Standard soft feather</td>
</tr>
<tr>
<td></td>
<td>Australorp (white)</td>
</tr>
<tr>
<td></td>
<td>Autosexing Breeds</td>
</tr>
<tr>
<td></td>
<td>Hamburgh (penciled)</td>
</tr>
<tr>
<td></td>
<td>Langshan (Croad)</td>
</tr>
<tr>
<td></td>
<td>Orpington (white)</td>
</tr>
<tr>
<td></td>
<td>Plymouth Rock (other than barred)</td>
</tr>
<tr>
<td></td>
<td>Poultry breeds/strains not known to be &gt;40 years*</td>
</tr>
<tr>
<td></td>
<td>Standard hard feather</td>
</tr>
<tr>
<td></td>
<td>Australorp, Judson Strain</td>
</tr>
<tr>
<td></td>
<td>Endangered (&lt;200 purebred breeding pairs)</td>
</tr>
<tr>
<td></td>
<td>Turkeys</td>
</tr>
<tr>
<td></td>
<td>Slate</td>
</tr>
<tr>
<td></td>
<td>Geese</td>
</tr>
<tr>
<td></td>
<td>Exhibition Toulouse</td>
</tr>
<tr>
<td></td>
<td>Ducks</td>
</tr>
<tr>
<td></td>
<td>Blue Swedish</td>
</tr>
<tr>
<td></td>
<td>Campbell (white)</td>
</tr>
<tr>
<td></td>
<td>Cayuga</td>
</tr>
<tr>
<td></td>
<td>Poultry strains (&gt;40 years)</td>
</tr>
<tr>
<td></td>
<td>Leghorn, White CSIRO Strain</td>
</tr>
<tr>
<td></td>
<td>Poultry breeds/strains not known to be &gt;40 years*</td>
</tr>
<tr>
<td></td>
<td>Standard soft feather</td>
</tr>
<tr>
<td></td>
<td>Ancona</td>
</tr>
<tr>
<td></td>
<td>Andalusian</td>
</tr>
<tr>
<td></td>
<td>Australorp (blue)</td>
</tr>
<tr>
<td></td>
<td>Campine</td>
</tr>
<tr>
<td></td>
<td>Silver Grey Dorking</td>
</tr>
<tr>
<td></td>
<td>Faveroilles (Salmon)</td>
</tr>
<tr>
<td></td>
<td>Hamburgh (gold spangled)</td>
</tr>
<tr>
<td></td>
<td>Langshan, Australian (blue, white)</td>
</tr>
<tr>
<td></td>
<td>Leghorn (pile, buff, duckwing)</td>
</tr>
<tr>
<td></td>
<td>Orpington (black)</td>
</tr>
<tr>
<td></td>
<td>Polish</td>
</tr>
<tr>
<td></td>
<td>Rhode Island (rosecomb, white)</td>
</tr>
<tr>
<td></td>
<td>Silkie (other than black, white)</td>
</tr>
<tr>
<td></td>
<td>Turkeys</td>
</tr>
<tr>
<td></td>
<td>Bronze</td>
</tr>
<tr>
<td></td>
<td>Geese</td>
</tr>
<tr>
<td></td>
<td>Chinese (brown)</td>
</tr>
<tr>
<td></td>
<td>Embden</td>
</tr>
<tr>
<td></td>
<td>Geese</td>
</tr>
<tr>
<td></td>
<td>Chinese (brown)</td>
</tr>
<tr>
<td></td>
<td>Toulouse</td>
</tr>
<tr>
<td></td>
<td>Ducks</td>
</tr>
<tr>
<td></td>
<td>Indian Runner (fawn and white)</td>
</tr>
<tr>
<td></td>
<td>Muscovy (white, black &amp; white)</td>
</tr>
</tbody>
</table>

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**Farm animal genetic resources: second national report—Australia**

### Poultry strains (>40 years)

<table>
<thead>
<tr>
<th>Status (criteria)</th>
<th>Breed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rouen Campbell (khaki)</td>
<td></td>
</tr>
<tr>
<td>Poultry strains (&gt;40 years)</td>
<td>Bronze turkey, King Island strain</td>
</tr>
<tr>
<td>Poultry breeds/strains not known to be &gt;40 years*</td>
<td>Standard soft feather</td>
</tr>
<tr>
<td></td>
<td>Araucana (Lavender strain)</td>
</tr>
<tr>
<td></td>
<td>Barnevelder (doubled laced)</td>
</tr>
<tr>
<td></td>
<td>Frizzle</td>
</tr>
<tr>
<td></td>
<td>Hambourgh (black, silver spangled)</td>
</tr>
<tr>
<td></td>
<td>Leghorn (brown, black, blue)</td>
</tr>
<tr>
<td></td>
<td>New Hampshire</td>
</tr>
<tr>
<td></td>
<td>Orpington (blue &amp; buff)</td>
</tr>
<tr>
<td></td>
<td>Welsummer</td>
</tr>
<tr>
<td></td>
<td>Wyandotte (partridge, pencilled)</td>
</tr>
<tr>
<td></td>
<td><strong>Standard hard feather</strong></td>
</tr>
<tr>
<td></td>
<td>Indian Game (Jubilee)</td>
</tr>
<tr>
<td></td>
<td>Bantam soft feather</td>
</tr>
</tbody>
</table>

*Only true bantams—those which have no large counterpart—are included in these lists.

Source: RBTA 2006.

**Population data**

A registry of poultry breeds in Australia does not exist. The Rare Breeds Trust of Australia is developing Australia’s first such system.

### Goats

#### List of breeds

The Rare Breeds Trust of Australia has recorded 14 breeds of goats in Australia.

**FIBRE BREEDS**
- Angora
- Australian Heritage Angora
- Cashmere

**MEAT BREEDS**
- Boer
- Kalahari Red

**DAIRY BREEDS**
- Anglo Nubian
- British Alpine

**AUS**
r

- Australian Melaan
- Australian All Brown

**AUSTRALIAN FERAL BREEDS**
- Australian Feral Goat
- Faure Island
- Bernier Island

Source: RBTA 2006

### Other animals important for livestock industries

#### Horses and donkeys

#### List of breeds

The Rare Breeds Trust of Australia has recorded 63 breeds of horses and three breeds of donkey in Australia.

**HORSE BREEDS**
- Andalusian*
- Australian Stockhorse
- Australian Pony
- Australian Draught Horse
- Australian Brumby (wild)
- American Saddlebred
- Arabian English (Crabbet)
- Arabian Polish
- Arabian Egyptian
- Appaloosa

**MEAT BREEDS**
- Belgian Draught*
- Belgian Warmblood
- Caspian*
- Cleveland Bay*
- Clydesdale*
- Connemara*
- Coffin Bay Pony* (wild, South Australia)
- Danish Warmblood
- Darley
- Dartmoor*
- Exmoor *

**FIBRE BREEDS**
- Saanen
- Toggenburg
- Australian Melaan
- Australian All Brown

**AUS**
r

- Australian Feral Goat
- Faure Island
- Bernier Island

**HORSE BREEDS**
- English Riding Pony
- English Spotted Pony*
- Fjord*
- Falabella
- Friesian*
- French Warmblood
- German Warmblood
- Greenbank Army Barracks Brumby
- Guy Fawkes River National Park Brumby
- Highland*
Minor and emerging breeds

The remainder of this Appendix provides a brief overview of other species of domestic farm livestock in Australia that contribute to the nation’s farmed-animal genetic diversity. They are relatively minor contributors to total livestock production, although many are emerging as new ‘niche’ industries, and can be classified as new and emerging industries. In 2009, the New Rural Industries Association program was established to create an environment for developing new and innovative Australian rural industries.

While the kangaroo is not domestic farm livestock, as it is harvested from the wild, it is included here because of an increasing demand for harvested kangaroo products, which amounts to around 7.7 million tonnes of meat exports from Australia each year.

Information and industry production details below have been sourced from the New Rural Industries Association at nria.org.au (2011) unless otherwise stated.

**Alpacas**

Alpacas and llamas are believed to be descendants of the wild, and now rare, Guanacos and Vicunas of Central America (Logans 2005). Guanaco and Vicuna populations have not been recorded in Australia (ALA 2011).

Australia’s alpaca industry was established in the late 1980s and by June 2006 had grown to a flock of around 90 000 animals. The Australian industry is in a flock-building phase so little commercial meat is produced as yet and the trade in breeding stock is substantial. Reflecting this phase, and a worldwide shortage of breeding stock, prices are very high for suitable breeding alpacas.

In 2006–07, an estimated 108 tonnes of alpaca fibre was produced worth $1.25 million (Table A2). The unit price was low compared with indicator prices because a significant part of the clip (14 per cent in 2006–07) has no commercial value. In the same year, the Australian industry exported 2.7 tonnes of alpaca fleece to Peru for processing and imported 37 tonnes of alpaca products including re-export of fibre to Australia as processed products.

The alpaca is native to South America and is farmed in Peru (2.5 million alpacas), Bolivia (500 000) and Chile and Argentina combined (50 000). The two main alpaca types are Huacaya and Suri. More than 90 per cent of Australian alpacas are Huacaya. South America’s tight restriction on export of alpacas means a worldwide shortage of good alpaca breeding stock prevails. In October 2006, the average price received at the annual show and sale in Canberra was $40 000, with a top price for a breeding male of $124 000.
Table A2 Alpaca industry production in Australia

<table>
<thead>
<tr>
<th>Year</th>
<th>Gross value of production $’000</th>
<th>Exports $’000</th>
<th>Imports $’000</th>
<th>Estimated no. of producers</th>
</tr>
</thead>
<tbody>
<tr>
<td>2006–07</td>
<td>1245</td>
<td>16</td>
<td>447</td>
<td>3600</td>
</tr>
</tbody>
</table>

Source: Australian Alpaca Association

For more information contact: Australian Alpaca Association
PO Box 1076, Mitcham North, Victoria 3132, Australia
Phone (03) 9873 7700
Fax (03) 9873 7711
alpaca.asn.au/index.shtml

Llamas

The llama is a docile camelid native to South America and valued for its fleece—which is warm and windproof—and for its hide, meat and sinew.

In 1858, 283 alpacas and llamas landed in Sydney with the aim of establishing an Australian industry. The plans failed for various reasons. By 1861 there were around 500 llamas in the country. With a change in direction by the authorities, the flock was broken up in 1864 and the animals sold to a diverse range of interests.

Until the early 1980s Chile, along with other South American countries, had maintained an export ban on llamas and alpacas. Several North Americans, New Zealanders and Australians capitalised on a Chilean Government decision to allow limited export of llama and alpaca. They began importing in commercial quantities from Chile and as a result Australian herds are derived from these animals. Australia currently has fewer than 2000 llamas.

For more information contact: Llama Association of Australia
Cloverdale Park, RSD E1328 MacFarlanes Lane, Mount Egerton, Victoria 3352, Australia
Phone (03) 5368 9616
Fax (03) 5368 9614

Buffalo

The first buffaloes in Australia were introduced to the Northern Territory in the early nineteenth century. A large feral buffalo population soon became established, peaking in the 1980s at around 350,000 head before eradication measures were introduced to control bovine tuberculosis in the early 1990s. The Northern Territory buffalo population was declared free of this disease in 1997. The feral population is estimated to be around 60,000 and 30 farms in the Northern Territory manage a domesticated herd of around 12,000. All other states also have small domesticated buffalo herds. In 2006, Australia had 67 buffalo farms with an estimated total number of 13,559 buffaloes (NRIA 2011).

The value of production of the buffalo industry in 2006–07 was nearly $5 million, mainly consisting of live exports from the Northern Territory to Indonesia (Table A3). Since then live export of buffalo for slaughter has ceased and the industry is awaiting the availability of suitable abattoirs to facilitate export of processed products. Live export of low numbers of breeding stock continues (Angus Fleming, Australian Buffalo Industry Council, 2012, pers. comm.).
Australia has two main breeds of Buffalo: the Australian Swamp Buffalo, introduced in the 1820s to 1830s from eastern Indonesian islands; and the Riverine Buffalo, introduced in 1994, 1995 and 1997 from Italy, Bulgaria and the United States.

Table A3 Buffalo industry production in Australia

<table>
<thead>
<tr>
<th>Year</th>
<th>Gross value of production $'000</th>
<th>Exports $'000</th>
<th>Imports $'000</th>
<th>No. of farms</th>
</tr>
</thead>
<tbody>
<tr>
<td>2006–07</td>
<td>4972</td>
<td>4774</td>
<td>0</td>
<td>67</td>
</tr>
</tbody>
</table>

Source: NRIA 2011

For more information contact: Executive Director Buffalo Industry Council Darwin, Northern Territory, Australia

Camels
The two species of camel are the dromedary or Arabian (*Camelus dromedarius*) with one hump and the Bactrian camel (*Camelus bactrianus*) with two humps. The camels brought into Australia were almost exclusively the dromedary which are found in hot desert areas and are highly suited to Australia’s climate. Only about 20 Bactrian camels, normally found in cold deserts, were imported into Australia (Camel Export Australia) but there are no modern records of feral Bactrian camels (NRIA 2011).

The Australian camel industry is largely based on live export of feral dromedary collected in the arid central regions of Australia. Australia’s feral camel population was believed to be as large as one million in 2007 and growing at a rate of more than 10 per cent a year. Roughly 50 per cent of feral camels are located in Western Australia, 25 per cent in the Northern Territory and most of the remainder in western Queensland and northern South Australia. Although slaughter of camels for human consumption commenced at Alice Springs in the 1980s, there does not appear to have been significant production of camel meat in recent years. In the four years to 2006–07, shipments from Australia of live camels were made to Malaysia (68 per cent of total), and Brunei (32 per cent) (Table A4). Before 2003, live camels were also exported to Saudi Arabia.

Table A4 Camel industry production in Australia

<table>
<thead>
<tr>
<th>Year</th>
<th>Gross value of production $'000</th>
<th>Exports $'000</th>
<th>Imports $'000</th>
</tr>
</thead>
<tbody>
<tr>
<td>2006–07</td>
<td>683</td>
<td>338</td>
<td>0</td>
</tr>
</tbody>
</table>

Source: NRIA 2011

For more information contact: Central Australian Camel Industry Association Inc. PO Box 8760, Alice Springs, Northern Territory, 0871, Australia Phone (08) 8951 8183 (within Australia) Fax (08) 8951 8188 (within Australia) camelsaust.com.au

Crocodiles
Two species of crocodiles are found in Australia; the saltwater or estuarine crocodile (*Crocodylus porosus*) and the freshwater or Johnstone River crocodile (*Crocodylus johnstoni*).
Commercial crocodile farming began in Australia in the 1980s. The main products are skins and meat. High quality handbags, boots, belts, briefcases and luggage are manufactured from the skins.

Australia has 14 commercial crocodile farms: five in the Northern Territory, six in Queensland and three in Western Australia (farming both freshwater and saltwater crocodiles). Crocodile farming involves captive breeding supplemented by regulated sustainable harvesting of eggs and juveniles from the wild in the Northern Territory and Western Australia. Farmed crocodiles are harvested when their belly skin measures at least 35 centimetres; this takes between 18 months and three years.

The total value of Australian crocodile product exports in 2006–07 was around $9 million, 98 per cent of which was related to skins (Table A5). Over the three years to 2006–07, the main export markets for Australia's crocodile skins were France (58 per cent), Italy (18 per cent), Singapore (15 per cent) and Japan (7 per cent). The main export markets for Australian crocodile meat were Japan, New Zealand, Malaysia and Hong Kong (NRIA 2011).

Table A5 Crocodile industry production in Australia

<table>
<thead>
<tr>
<th>Year</th>
<th>Gross value of production $'000</th>
<th>Exports $'000</th>
<th>Imports $'000</th>
<th>No. of crocodile farms</th>
</tr>
</thead>
<tbody>
<tr>
<td>2006–07</td>
<td>8950</td>
<td>8845</td>
<td>0</td>
<td>14</td>
</tr>
</tbody>
</table>

Source: NRIA 2011

For more information contact: Northern Territory Government Department of Primary Industries and Fisheries nt.gov.au/d/Primary_Industry/index.cfm

Kangaroo

The Australian kangaroo industry is based on wild harvest on mainland Australia. The industry has developed over 30 years. Initially the main objective was to reduce the population (Table A7) because of its impact on agriculture and the environment but the industry developed when the animals began to be used for pet and human food and for leather.

Kangaroo harvesting operates under a quota system administered by the Australian and state and territory governments. Kangaroo populations vary substantially from year to year depending on seasonal conditions. State conservation agencies and the Australian Government Department of Sustainability, Environment, Water, Population and Communities monitor kangaroo populations and sustainability of harvesting. The number of kangaroos harvested is considerably below quota.

The gross value of production of the kangaroo industry was an estimated $43.9 million in 2007 (Table A6), down considerably from the early 2000s due to the effect of severe drought on kangaroo populations. This is a measure of the total amount paid to kangaroo harvesters at the meat processing plant gates.

Table A6 Kangaroo industry production in Australia

<table>
<thead>
<tr>
<th>Year</th>
<th>Gross value of production $'000</th>
<th>Exports $'000</th>
<th>Imports $'000</th>
</tr>
</thead>
<tbody>
<tr>
<td>2007</td>
<td>43 913</td>
<td>73 566</td>
<td>0</td>
</tr>
</tbody>
</table>

Source: NRIA 2011
Kangaroo meat exports for human consumption have grown strongly over 15 years although in 2009–10 a significant reduction occurred due mainly to loss of market access to Russia. Despite this, demand appears to be growing in Europe where kangaroo meat is considered a game meat. The export market for pet food was worth $0.7 million in 2007.

Kangaroo skins are an important component of the kangaroo industry. However, owing to confidentiality requirements, only limited details are available for kangaroo skin exports.

### Table A7 Population estimates for kangaroos within commercial harvest areas, 2010

<table>
<thead>
<tr>
<th>State</th>
<th>Red (Macropus rufus)</th>
<th>Western Grey (Macropus fuliginosus)</th>
<th>Eastern Grey (Macropus giganteus)</th>
<th>Wallaroo/Euro (Macropus robustus)</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>New South Wales</td>
<td>3 013 908</td>
<td>662 982</td>
<td>4 756 792</td>
<td>88 430</td>
<td>8 522 112</td>
</tr>
<tr>
<td>Queensland</td>
<td>3 603 509</td>
<td>--</td>
<td>6 652 443</td>
<td>1 916 855</td>
<td>12 172 807</td>
</tr>
<tr>
<td>South Australia</td>
<td>1 074 000</td>
<td>720 000</td>
<td>--</td>
<td>411 000</td>
<td>2 205 000</td>
</tr>
<tr>
<td>Western Australia</td>
<td>850 731</td>
<td>1 407 376</td>
<td>--</td>
<td>--</td>
<td>2 258 107</td>
</tr>
<tr>
<td>Total</td>
<td>8 542 148</td>
<td>2 790 358</td>
<td>11 409 235</td>
<td>2 416 285</td>
<td>25 158 026</td>
</tr>
</tbody>
</table>

Note: Population estimates are based on aerial and ground surveys and are for the areas within Australia where commercial harvesting occurs. The actual national populations would be significantly higher as these figures do not include estimates for areas not surveyed.

Source: DSEWPAC 2012

For more information contact: Mr John Kelly
Lenah Consultancy
PO Box 294, Mowbray, Tasmania 7248, Australia

### Wallabies

Commercial harvesting of wallabies is undertaken on Flinders Island and King Island in the state of Tasmania under formal management plans aimed at ensuring the sustainability of the harvest. With the new plans commencing in 2005–06, there are quotas for the harvest of Bennett’s wallaby (Macropus rufogriseus) and the Tasmanian Pademelon (Thylogale billardieri) on Flinders Island and of Bennett’s wallaby on King Island.

### Table A8 Wallaby industry production in Australia

<table>
<thead>
<tr>
<th>Year</th>
<th>Gross value of production $’000</th>
<th>Exports $’000</th>
<th>Imports $’000</th>
</tr>
</thead>
<tbody>
<tr>
<td>2005–06</td>
<td>136</td>
<td>na</td>
<td>0</td>
</tr>
</tbody>
</table>

Source: NRIA 2011

For more information contact: Mr John Kelly
Lenah Consultancy
PO Box 294, Mowbray, Tasmania 7248, Australia

### Deer

The main products from Australian deer farming are venison and velvet—the immature antler that is widely used in traditional Asian (particularly Chinese) medicine. Other parts of deer, including the tail, sinews, heart and blood, are also used in traditional Asian medicine. About 180 000 deer are farmed in Australia on about 1000 farms (Table A9; RBTA 2006).

The Deer Farmers Federation of Australia represents farmers, processors, transporters, breed organisations and other parties involved in the deer industry.
In Australia, farmers usually sell deer direct to processors that arrange transport, slaughter, boning, packaging and marketing. Around 85 per cent of all venison produced in Australia is exported, principally to Europe. However, Australia also imports venison from New Zealand.

Australian velvet is sold through pooling arrangements or at the farm gate. Deer velvet makes up around one-quarter of the value of deer products in Australia. The main export markets for Australian velvet are Hong Kong, China, Korea, Chinese Taipei and New Zealand.

Six species of deer are established in the wild in Australia, they are:

- **Chital** (*Axis axis*) is also known as the Indian Spotted Deer. The primary range of the chital is now confined to a few cattle stations in north Queensland near Charters Towers.

- **Fallow deer** (*Dama dama*) were introduced into Tasmania before 1850, with later releases in the eastern states of Australia. Fallow deer are not present in either Western Australia or the Northern Territory, but populations are thriving in all other states.

- **Hog deer** (*Axis porcinus*) were first released in Victoria in 1865 and have established a range in the coastal regions of south and east Gippsland.

- **Red deer** (*Cervus elaphus*) were introduced from Britain in about 1860. Victoria has a significant population in the Grampians National Park and its surrounds and it is also present in Queensland.

- **Rusa** (*Cervus timorensis*). Two types of Rusa were released in various areas of Australia. These were the Javan rusa (a smaller subspecies) and the Moluccan rusa. Populations survive around Sydney’s Royal National Park and surrounds and in tropical Queensland. Rusa are mainly used in venison production.

- **Sambar** (*Cervus unicolor*) from Ceylon (Ceylon Elk) was first released in Victoria in 1863 with others from India and Malaysia subsequently released. The Sambar’s range now extends throughout the Central Highlands of eastern Victoria and into southern New South Wales (RBTA 2006).

### Table A9 Deer industry production in Australia

<table>
<thead>
<tr>
<th>Year</th>
<th>Gross value of production $'000</th>
<th>Exports $'000</th>
<th>Total Australian farmed deer population</th>
<th>No. of deer farms</th>
</tr>
</thead>
<tbody>
<tr>
<td>2006–07</td>
<td>3 003</td>
<td>17 (live)</td>
<td>68 600</td>
<td>533</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 522 (venison)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>386 (hides)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 504 (velvet)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2009</td>
<td>43 856</td>
<td></td>
<td></td>
<td>196</td>
</tr>
</tbody>
</table>

Source: NRIA 2011

For more information contact: Deer Industry Association of Australia
191 Hamilton Highway, Lismore, Victoria 3324, Australia
Phone (03) 5596 2323
Fax (03) 5596 231
deerfarming.com.au

### Rabbits

Rabbits are mainly produced in intensive feedlot-type farms but are also harvested from wild populations. The main product is meat, but rabbit underfur is also used in felt making.
Australia's farmed rabbit industry established after the wild harvest industry collapsed when rabbit calicivirus was introduced in 1996. Rabbit farms in New South Wales, Victoria, Tasmania, South Australia and Western Australia predominantly use purpose-bred rabbits.

Australian rabbit meat production in 2006–07 was 324 tonnes, three times larger than in 1998–99. During development of the industry there was a trend of consolidation; in 1999, about 115 rabbit farms had an average of 57 breeding does each and by 2007, 43 farms had an average of 297 does per farm (Table A10). The Australian industry is now focused on supplying the lucrative domestic market and minor export markets have been established in Germany and Thailand.

### Table A10 Farmed rabbit industry production in Australia

<table>
<thead>
<tr>
<th>Year</th>
<th>Gross value of production $’000</th>
<th>Exports $’000</th>
<th>Imports $’000</th>
<th>No. of rabbit farms</th>
</tr>
</thead>
<tbody>
<tr>
<td>2006–07</td>
<td>3 076</td>
<td>18.3 (includes wild rabbits)</td>
<td>4 (skins)</td>
<td>43</td>
</tr>
</tbody>
</table>

Source: NRIA 2011

For more information contact: Farmed Rabbit Industry of Australia
fria.com.au

### Ostrich

The ostrich is a flightless bird of the ratite family. Ostriches are farmed for their meat, skin (leather), oil and feathers. Australia has three main breeds of ostrich: the Masai, (Red Neck), the Somali (Blue Neck) and the African Black (a stable cross of the Masai and the Somali). About 200 ostrich producers in Australia run 80 000 to 100 000 birds. In 2007, the gross value of ostrich production in Australia was an estimated $1.74 million. In the same year meat production was around 173 tonnes and most was exported. Ostrich skin production in 2007 was also mainly exported (Table A11).

The main export markets for Australian ostrich products has been the United States (55 per cent of total volume), Switzerland (11 per cent), Honk Kong (5 per cent), Singapore (5 per cent), Japan (4 per cent) and the Netherlands (4 per cent). Nearly 40 per cent of the volume of ostrich skin trade has been accounted for by the Republic of Korea. The other important markets for ostrich skins were South Africa (23 per cent of total volume), Thailand (20 per cent) and Italy (15 per cent). There have also been exports of live ostriches to Japan and Vietnam.

### Table A11 Ostrich industry production in Australia

<table>
<thead>
<tr>
<th>Year</th>
<th>Gross value of production $’000</th>
<th>Exports $’000</th>
<th>Imports $’000</th>
</tr>
</thead>
<tbody>
<tr>
<td>2007</td>
<td>1 731</td>
<td>2 068</td>
<td>0</td>
</tr>
</tbody>
</table>

Source: NRIA 2011; RBTA 2006

For more information contact: Australian Ostrich Association
45 Settlement Road, Bellarine, Victoria 3223, Australia
Phone (03) 5251 3610
Email terry@aoa.asn.au
aoa.asn.au:8080/Menu/index.html
**Emu**

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

Commercial farming of emus began in 1987 and has spread to all Australian states and to some other countries. By 1994, all states of Australia permitted emu farming, but wild harvesting of emus is prohibited. In 2001, around 145 establishments were producing emus in Australia, but the number declined to around 41 in 2006.

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

The United States now has the largest population of farmed emus with an estimated population of 1.5 million birds. Europe and Canada have 15 000 to 20 000 birds and New Zealand has 2000 to 3000 birds. No recent population estimates are available for Australian farmed emus but production has declined substantially from the peak of 21 000 birds slaughtered in 1996. A series of droughts in the 2000s contributed to the production decline. However, the value of emu production in recent years has been boosted by higher export prices for emu meat. The value of emu production in 2007 was an estimated $1.34 million (Table A12; NRIA 2011).

In 2000 the population estimate for wild emus was 600 000 to 750 000 and they are found over 85 per cent of Australia’s land mass. These figures suggest that wild emus, as a genetic resource, are not threatened.

**Table A12 Emu industry production in Australia**

<table>
<thead>
<tr>
<th>Year–07</th>
<th>Gross value of production $’000</th>
<th>Exports $’000</th>
<th>Imports $’000</th>
<th>No. of emu farms</th>
</tr>
</thead>
<tbody>
<tr>
<td>2006–07</td>
<td>1340</td>
<td>160</td>
<td>na</td>
<td>41</td>
</tr>
</tbody>
</table>

Source: NRIA 2011; RBTA 2006

For more information contact: Emu Industry Federation of Australia
PO Box 1180, Marleston, South Australia 5033
emuindustry.asn.au

**Southern Cassowary**

The southern cassowary (*Casuarius casuarius*) is a small ratite and belongs to an ancient group of flightless birds that includes Australia’s emu, Africa’s ostrich and New Zealand’s kiwi. It is not a livestock animal in Australia but it has cultural significance for communities in Papua New Guinea as it is used as a food source. Live Australian native mammals, reptiles, birds and amphibians and their reproductive material may not be exported for commercial uses under any circumstances. However some can be exported under permit for a range of non-commercial uses, including conservation breeding purposes.

While the southern cassowary is found in New Guinea and surrounding islands, one subspecies (*Casuarius casuarius johnsonii*) lives in Australia, mostly in dense, tropical rainforests that provide a year-round supply of fruit. The southern cassowary subspecies is listed as endangered under Australia’s *Environment Protection and Biodiversity Conservation Act 1999*. At the time of European settlement, the cassowary lived in tropical rainforests from Paluma Range (north of Townsville) to the tip of Cape York. The species is now listed as nationally endangered, and it is
estimated that fewer than 2200 individuals live in populations near Mission Beach and Cooktown and on Cape York. The bird swallows fruit whole and is critical to the survival of many rainforest plants, spreading the seeds of about 150 species.

Only 20 to 25 per cent of former cassowary habitat remains, and much of it is under pressure. To survive, the cassowary needs large areas of rainforest. Australia is establishing a national reserve system and has established national parks and other rainforest conservation areas. Rainforest on private land can be subjected to clearance and fragmentation under vegetation clearance legislation. As well as creating protected areas, such as national parks, some local residents are establishing nurseries of cassowary food plants to restore rainforest on cleared land and create corridors to link remaining patches of vegetation. Increased mortality, from motor vehicles and dogs, has reduced cassowary numbers. The endangered species status of Casuarius casuarius johnsonii prevents the export of animals or their reproductive material without official authorisation (DSEWPAC 2011a).

For more information contact: Australian Government Department of Sustainability, Environment, Water, Population and Communities GPO Box 787, Canberra ACT 2601, Australia
environment.gov.au
# Glossary

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABARES</td>
<td>Australian Bureau of Agricultural and Resource Economics and Sciences</td>
</tr>
<tr>
<td>ABS</td>
<td>Australian Bureau of Statistics</td>
</tr>
<tr>
<td>ACIAR</td>
<td>Australian Centre for International Agricultural Research</td>
</tr>
<tr>
<td>ACMF</td>
<td>Australian Chicken Meat Federation</td>
</tr>
<tr>
<td>AECL</td>
<td>Australian Egg Corporation Limited</td>
</tr>
<tr>
<td>ADHIS</td>
<td>Australian Dairy Herd Improvement Scheme</td>
</tr>
<tr>
<td>ALA</td>
<td>Atlas of Living Australia</td>
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<td>ARCBBA</td>
<td>Australian Registered Cattle Breeders' Association</td>
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<tr>
<td>AWI</td>
<td>Australian Wool Innovation</td>
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<tr>
<td>APL</td>
<td>Australian Pork Limited</td>
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<tr>
<td>BLUP</td>
<td>best linear unbiased prediction</td>
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<tr>
<td>DAD-IS</td>
<td>Domestic Animal Diversity Information System</td>
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<td>DAFF</td>
<td>Department of Agriculture, Fisheries and Forestry</td>
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<tr>
<td>DSEWPAC</td>
<td>Department of Sustainability, Environment, Water, Population and Communities</td>
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<tr>
<td>FAO</td>
<td>Food and Agriculture Organization of the United Nations</td>
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<td>MLA</td>
<td>Meat Livestock Australia</td>
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<td>NRIA</td>
<td>New Rural Industries Association</td>
</tr>
<tr>
<td>R&amp;D</td>
<td>research and development</td>
</tr>
<tr>
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<td>Rare Breeds Trust of Australia</td>
</tr>
<tr>
<td>RDC</td>
<td>research and development corporations</td>
</tr>
<tr>
<td>RIRDC</td>
<td>Rural Industries Research and Development Corporation</td>
</tr>
</tbody>
</table>
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Glatz, P & Ru, Y 2004, Developing free-range animal production systems, Rural Industries Research and Development Corporation, Barton, Australia.


