



Final Report

Developing a sustainable high-value market driven goat supply chain

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Abstract

Goat is a versatile meat consumed across the world in a range of cooking styles. Goats have recently been recognised by Australian primary producers as an important income diversification strategy, due to browsing habits and an ability to quickly expand herd numbers post drought. Goat meat is predominately exported frozen as whole carcasses or 6 way cut carcass pieces from Australia. The United States was a key importer, with increased demand from China and Korea in 2023 due to product available at a lower price point.

This project reviewed supply chain pathways, interviewed industry stakeholders and identified options to develop high value market driven supply chains. Goat meat is roasted or utilised in curries, hot pots and soups with traditional goat recipes part of the Indian sub-continent, Southeast Asia and Caribbean cuisine. There is potential for Australian processors to develop value-added goat products, however this requires an understanding of the market requirements, alignment of carcass attributes to customer segments, cost effective processing technology and year-round supply.

Executive summary

Background

The project was undertaken to understand the international and domestic demand for goat meat products and the technical trade barriers for new and existing products and markets. Stakeholders in goat meat supply chains were interested to understand market opportunities and the required supply chain interventions to develop value-added goat meat products. The interventions required were identified at different points in the supply chain, across the chain. The findings from this report provide insights to guide research and development investment priorities and industry development activities by private sector, industry and governmental organisations.

Objectives

Findings and recommendations for whole-of-chain, market-orientated industry development were explored. In alignment with domestic and international market opportunities, technical trade barriers and new product development opportunities were identified, achieving the project objectives.

Methodology

Qualitative, semi-structured, expert interviews were undertaken with desktop research and data analysis. Interviewees were from across the supply chain including producers, processing plants with a range of capacities from 20-800 goats per day, butcher shops, consumers, researchers (meat science, animal husbandry, genetics), extension officers and government stakeholders.

Results/key findings

There is potential to develop value-added products and continue to supply to existing markets. An irregular supply-base means processors are unable to sign more lucrative, longer term supply contracts and develop high margin markets. Flow-on effects include boom and bust cycles of an oversupply and low prices with spot market buyers trading off against mutton prices.

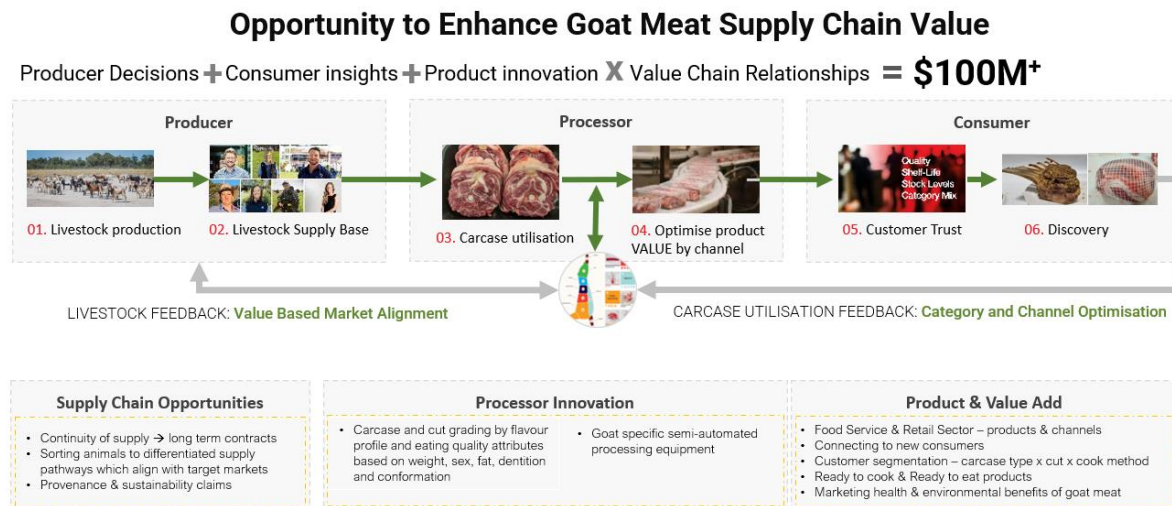
Innovative supply solutions combined with new product and market development provides an opportunity to break the commodity boom and bust cycles. Markets exist for cubed products, grilling and roasting cuts, however,

- a lack of goat dedicated processing technology,
- high processing costs per kilogram of meat sold,
- workplace health and safety issues on bandsaws, and
- limited market development,

has meant processors have maintained the status quo, selling a frozen carcasses sliced 6 ways. Understanding value attributes in different markets and aligning the supply chain to meet the consumers' needs combined with innovation in processing is required to develop a sustainable, high-value, market driven supply chain.

Benefits to industry

The project has connected various stakeholders including technology providers, private and public sector as well as researchers with interests in genetics, animal husbandry and meat science who are all looking to uplift the Australian goat industry. The research undertaken in this project has created an understanding of what is known, unknown and identified issues across the supply chain which require additional research and development. There is an opportunity for a \$100+ million uplift in export value of goat meat each year by obtaining the average price for 2022 of \$12.28 compared to the current average price for January-June 2023 of \$7.38 per kilogram (calculated using ABS data supplied by MLA).



Future research and recommendations

Future research requires uplifting the entire supply chain from innovative on farm solutions to guarantee consistency of supply to processing technology and branding which differentiates flavour profiles and carcase attributes.

Recommendations include:

(1) Development of innovative solutions to guarantee consistency of goat supply throughout the year enabling processors to secure long term supply contracts. Examples include:

- forward contracting producer consignments,
- coordinated mustering times with producers to link with processor supply windows, and
- supplementary feeding so that they kid at different times and maintain body condition.

(2) Processing in Australia to value-add and differentiate carcasses requires investment in technology and equipment. Semi- and fully automated goat specific equipment for cubing and slicing the carcase into different cuts requires research and development investment.

(3) Development of a flavour profile system linked to carcase attributes. This will help producers and processors deliver a consistent eating flavour, selected by the consumer for their recipe and cooking method. For example, Consumer A prefers the flavour profile of entire rangeland males, used in curry recipes while Consumer B prefers younger animals with a mild flavour and higher marbling for roasting and grilling. Differentiating the flavour, carcase attributes and cut type to align with cooking method requires research and development at a market level while also developing systems for processors and producers to identify their target market.

The Goat Value Chain

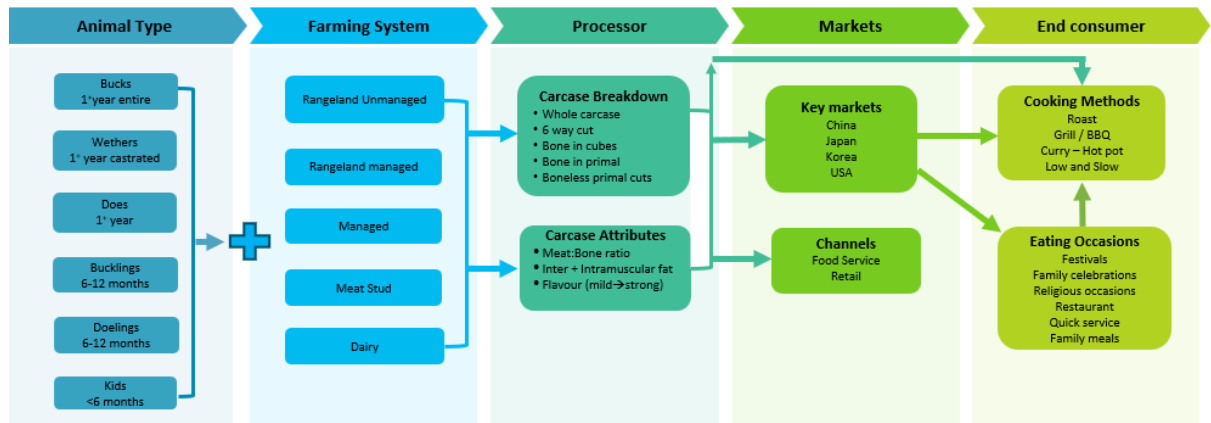


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1. Background

Worldwide, goat is one of the most consumed meats. Australian goat meat is predominately exported as frozen 6 way, with further processing occurring at destination country. When marketed, goat is rarely differentiated by sex, age, flavour profile, consumer need or cooking style. Current differentiation is by carcass weight range (>12kg, 12-16kg, 16-22kg, 22+kg), dairy goat or rangeland (with some breed differentiation for domestic markets), skin on, burnt or skin off.

This project was undertaken to understand the issues and opportunities to develop domestic and export markets. To grow and develop market-orientated value chains, different stakeholders were interviewed to understand the perspectives from producers, processors and input suppliers. This project has been timely as producers face lower prices and processors are diversifying export markets outside of United States of America. Processors are looking to understand how to value-add and in what areas they should value-add (individual cuts, chilled, ready to eat, by-products). Understanding trade access barriers is important before new product development is undertaken.

This project has built on the research undertaken by New South Wales Department of Primary Industries, Queensland Department of Agriculture and Fisheries, Rural Economies Centre of Excellence, Queensland Goat Producers Incorporated and Meat & Livestock Australia funded projects. Interviews were undertaken to gain an understanding of the issues, opportunities, bottlenecks and information gaps across the different elements of the chain. Carcass deconstruction was undertaken to understand the implications of new product development (NPD) from a yield, cost per kilogram and labour requirement perspective. The research enabled whole of chain understanding building on previous research undertaken at different stages along the chain.

Industry maturity

Goat producers have moved beyond rangeland harvesters and are managing goats behind fences in large areas of Queensland and New South Wales. Producers are generally disconnected from processors in understanding what is required from a carcass specification perspective and are looking for direction. Goats producers supply to processors for a range of reasons, beyond price including convenience, transport access and costs, ability to consign livestock direct, dual species consignment and payment terms. Participating in a market-orientated value chain will be of interest to producers relying on goats as part of their farm income diversification strategy as well as producers who are 100% goat focused.

The Australian goat processing industry has limited technology which facilitates low-cost carcass processing. The processing of mutton and goat in other large goat producing countries provides an opportunity to import and test equipment to Australian standards and requirements. It is envisaged equipment like cubing and slicing can be developed (and/or adapted from other meat applications) to provide automated value-adding options in Australia to service the South East Asian and Australian markets with ready to cook options.

The development of objective measurement technology to (1) grade carcasses to align carcasses to product and consumer specifications and (2) provide feedback to producers for selection of desired animal traits is necessary to continue to develop and professionalise the industry. Producers with managed herds and improved bucks are looking to market signals and pricing feedback based on Objective Measurement (OM) Technology. That is, adaption from Beef/Sheepmeat objective measurement platforms to goat is an area for further consideration.

Market differentiation through meaty goats with yields akin to lamb, offers an opportunity to undertake research and development in value-adding for western cooking styles. Goat is the preferred meat when celebrating religious occasions, festivals and events (New Years) for members of the Muslim, Hindu, Nepalese, Indian, Greek, Caribbean and Hispanic communities. China is one of the largest goat meat consuming countries in the world, with over 2.1 kilograms of goat consumed per person per year (World Integrated Trade Solution 2023), with Taiwan, Korea and Japan having cuisines based on goat. There is an opportunity to value-add and develop Australian goat meat into a highly valued and differentiated product given the large population base which already consumes goat meat.

1.1 Project purpose

The purpose of the project was to initiate the transformation of the goat industry on the East Coast of Australia from a commodity boom and bust industry to a market-orientated, value-based approach where quality products sought by consumers are rewarded through a producer pricing grid. Key stakeholders were engaged including industry leaders, seed-stock producers, researchers, extension officers, chefs, butcher shops, producers and processors.

The project reviewed and analysed domestic and international market opportunities for primals, bone-in product, ready-to-cook and manufactured products followed by the required processing and packaging equipment to reach the target markets. Research was undertaken to identify technical trade barriers in new and emerging international markets on ready to cook cuts including shelf-life requirements, residue and raising claims as well as market acceptance levels for bone dust, bone chips and bone in products.

Value chain innovations, collaboration, connectivity, technology, new product development, market research and supply chain capability building will be required to overcome the transactional, commodity-based dynamics. This project provided insight into what is known, unknown, has worked well, issues and opportunities from a whole of supply chain perspective.

2. Objectives

2.1 Research focus

The research problems addressed through the project were:

- Understand international and domestic demand for high-value goat products,
- Understand technical trade barriers to export value-added cuts to new and existing markets,
- Understand capabilities, capacities and relationships required for industry growth and stability, new market-orientated value chains, whole-of-chain information sharing, and the development of objective pricing structures.

The objectives of the project included:

1. Review and identify domestic and international market opportunities, products to develop for the target markets, technical trade barriers to value-added goat products, and priority target markets.

2. Identify New Product Development (NPD) which aligns goat supply, seasonality, consumer demands, technical trade barriers, future trends and equipment available to process goat carcasses efficiently and effectively.
3. Summarise the applicability of objective measurement technologies, processing and packaging equipment, carcase and chilling equipment and value-adding options for primals, offal and by-products investment opportunities.
4. Identify innovative goat supply chain interventions to ensure continuity of supply.
5. Document findings and recommendations to develop a whole of chain market-orientated value-based industry, identifying opportunities, constraints and knowledge gaps.

The objectives were successfully achieved. The activities in the project have resulted in connecting different elements of the supply chain together with insights provided from Greenleaf expertise in supply chain dynamics, automation within processing plants, advanced chilling technologies and market segmentation.

3. Methodology

3.1 Demand for high value goat products and trade barriers

The steps taken to understand international demand for goat products were as follows:

1. Data analysis was undertaken comparing current 2023 goat consumption and product type, price and availability using international data from Meat & Livestock Australia, Department of Foreign Affairs and Trade, Food and Agricultural Organisation, World Bank and World Integrated Trade Solution.
2. Analysis of 2 years of Australian goat meat export data.
3. Desktop review and analysis on traditional cuisine uses for goat meat across cultures to identify cut by cooking methods, preferred flavour profiles and skin on/skin off desirability.
4. Future market growth potential was identified based on economic indicators, supply base, changing consumer trends and internal dynamics.
5. Semi structured qualitative interviews with Australian goat exporters, processors, international sales and marketing representatives and importers were undertaken to understand technical trade barriers, current and future inquiries and new product development trials which have been undertaken by individual processing plants.
6. Findings and recommendations were developed from triangulating interviews with data analysis and desktop reviews.

A domestic market review was undertaken which included the following activities:

1. Analyse and review existing market reports.
2. Interviews with consumers, processors, marketing and sales managers, researchers, agribusiness professionals and butchers.
3. Butcher shops were visited in person and butcher shops Facebook pages were reviewed to understand the current issues and opportunities in the domestic market.
4. Findings were documented and presented to industry experts for discussion and validation.

3.2 Understand requirements for industry growth and development of market-orientated value chains

Interviews were undertaken during 2023 with 30+ key stakeholders, (600+ minutes of interviews) including industry, producer and service providers. The interviews were recorded, transcribed, de-identified and analysed. It was difficult to obtain more than 20 minutes of insights from producers regarding current management and supply chain practices, which limited some of the data collection. Supply chains were mapped to identify the main routes to market for producers across the different regions.

A researcher attended a sheep and goat feedlotting workshop in Toowoomba on the 28th February 2023 which had 70+ producers from roughly 40 businesses as well as researchers, input suppliers and governmental staff. Findings from this workshop have been included in this report. A second-generation goat producer south of Morven was visited where goats were an integral part of their mixed species farming enterprise to understand day to day management practices of rangeland goat producers.

Greenleaf researchers interviewed processing plant managers to understand:

- What cuts are buyers asking for that are currently not available(chilled/frozen)?
- What products have you seen in the market place (domestic + export) that you think would be interesting to consider?
- How are goat carcasses processed now?
- What cuts are currently sold and have been sold in the past?
- Are carcasses segregated based on carcass attributes or breed?
- Are you satisfied with your market outlets for skin, offal, horns and hooves?
- What goat meat products are currently produced and what have you previously tried?
- What issues have been observed with processing goat carcasses?
- What goat processing ideas have you considered?

The findings from these interviews along with desk top market research was analysed and summarised.

4. Results

The results section presents the collated findings from the research and data analysis. The first section examines the goat supply chains starting with where the producers are located, their production systems and connection with processors. The second section presents the market analysis, the third and fourth sections outline processing equipment and technologies which could support the development of value-added processing in Australia.

4.1 Goat supply chains

Regional location impacts goat supply chains, with the majority of Queensland and Western Australian producers selling direct to processing plants. In North-Western and Central New South Wales producers sell to depots who act as aggregators. In New South Wales and South Australia 53% and 43% were sent to a depot before processing plant according to Department of Regional NSW (2022) using unpublished ISC data.

The goats sold in Australia come from free roaming rangeland, semi-managed or managed production systems. The number of goats sold to processing plants per district for 2021-22 financial year is presented in Figure 1 based on National Livestock Identification System (NLIS) data.

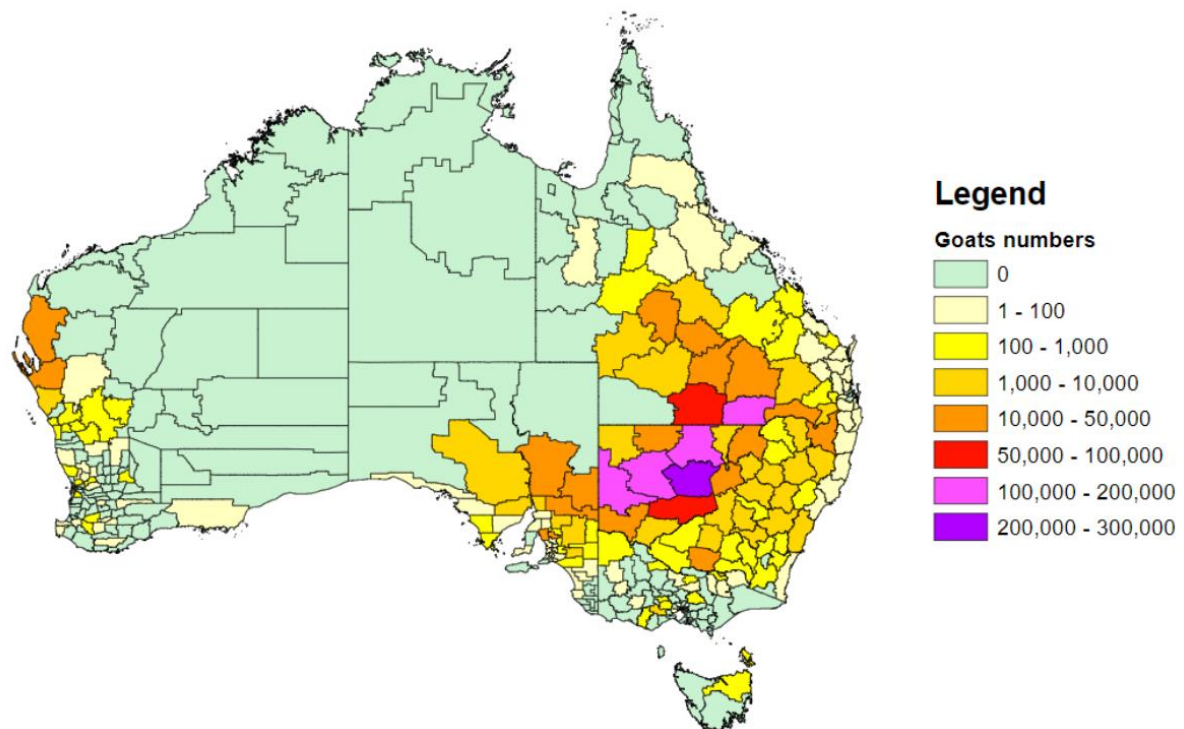


Figure 1: Goats supplied for processing based on NLIS region 2021/22

Department of Regional NSW 2022 p10 Data source: ISC

From a marketing and processor perspective, goat supply is highly variable. The supply is dependent on:

- (1) Goat herd numbers which are influenced by seasonal conditions:
 - a. Spring and summer rains increase feed availability and nutritional content enabling fertile rangeland nannies to have sets of twins, twice per year increasing the numbers available for turnoff.
 - b. Extended dry periods result in lower pregnancy rates and lower numbers of multiple kids per pregnancy. Does on a lower nutritional plane are more likely to have one kid than twins.
 - c. Unseasonably wet weather for extended periods of time results in a high kid loss from hypothermia and anaemia due to an unsustainable worm burden.
- (2) Ability to muster:
 - a. An extended wet season limits the ability to use trap yards at permanent watering points.
 - b. Wet roads, paddocks and flooding limits vehicle access to properties to muster and truck stock out.
 - c. Thunderstorms and overcast conditions curbs the ability to deploy helicopters and aeroplanes to help muster.
- (3) Labour force availability to muster and process animals.
- (4) Price paid to the producer.
- (5) Producers need for supplementary income.
- (6) Availability of trucks which can transport goats from property to sale destination (depot or processing plant) has been identified as an issue by producers in some regions.

Goat producers who were interviewed preferred to deliver direct to processing plant. Processing plants have started to develop relationships with larger producers however for many processing plants the supply is transactional and highly variable. Some processors buy goats from producers as a service to secure lamb suppliers. The fat lambs producers want to utilise the semi-trailer (6 decks) they are paying for to transport animals to the processing plant so they load the truck with their lambs and fill the remaining truck space with goats they have mustered from the hills.

Other producers muster and sell depending on the season and the price. For some producers the supply is dependent on when the plane / helicopters are available to muster the goats out of the rough country and hills into the holding paddocks.

The type of producer impacts the supply chain in which they participate in. Producer types have been characterised as (1) rangeland unmanaged, (2) rangeland managed, (3) managed herds. While the following is a generalisation, creation of personas helps understand decision drivers for different producers.

Rangeland Unmanaged

- Large property areas
- Rougher hillier country is where rangeland goats reside.
- Primarily run fat lambs, cattle or fine wool merino's
- Harvest rangeland goats when (1) need money, (2) labour is available, (3) prices are high and (4) helicopter or plane is available.
- Goats are sold to depots or direct consignment to processing plants as part of mixed load of lambs or sheep.

- Goat specific infrastructure consists of basic large holding paddocks to keep the goats behind wire until trucks arrive and animals are consigned to processing plant or direct consign to depot when mustered.
- Little to no management activities or investment in goat herd management and husbandry.

Rangeland Managed

- Property income depends on goats and a combination of meat sheep, fine wool and beef.
- Investments include predator proof fencing plus internal fencing and watering points.
- Muster and sell two to four times per year.
- Remove feral bucks and replace with improved genetics over genetic base of rangeland does.
- Animals are processed in yards where producers select breeding does to retain and sell old does, males and surplus females.
- Goats are sold via direct consignment to processing plant, depot, agent for live export or to other producers and online for example AuctionsPlus.
- Management includes supplementary feeding during extended dry periods, provision of additional watering points and paddock rotations.

Managed herds and Studs

- 100% goats or a mixed livestock and cropping enterprise.
- Management practices include controlled genetics and herd selection for desirable traits and controlled mating for example:
 - Young does separated from bucks after weaning,
 - Bucks in for a controlled time period with does.
- Paddock management and husbandry interventions as required:
 - Mustering 4 times per year or more to wean and or remove young bucks from paddocks and separate young does from bucks.
 - Paddock rotations and worm control are regularly undertaken.
- Based on selection of meatier animals and use of improved genetics carcasses will have a higher meat to bone ratio than carcasses from unmanaged rangeland animals.
- Supplementary feeding undertaken as required.
- Due to higher inputs and management costs producers are seeking higher price for stock with a preference to sell to supply chain where they can capture additional margins including selling to producers, direct to toll processors, butcher shops and or live export.

4.1.1 Why producers keep goats?

Increasingly producers now recognise goats as a component of their income diversification strategy. The move from pest status or harvesting for income supplementation to a valuable resource has occurred due to:

- (1) Hardiness: a recent drought where goats survived and thrived and quickly built up numbers when it rained while cattle and sheep needed to be de-stocked off properties.
- (2) Lower labour requirement: skilled rural labour shortage with producers looking for options that do not require outside labour for example shearing, marking and branding as required for sheep and cattle respectively,
- (3) Relatively high goat prices in 2022 and
- (4) An expansion of predator proof fencing enabling goat kids to survive into adulthood.

Land suitability and available resources

Some producers are 100% goats, and this has been driven by land suitability and resources available. The producers may not have the ability, interest or labour to continue with wool sheep or with drought identified cattle was no longer a viable option, switched to goats and found it suited their land type and lifestyle.

Long term income diversification strategy

Producers are familiar with boom-and-bust cycles, drought and low rainfall and have invested in goats as a drought mitigation tool and income diversification strategy. The property can continue with goat production when it can no longer support cattle (due to feed availability), thereby keeping goats as a cash flow and operational management decision. Producers with larger landholdings can hold back from selling until the market price provides the return they are seeking.

Within Central and Western Queensland properties and districts have invested in predator proof fencing and purchased in goats as a diversification strategy – typically running a beef enterprise but also fine wool or meat sheep depending on the location, land type and producers' preferences. These producers may have been fine wool producers and are unable to find shearers and crutching teams, due to labour shortages have moved into goats.

New producers seeking profit margins

Some producers have bought into goats when the market price was increasing as they were looking to capitalise higher profit margins than their beef/sheep enterprise when the prices peaked in 2022. These producers have invested in predator proof fencing and in purchasing does. Producers who are new to goats in the last three years are looking for direction from industry and processors on the medium-term price outlook and market access opportunities. Time will tell if these producers stay in the industry.

Rangeland unmanaged

Large properties running sheep and or other livestock have goats which are moving across the landscape and living in the rocky and hilly areas. These properties have sheep and cattle fences which do not contain goats. These properties have created large holding paddocks with fencing that will hold goats. One producer has fenced off two holding paddocks of 7 stands of wire with a strong plain wire at the bottom while others have netting to retain goats in an enclosed area while waiting to load onto trucks for direct consignment to processing plants. Portable dorper/goat yards are used to draft and hold the goats. The free-range rangeland animals are mustered when human resources and equipment is available and or when cash flow is important.

Stud and managed herds

Managed herds are often located on properties of a smaller scale than large semi-arid pastoral holdings. It should be noted there are producers in extensive operations who are running studs in smaller paddocks closer to the yards to breed and select animals adapted to local environments. The stud enterprises' key market is other producers.

For a detailed description of goat producers and their production systems for New South Wales and Queensland refer to Parker, Nogueira and Fitzpatrick (2014) 'Meat goat producer survey report'. The findings from the report remain relevant with additional predator proof fencing, breeding and genetic selection being undertaken since the report was published in 2014.

4.1.2 Goat processing plants

Goat carcasses are predominately processed hot and sold as frozen 6 way with mixed carcass pieces, ages and sexes placed in a box and frozen. Some processing plants are accepting the smaller animals which dress at less than 12 kilograms which are sold as whole carcasses. The largest processor in Queensland collects goats from properties and brings direct to the processing plant or buys direct consigned animals from producers. Smaller mixed species plants located in Southeast Queensland processes 1000 animals per week (beef, sheep, goats, pigs) undertaking toll processing, custom kills and supplying butcher shops. A mixed species processing plant in Southeast Queensland is providing a toll processing service for a branded goat program into the chilled domestic market.

The smallstock plant in Bourke, New South Wales can process 3000 head of goats per day with two skin on chains and a skin off chain (MLA 2022). In Victoria there are 5+ medium to large smallstock processing options which prioritise lamb processing, however process goat when they are available, and when profit margins are favourable.

Goat when hot boned doesn't utilise chiller space, so processing plants will process goat to fill numbers on the chain for the day with priority space offered to lamb. Goat isn't the preferred species for many smallstock processing plants. One processing plant representative stated they were not able to make money from the skins, offal and there was no fat to sell, combined with small carcass weights (12-16kg) compared to lambs weighing 26 kilograms, make it an expensive animal per kilogram carcass weight to process.

Domestic market for goat is estimated at 2-5% of total processed volumes according to industry representatives who have undertaken research in consumers and market development. The high international goat prices in 2022 meant the local food service industry was priced out of goat market. Interviews with butcher shops have identified small domestic abattoirs and butcher shops are processing goat to order for the food service trade and for consumers who prefer goat meat.

As of May 2023, with the lower market prices and limited processing capacity in Queensland, butcher shops are developing their own local supply chains and selling goat across Southern, Western and Central Queensland. Butchers are breaking down the carcasses as they would a lamb carcass with a focus on bone in. Goat is starting to be included on the menu at food service restaurants as the 2023 price parity with other proteins makes it an affordable option.

Impact of goat supply on market development

The fluctuating goat supply has meant processing plants in New South Wales and Victoria have built relationships with goat depots. The goats can remain at the depot and provide a continual supply to the processing plant for a week or two. The issue with using the depot is that rangeland goats are not familiar with confinement nor eating supplementary food and can go backwards in weight and develop a worm burden.

The inability to guarantee supply impacts the ability to develop markets and forward sell product. Processing plants do not want to be holding excessive volumes of frozen inventory. The unpredictability of supply also means processing plants are not in the position to develop long term supply contracts which tend to be more lucrative for example cruise ships, 3+ star food service and supermarket supply contracts. The unpredictability of supply is due to:

- (1) total number of goats available to slaughter for the year,
- (2) limited data to help with forward planning,
- (3) transactional nature of goat market,
- (4) limited volumes available in feedlots and depots.

4.1.3 Connection to processors

Producers identified there was no feedback from processors on what to select, what to breed for or how to gain price premiums. Some producers lamented that processors were penalising them for higher fat coverage due to infusion of Boer genetics and when questioned processors explained their customers were wanting a lean carcass.

The only formal pricing signal producers receive is weight as producers are paid on liveweight or dressed weight. Producers were selecting for the heavier animals and buying in genetics to breed heavier goats. Producers were also culling animals who were older, had long mohair or poor conformation.

The payment method (live weight and Over the Hook - OTH), location and accuracy of weights vary between aggregators, depots, agents and processing plants. Supply chain examples from producer to processor are described below:

Supply chain 1 – Direct consignment

Producer → Processor

The producer contacts the processor to organise a date for a set number of head to be delivered to the processing plant. The producer will deliver the livestock at their own cost to the processor. To guarantee supply the processor will also collect goats directly from properties at their own expense particularly for larger numbers of animals or if located nearby.

Supply chain 2 – Agent

Producer → Agent → Processor

Livestock will travel direct from the farm to processor. A livestock agent acting on behalf of the producer will take a \$/head fee or a % commission. Agents may also become intermediary owners taking payment direct from the processor, then pay the producer once they have taken out their fees. Depending on the livestock agent the producer may or may not receive feedback provided by the processor.

A buying agent acting on behalf of the processor receives direction and buying preferences from the processor and it paid on a \$/head fee or commission for organising procurement of the livestock paid by the processor. The producer working with a buying agent is paid OTH and usually receives feedback direct from the processor.

Supply chain 3 – Processor employed goat buyers

Rather than relying on producers phoning in goats for consignment, the processor has staff either employed or contracted on a commission basis which connect directly with producers and depots to buy goats for the processor. The goat buyer is contracted to source and secure supply for one

company. Goats are delivered direct to processing plant and producers are paid on over the hooks (OTH) weight. If the goats are purchased through the depots, they are typically paid on liveweight at the time the depot purchases the animals.

Supply chain 4 – Own supply base

Processor 4, a small domestic abattoir supplying food service and butcher shop orders started their own goat feedlot to process goats when orders were received. Previously they relied on goat producers supplying direct however the abattoir found goat producers were notoriously unreliable suppliers so they started buying goats to keep in their own feedlot.

Supply chain 5 – Producer → Depots → Processors

Producers sell to depots, who aggregate livestock for transport and sale to processing facilities. For some producers who are remote and or have small numbers (<200) selling to depots is a convenient option. Producers selling to depots have little to no feedback or connection with the processing plants.

4.1.4 Price verses market orientation

Southern producers choose their buyer based on who they trust to pay them a fair price. It was identified the arrangements for deductions, transport costs, payment method, payment calculation and accuracy of weights varied between agents, aggregators, depots and processing plants. For some producers supply was based on relationships with agents. Producers who are chasing cash flow are interested in payment terms, price, and the ability to supply as resources become available for example personnel, gyrocopter, aeroplane and trucks.

For producers who have smaller holdings; convenience of transport and access to facilities is more important than price. These producers need to sell when feed starts to get short and or older male kids reach sexual maturity in preparation for next generation of kids to be born to not be overstocked. These producers on smaller holdings are also looking for longer term relationships to know they have access to transport and markets. Working with these producers on long term sustainable prices and business structures for example feeding meatier goats grain for a different market offers opportunity for developing high value niche markets.

For larger producers in Queensland, the focus was on finding a processing plant that will accept their animals. One producer with their own transport found they could book in 200 rather than 500 head at a time, so then created multiple bookings of 200 animals over a period of a few weeks.

For extensive rangeland producers who have goats as part of a diversification strategy when prices are below what is considered reasonable profit margin they will not muster and allow the herds to build up naturally. It is recommended that processing plants work with these producers to understand their profit requirements and mustering schedules to enable them to consign goats as required by the processing plant. These producers are looking for long term relationships with reasonable price base year in year out.

Goat and meat sheep producers in Western Queensland have expressed interest in starting feedlots and to wean animals onto rations as familiarisation process to facilitate confinement during periods of extended low rainfall. A sheep and goat feedlotting workshop was held in Toowoomba, Queensland on 28 February 2023, with 70+ producers attending from an estimated 40 businesses. Greenleaf is aware of three sheep/goat feedlot applications which have been submitted or are being prepared to submit for governmental approvals.

4.2 Market analysis

The analysis of export and domestic markets including product differentiation, branding, market differentiation, consumer preferences, price points and volumes identified market and product differentiation opportunities. Currently goat meat is sold using the AUS-MEAT category description as “Goat – Any caprine animal”. Product differentiation opportunities including using alternative AUS-MEAT categories including Capretto, Capra, Doe and Buck. Goat products are currently differentiated into rangeland and dairy (animals with high fat coverage) and hot standard carcass weight (HSCW) >12kg, 12-16kg, 16-24kg, >24kg.

The Handbook of Australian Meat (HAM) cut codes which is used to facilitate accurate red meat product descriptions does not have separate codes for all goat products, with sheep product codes being applied to goats cuts. Refer to Appendix B which outlines the goat and sheep cut codes based on AUS-MEAT Handbook and website. Exports of goat products by HAM cut codes were provided by MLA with a summary presented in Table 1 below.

Table 1: Description of goat products exported (t) by cut code

Cut code	Item	2021	2022	YTD 2023	2023*
4640	Goat carcass or 6-way	14,144.82	17,069.19	14,825.27	25,414.74
4645	Goat carcass telescoped		8.99	26.19	44.90
4800	Leg chump on			0.29	0.50
4801	Leg chump on - aitch bone removed			0.02	0.03
4805	Leg chump off - aitch bone removed			1.50	2.56
4820	Leg chump off	129.32	178.29	21.67	37.15
4860	Loin			50.06	85.82
5020	Neck	1.86	5.11	4.70	8.05
5036	Assorted cuts - Bone in	4,610.44	4,358.15	2,670.12	4,577.35
5037	Cubed pieces	132.50	206.24	92.82	159.12
5080	Tenderloin - boneless	5.30			
5199	Assorted cuts - Boneless	20.37	4.09	72.60	124.45
5201	Carcass - Boneless			1.02	1.75
5202	Carcass meat - Boneless	1.44	0.98		
Total (tonnes)		19,046.06	21,831.03	17,766.25	30,456.43

Source data: MLA Category and Market insights 2023 export product dataset

Note: 2023* data is January to July 2023 data extrapolated to a full year.

Frozen 6 way cut carcasses and whole carcasses (HAM code 4640) is the main product form of exported goat accounting for 83% in 2023, 65% in 2022 and 77% in 2021 of the total volume. In January to July 2023, 50 ton of loin was exported to China. There was cubed meat exported out of Australia in 2021 and again in May-June-July with 96% going to the East Coast of America. Processing cubed meat is currently prepared manually with bandsaws which limits production when there are labour shortages according to the processors interviewed.

The increase in export volume in 2023 compared to 2021 and 2022 is reflected in the increase in animals processed as shown in Figure 2.

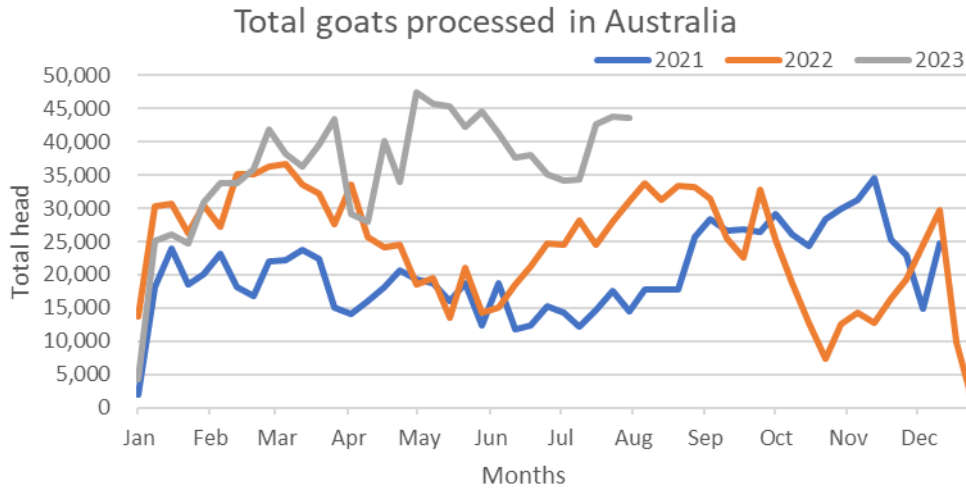


Figure 2: Total number goats processed

Data source: MLA 2023b

The lower OTH prices seen in 2023 have seen increase appetite and volumes purchased for goat products at the lower price point.

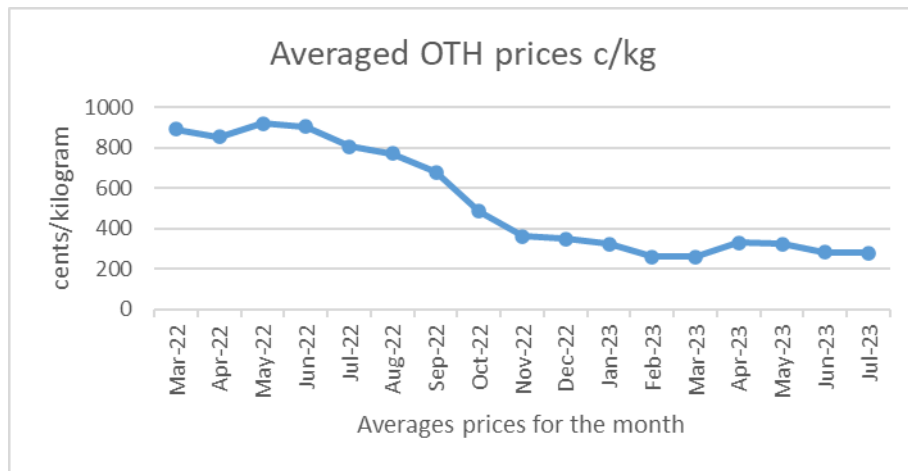


Figure 3: Averaged OTH prices 2022-23

Data source: MLA 2023a

The reduction in OTH prices and increased availability of goats have seen an increased sales to China, South Korea, Taiwan, Trinidad and Tobago as well as the traditional USA market in 2023 as shown in Table 2.

Table 2: Export volumes per country by tonne

Country	2021	2022	July YTD	2023*
Abu Dhabi	0.18			
Antigua & Barbuda	1.02	12.18		
Bahamas			0.68	1.17
Barbados	0.22	6.32	9.01	15.44
Canada	1,278.96	1,339.47	482.99	827.98
Cayman Islands	33.56	102.91	75.00	128.56
China	148.20	289.51	4,047.01	6,937.72
Cuba			19.98	34.25
Fiji		74.74	148.41	254.42
Grenada			12.00	20.57
Hong Kong	68.27	48.42		
India			0.53	0.91
Indonesia			139.13	238.50
Jamaica		24.99	72.50	124.29
Japan	458.34	424.93	337.05	577.79
Jordan			16.56	28.39
Malaysia		20.09	12.45	21.34
Nauru		0.24		
New Zealand		1.34	12.56	21.53
Papua New Guinea	5.93	3.42	2.02	3.47
Seychelles			12.14	20.81
Singapore	7.02	9.68		
Solomon Islands		0.46	0.40	0.69
South Korea	2,128.44	3,756.67	3,244.64	5,562.25
St Lucia		25.40	27.65	47.40
Taiwan	1,868.76	2,149.85	1,369.41	2,347.55
Thailand			0.20	0.34
Trinidad And Tobago	438.65	975.58	946.85	1,623.17
United Kingdom			0.02	0.03
United States of America	12,589.01	12,505.05	6,776.80	11,617.37
Vietnam	19.50	59.80	0.28	0.48
Total (tonnes)	19,046.06	21,831.03	17,766.25	30,456.43

Source: MLA Category and Market Insights 2023

July YTD – actual values for January to July 2023

2023* - July YTD data extrapolated to 12 months.

The export volumes and destination country by month for 2022 is shown in Figure 4 below. The peaks and troughs of goat supply is weather and supply dependent, with processors needing to find markets based on supply availability.

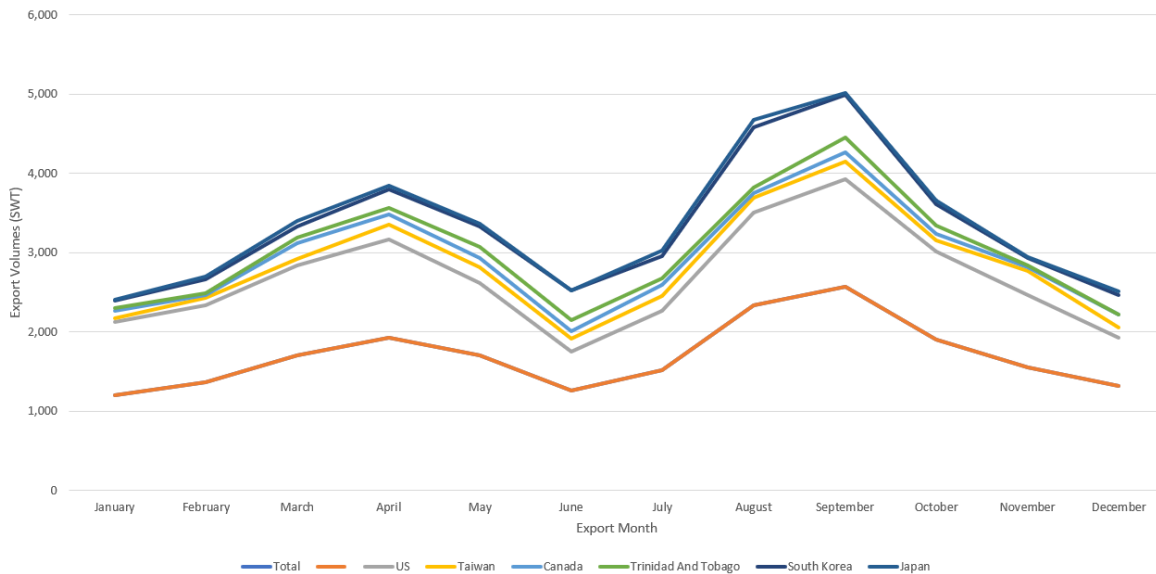


Figure 4: Cumulative Australian export volumes (t) per month per country for 2022

Source: MLA Category and Market insights 2023

The variation in export volumes for the previous two years and year to date to July are shown in Figure 5 with a peak in volume exported in March and again towards the latter half of the year.

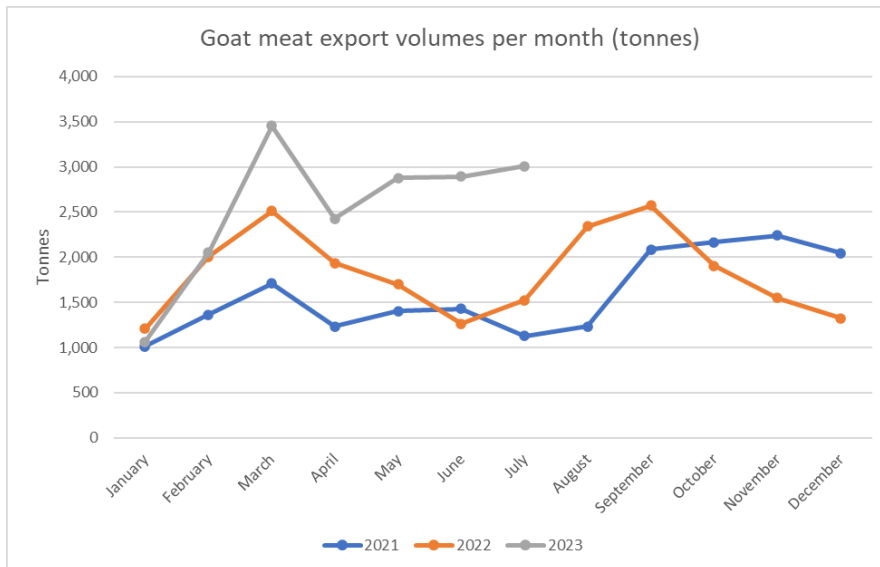
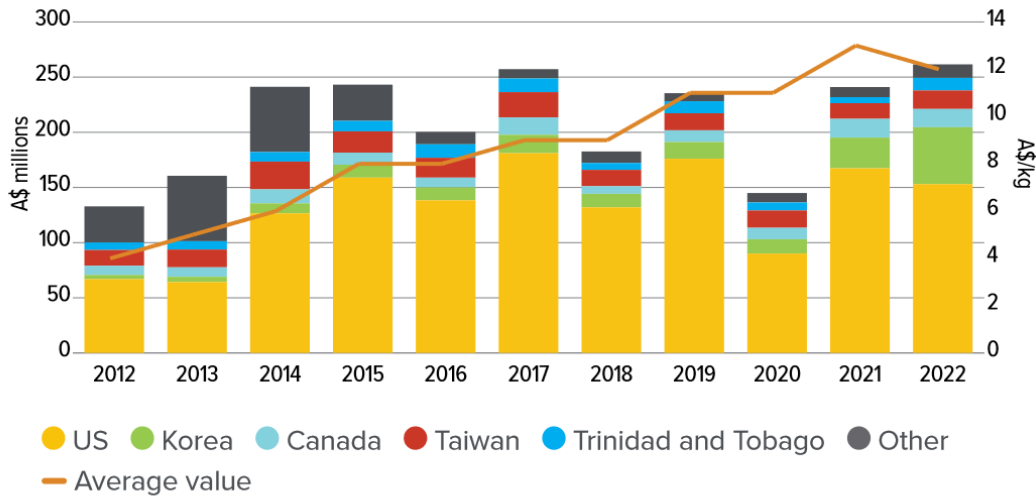


Figure 5: Total goat meat export volume (t) per month

4.2.1 Australian export market by value and average \$/kg

The growth in markets outside of the USA, particularly Korea, Taiwan and China provide an opportunity for exporters to capitalise on the Australian clean green free-range image, while addressing culinary and consumer needs. The Korean market opportunity includes replacement of dog meat in specific dishes due to low fat meat and flavour profile which is closer to dog than beef or sheep meat.



Source: IHS Markit

Figure 6: Australian goat export markets by value and average price per kilogram

Source: MLA 2023

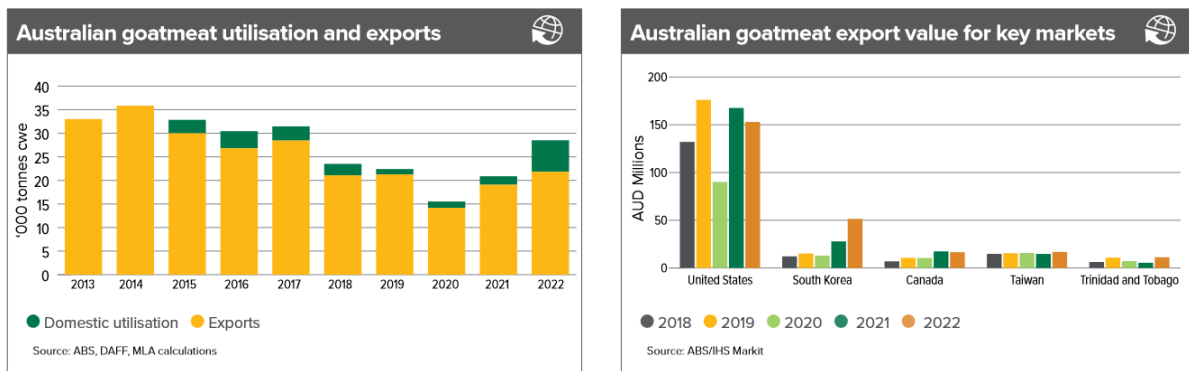


Figure 7: Australian goat meat export and domestic sales

Source: MLA 2023

The USA was the main export market by value prior to 2023 as shown in Figure 7 . In the USA goat is sold in bulk to customers with 3-6 pieces of frozen 6 way in a box. Australian frozen 6 way cut carcasses are value-added in the USA, sliced into 1 or 2 inch cubes and sold into retail ready packs including 2lb bags and 15lb boxes. Figure 8 highlights the broad consumer base for goat meat in the USA.

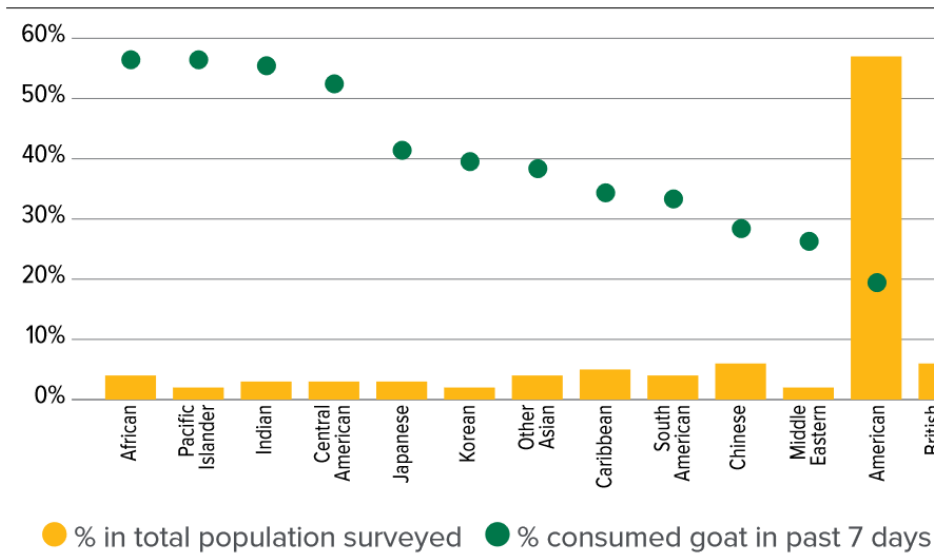


Figure 8: Ethnic backgrounds of US Goat meat consumers

Source: MLA 2023

4.2.2 Australian competitors and international market

The Global Goat Market based on 2021 World Bank data is shown in the Table 3 below. Australia is the largest exporter followed by Ethiopia and Kenya. Australia commands a premium price in the international market due to the clean green image of brand Australia.

Table 3: Goat export volume (t) and price paid (USD) for 2021

Country	Export volume (Tonne)	Price (USD)
Australia	19,292	\$ 9.43
Ethiopia(excludes Eritrea)	15,464	\$ 5.59
Kenya	10,582	\$ 4.36
France	2,287	\$ 8.28
Greece	2,434	\$ 7.59
Spain	3,365	\$ 5.32
Other	9,883	\$ 5.74
Total	63,306	\$ 6.74

Source: World Integrated Trade Solution 2023. 2021 data

Australia’s biggest competitors are Ethiopia and Kenya. The markets that these countries export to are outlined below with United Arab Emirates taking most of Ethiopian and Kenyan products.

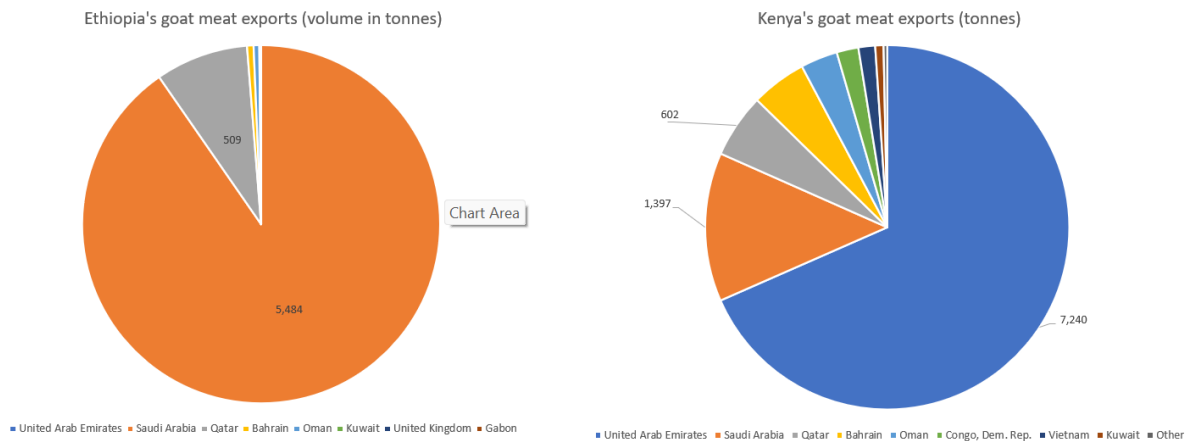


Figure 9: Importing countries for Ethiopia and Kenya (t)

Source: World Integrated Trade Solution 2023. 2021 data

4.2.3 Export market opportunities based on price and goat consumption

The markets have been analysed and the markets which are under-developed from an Australian export potential have been identified. These include Japan, China, United Arab Emirates, Vietnam, Qatar, European Union and United Kingdom as shown in Figure 10.



Figure 10: Target markets for Australian product

Source: World Integrated Trade Solution 2023. 2021 data referencing country import volumes and average price paid per kilogram.

The total goat consumed per capital per year in kilograms for target export destinations are shown with China and Qatar as highest consumers of goat meat per person. China has a large domestic herd in addition to importing product. China is price sensitive and will switch between mutton and

goat depending on price. The China market growth in 2023 has been exponential for the China listed Australian processing plants.

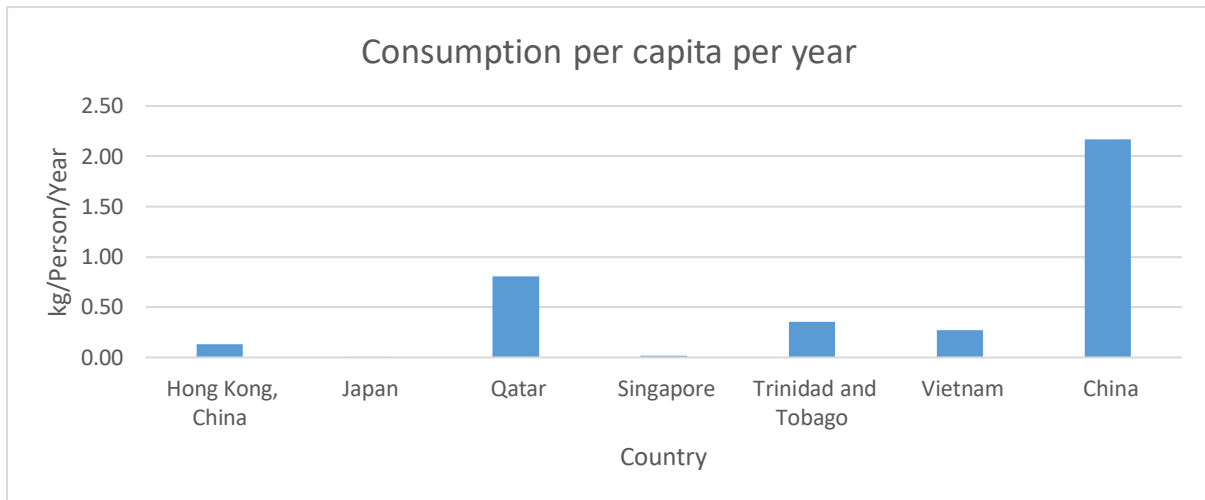


Figure 11: Calculated goat consumption per capital for target destinations

Calculated using: World Integrated Trade Solution 2023. 2021 data and FAO 2023 data

An opportunity exists to grow the goat per capita consumption from a very low base in South Korea, United States of America and the United Kingdom. Within South Korea there has been increasing calls to ban the farming and eating of dog meat (Maresca 2023). Goat meat is seen as a substitute for dog meat due to its flavour profile and meat colour for the hot pot dishes and stews thus opening new market channels and opportunities for Australian rangeland goat products. The USA consumes less than 100 grams of goat per person per year based on calculations from World Integrate Trade Solutions and FAO 2021 data.

The United Kingdom (UK) currently consumes less than 20 grams of goat per person per year. The Free trade agreement with the UK combined with ethnic groups who are familiar with eating goat and a low consumption per year provides an opportunity to expand Australian goat products into the UK. The products will need to be retail or food service ready as high labour costs will restrict in country processing. The non-British born population in the UK is estimated at 6 million people, with the largest proportion of non-UK (37%) non-British (24%) population living in London with an estimated 1.35 million people from India and Pakistan (Office for National Statistics 2021).

The countries with the highest levels of goat meat per capita consumption were Nepal (2.47 kg per person), Myanmar (1.89 kg per person) and Pakistan (1.72 kg per person) (World Integrated Trade Solution 2023). Expats of these communities living around the world provide an opportunity to market Australian goat products, with price premiums paid for Halal frozen cubed goats based on data from Japan in shops servicing expatriate communities.

Spain currently is the main supplier of goat meat to the United Kingdom followed by Greece and Ireland as shown in Figure 12.

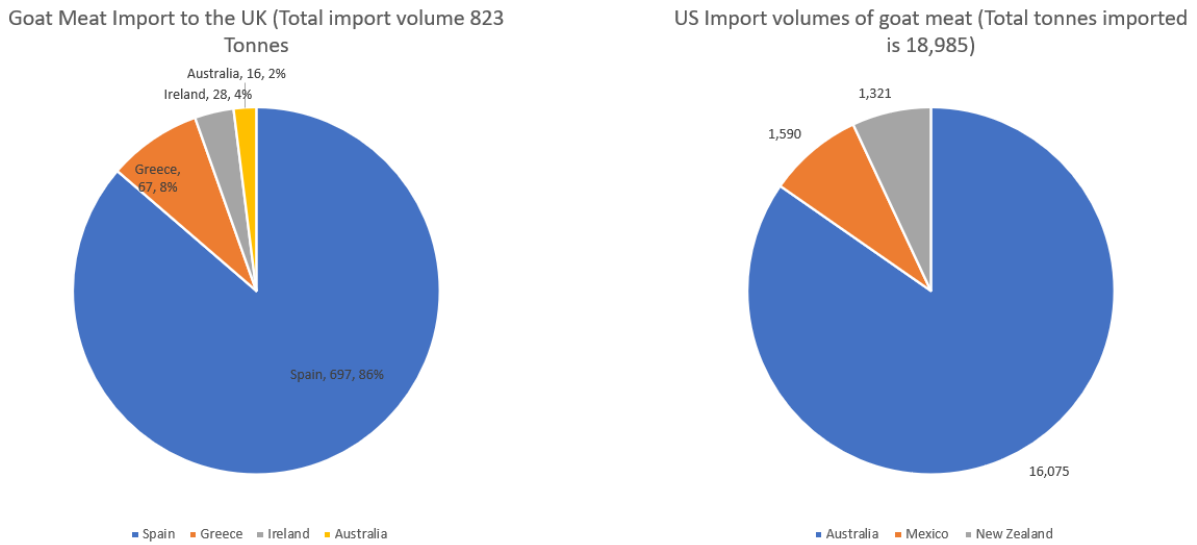


Figure 12: Goat meat importation by country for UK and USA

Source: World Integrated Trade Solution 2023. 2021 data

An example of Spanish free-range goat sold in the UK is shown in Figure 13. Frozen 1.5 inch cubes of mixed neck breast, shoulder, loin and shank cut by a bandsaw operator are sold in 1 kilogram or 15 kilogram sealed bags.



Figure 13: Spanish frozen cubed goat meat

Source: <https://chestnutmeats.co.uk/product/spanish-goat-diced-on-the-bone/>

4.2.4 Tariffs and technical access

The MLA Global snapshot of Goatmeat in Table 4 provides an overview of the trade agreements in place and the import tariffs. The January 2023 reduction in Korean goat meat tariffs to zero offers an additional competitive opportunity.

Table 4: Trade agreement and import tariff status

	Trade agreement			Import tariffs		Technical access	
North America	US – Australia-United States Free Trade Agreement (AUSFTA)	Canada – CP-TPP	Mexico – CP-TPP	0%		US – issues include port mark compliance	Mexico – flat stacking of carcasses
Greater China	China mainland – Australia Free Trade Agreement (ChAFTA)		Taiwan – no free trade agreement	China mainland Goatmeat – 0% since Jan 2023 Live goats – 0% since 2019	Taiwan – NT\$11.30/kg or 15%, whichever is higher		
Korea	Australia Free Trade Agreement (KAFTA)			0% for goatmeat and live milk goats since Jan 2023			
Trinidad and Tobago	No free trade agreement			0% (under Common external tariff of the Caribbean Community (CARICOM CET))			
Malaysia	ASEAN-Australia-New Zealand Free Trade Agreement (AANZFTA) and Malaysia-Australia Free Trade Agreement (MAFTA)			0% (for meat of goat and live goat)		Maintains import regulations in accordance with Halal requirements	
United Kingdom	A-UK FTA EIF 31 May 2023*			From 31 May 2023 FTA EIF – 10.5% + 125.12 GBP/ 100kg			

*A-UK The Australia-United Kingdom Free Trade Agreement (a-UK FTA) was signed by parties in December 2021 and entering into force 31 May 2023. During the transition period, goatmeat will continue to access the existing WTO quota (22 tonnes) at 0% in quota tariff. Source: World Trade Organization, Canada Border Services Agency, MLA, Customs Administration, DFAT, Customs Administration - Republic of China, St. Lucia Customs & Excise Department.

Source: MLA 2023 & DFAT 2023

Technical access issues arise for boned out and chilled product, particularly to the USA and Canada. Boned out goat to USA requires no cartilage and bone to be present. The ability to remove cartilage and bone requires a high level of skill on the part of the boner. Exporters have identified the opportunity for boneless product however with skilled boners – in limited supply have been unable to ensure the product will pass USDA inspections. For this reason, exporters prefer the bone in product which means there are no issues with bone chips or bone dust.

The extended shipping times and in country supply chain logistics challenges have seen a preference for products to be frozen to manage shelf life.

The presence of hair as a contaminant is an issue which exporters face. When whole carcasses are exported specialised staff undertake additional inspections to look for hair on each carcass prior to export. Hair which hasn't come out properly for skin on whole carcasses to USA has been identified as being recorded as a defect by United States Department of Agriculture inspectors.

Technology is in development stages which can scan carcasses and identify contaminants. Identifying chlorophyll is in early prototype stage, while other contaminants are still be tested and refined using spectrometry equipment. Ensuring hair and other contaminants are removed from the goat carcass will open the markets to processing in Australia, extending shelf life and developing chilled product lines.

4.2.5 Market and new product development

Brand ‘Australian rangeland goat’ is regarded as a clean, green, natural product which has been processed under strict hygiene standards. There is an opportunity to extend ‘Brand Australia’ to include environmental and sustainability elements. Market research in the USA has identified goat as offering health advantages for those seeking a low cholesterol diet. Further market research is required to understand what health, provenance and sustainability claims resonate with current and potential goat consumers. In terms of developing “menu options” and/or “retail merchandising planograms” – the normal “product-market fit” new product development process is required along with the need to “balance and utilise the carcass”.

4.2.5.1 Export market development

Based on the import volumes and average price paid per tonne the markets which are of interest to develop new products and new opportunities are identified in Figure 14. Each market and each product will have different technical access barriers particularly if considering chilled and boned out product. Chilled Indian goat neck, mince and boneless cubes are advertised in supermarkets in Singapore for AUD55 per kilogram, as of June 2023. Average import value of goat products was above USD12/kg in 2022 (Figure 14). Research and development is needed to develop processing equipment as outlined in Section 4.3 and shelf life testing to value-add product in Australia and target the chilled markets of South East Asia.

Research in United States of America (Tennessee and Georgia) identified there was an interest in non-goat consumers eating goat (Ibrahim et al. 2018), with a preference (77%) for buying fresh rather than frozen, with 30% wanting to buy chops and 52% happy just to buy goat for their special occasions (Ekanem et al. 2013).

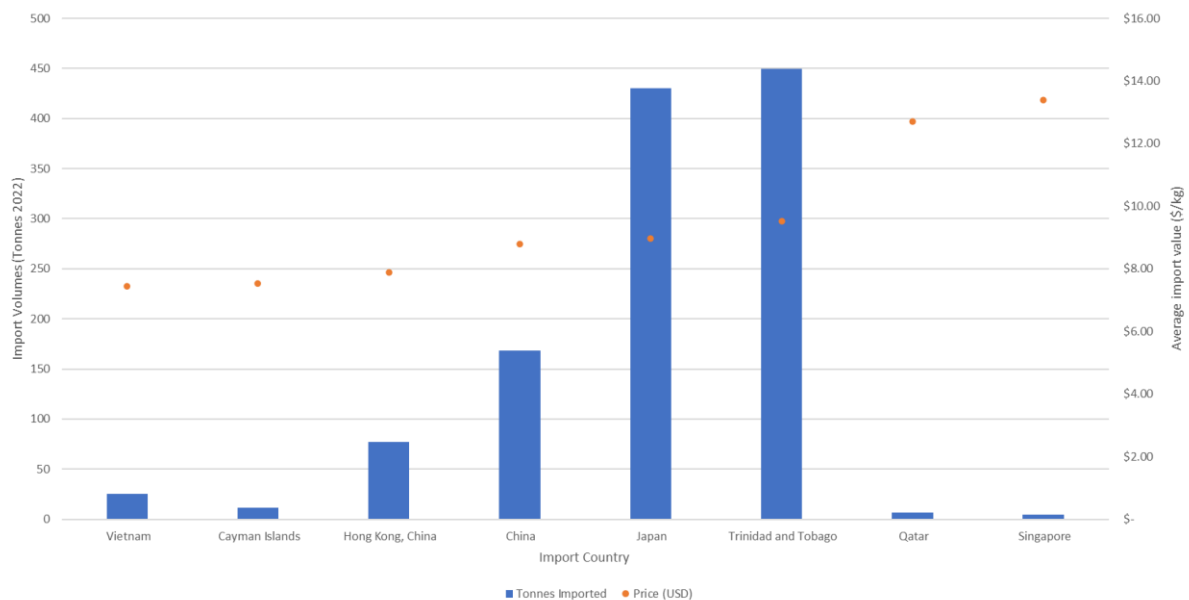


Figure 14: Market development opportunities

Vietnam has growth potential as Figure 13 albeit at a lower price point with traditional Vietnamese recipes (Goat Pho soup) using the neck. The question which needs to be investigated is – What is the value creation opportunity and opportunity cost in selling necks separately to Vietnam? Further

research is required to understand (1) will cutting the neck separately to match to recipes increase product sales and (2) will it create more economic value for the overall carcass.

4.2.5.2 Domestic market development

Small domestic processing plants are supplying goat meat and carcasses direct to ethnic restaurants in major cities. Butcher shops were purchasing goat carcasses in response to consumers requests for goat and started breaking the goat carcasses down as per lamb cuts. The butchers were unaware of alternative carcass breakdown options, learning from customers there is a demand for skin-on cubed goat meat and for half carcasses of small goats. Butchers interviewed realised there were a number of different market segments for goat products, and they lacked an understanding of the product and cut requirements for each of the different customer / market segments.

Of the butchers surveyed by Star et al. (2021), 50% were providing goat meat to local families based on orders. Goat meat was considered a category range they were looking to grow, with bone-in product being preferred by butchers due to less product weight loss compared to boned out products. Butchers acknowledged they had knowledge gaps on the best ways to break down a goat carcass to service consumer needs and on techniques to cook different goat cuts to then educate customers (Star et al. 2021). This lack of knowledge was highlighted by customer requests for cubed and skin on goat which the butchers were not familiar with.

To increase the sales of goat meat on the domestic market support is required at a grassroots level working with the local butcher shops, processing plants, social media influencers, restaurants and chefs. Activities to increase domestic demand include:

- (1) supporting butcher shops to understand the different market profiles and customers' needs,
- (2) providing butcher shops with marketing materials,
- (3) encouraging the consumption of goat meat through social media, media and events with cooking demonstrations and recipes,
- (4) linking restaurants to goat meat suppliers enabling goat to be added as a menu item and
- (5) encouraging 'gourmet at home' eating experiences using goat meat through social media engagement with provision of recipes based on restaurant experiences.

The aligning of carcass types and cuts to cooking styles and consumer segments is required to achieve positive consumer eating experiences. The next sections explore carcass types, product differentiation and cooking method by carcass type.

4.2.6 Carcass and product differentiation

Goat meat is a completely different product to ovines (lamb/sheep) in terms of carcass composition, cooking style and eating qualities (Tshabalala et al. 2003). Goats have naturally low glycogen levels in muscles (Abhijith et al. 2021), combined with significantly less subcutaneous fat than sheep (Tshabalala et al. 2003), goat carcasses are prone to cold shortening when in chillers set for sheep, resulting in lowering eating quality (Pophiwa, Webb & Frylinck 2020). The low muscle glycogen levels and lean carcasses also means goats do not pass through the lamb pH temperature decline window. At export orientated processing plants, to reduce the impact of cold shortening goat carcasses are processed hot, packed into cartons and into a freezer to chill the carton and product rapidly.

Goat is a complex product segment with a large range of cooking methods, eating occasions and cuisines. To optimise consumer satisfaction the specific cuts and products from different goat

carcase types needs to be matched to the consumer needs as required by the cooking method, eating occasion and recipe.

It is important to start with the consumer and match the consumers' needs with the carcase type. An example is a butcher shop in the UK where the marketing material states:

- For a leaner dish, choose Goat Leg Diced.
- Looking for even more flavour, try Male Goat Diced.
- If you prefer a more tender option, choose Kid Goat Diced.
- Looking to simply cook and serve, try Boneless Goat Meat (Chestnut Meats 2023).

Christine Ferguson 2010 Nuffield Scholar found when researching opportunities for the Australian rangeland goat found USA consumers preferred Australian entire male goat for the strong flavour. The concept of flavour profiles needs to be considered for domestic and international market development in addition to eating quality, cooking method, and fat profiles. This may mean entire rangeland males have their own category (flavour profile), then crossbred and meaty goats have their category based on fat coverage and the grain assisted finished animals have a separate branding profile with cuts matching the carcase and cooking methods. The separating by weight is already happening however research is needed to understand if these are the correct weight range separations required by the customers.






- Separation of carcase weight:
 - >12kg
 - 12-16
 - 16-24
 - 24+kg

The basic AUS-MEAT category currently used in industry is Goat (G) described as any caprine animal with 0-8 teeth. Using the alternative categories shown in Figure 15 offers the ability to develop product branding linking the goat meat flavour and attributes to consumers and cooking styles.


Dentition, sex and carcase weight differentiation by carcase attribute however for consumers they are looking at the product attributes related to an eating experience when purchasing. Examples of different product attributes based on carcase types aligned with consumers needs are outlined below:

- Dairy goat (more fat than rangeland): sausages, mince, hamburger patties, roast products
- Dairy goat male kid: mild flavour profile, some fat, processed young – roast products, gourmet marinated cut similar to Australian lamb products.
- Rangeland kid: stronger flavour than dairy goats, low fat content, low muscle to bone ratio – whole goat for roasting in a spit or half carcase for roasting.
- Rangeland males <24kg and cull rangeland females: lean, low fat content, medium flavour profile – curry, stews, hot pots
- Rangeland entire males >24kg: lean, high muscle to bone ratio, strong flavour – curry, stews, hot pots
- Pure and cross bred meat goats (Boer + Kalari x Rangeland) – higher fat content than lean rangeland goats, when well grown they have a similar carcase composition and yield to lamb.

CAPRINE – ALTERNATIVE CATEGORIES (GOATMEAT)

DENTITION	DESCRIPTION	CATEGORY/CIPHER
<p>0</p> 	<p>Carcase derived from female or male caprine that:</p> <ul style="list-style-type: none"> ◆ Has 0 permanent incisor teeth (in addition): ◆ In male shows no evidence of Secondary Sexual Characteristics (SSC). ◆ CHEVON can be used as an optional description for this category. 	<p>KID * GK *</p>
<p>1 - 2</p> 	<p>Carcase derived from female or castrate male caprine that:</p> <ul style="list-style-type: none"> ◆ Has 1 but no more than 2 permanent incisor teeth. ◆ In castrate male has no evidence of Secondary Sexual Characteristics (SSC). ◆ CHEVON can be used as an optional description for this category. 	<p>CAPRA * GC *</p>
<p>0 - 8</p> 	<p>Carcase derived from female caprine that:</p> <ul style="list-style-type: none"> ◆ Has up to 8 permanent incisor teeth. 	<p>DOE * GD *</p>
<p>0 - 8</p> 	<p>Carcase derived from castrate or entire male caprine that:</p> <ul style="list-style-type: none"> ◆ Has up to 8 permanent incisor teeth. ◆ Has no evidence of Secondary Sexual Characteristics (SSC). 	<p>GOAT WETHER * GW *</p>
<p>0 - 8</p> 	<p>Carcase derived from male caprine that:</p> <ul style="list-style-type: none"> ◆ Has up to 8 permanent incisor teeth. ◆ Shows Secondary Sexual Characteristics (SSC). 	<p>BUCK * GB *</p>

OPTIONAL - SUPPLEMENTARY SPECIFICATION CAPRETTO

DENTITION	DESCRIPTION	CATEGORY/CIPHER
<p>0</p> 	<p>Kid Goat definition may as an option be alternatively described as "CAPRETTO" but the carcass must meet the following requirements:</p> <ul style="list-style-type: none"> ◆ Be within the following weight classes (HSCW): <ul style="list-style-type: none"> - class 6 – up to 6 (kg) - class 8 – over 6 and up to 8 (kg) - class 10 – over 8 and up to 10 (kg) - class 12 – over 10 and up to 12 (kg) ◆ Have pale pink meat colour of the internal flank muscle. ◆ In male shows no evidence of Secondary Sexual Characteristics (SSC). 	<p>CAPRETTO KID * GK *</p>



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Figure 15: Aus-Meat Caprine Alternative Categories for Goat Meat

© AUS-MEAT Limited 2005, Accessed online 31 July 2023 www.stockyardbeef.com.au/wp-content/uploads/2020/07/Ausmeat-Language.pdf

4.2.8 Hair removal and skin on burnt

Goat products are differentiated by skin on, skin off and skin on burnt. Varies levels of sophistication are being used by goat processors in Australia from a handheld blow torch to specialised burnt processing line. Issues within the goat processing sector is the burning processing is not able to keep up with existing chain speed of 9-13 per minute depending on plant. Refer to MLA funded project "Automated goat head browning" for information on the development of a skin on browning process which developed a commercially available machine (Lofthouse 2015).

The goat carcass can be skinned with the same equipment used for sheep, with special care required to avoid hair contamination. Efficient equipment to remove hair from skin off carcasses would be of benefit to the development of export markets and processed in Australia. Hair left on carcasses is a reason for carcass defects to the USA Market as shown in Table 6.

Table 6: Classification of carcass defects

	Minor	Major	Critical	Zero Tolerance
Faeces, Milk, Ingesta, Urine				Any Amount¹
Bruises / Blood Clots	2 - 5 cm (GD)	> 5 cm (GD)	2 or more majors	
Seed² (Not associated with inflammation)	5 - 10	11 - 20	> 20	
Rail Dust, Specks, Hide & Wool Dust	5 - 10 scattered specks	11 - 20 scattered specks	> 20 scattered specks	
Smears & Stains (inc bile, oil & grease)	≤1 cm diam	1 - 2 cm diam	> 2 cm diam	
Hair & Wool Strands³	5 - 10 strands	11 - 20 strands hair/wool	> 20 strands hair/wool	
Hair & Wool Clusters, & Hide, scurf, toenails³	1 cluster of hair Hide < 1 cm diam	2 - 3 clusters hair/wool Hide 1 - 5 cm diam	> 3 clusters hair/wool Hide > 5 cm diam	
Foreign Objects & Extraneous Tissue⁴ includes parts of other organs & loose attached mucosa	1 incidence	2 incidence	3 incidence	
Pathology⁵			Any incidence	

Source: Commonwealth of Australia (2002) p42

4.3 Processing and chilling equipment

A review of processing and chilling equipment and technologies was undertaken as part of the research work to understand what currently is being used by industry and what research and development is needed to develop a market driven goat meat value chain. The findings of the desktop review, observations and interviews are presented in this section.

Chilling techniques

The chilling used will depend on the processing plant facilities, the product specifications and type of cuts prepared. Existing smallstock chillers set for lamb results in goat carcasses cold shortening due to being a lighter carcass with less fat coverage. New technology is available which rapidly chills or rapidly freezes cuts of meat in cartons. This technology was undergoing red meat trials when this report was being prepared to understand the opportunity to rapidly chill carcasses to avoid cold shortening and provide an opportunity to process goat cold to reduce microbial growth rates while still value-adding. Research is required to investigate and validate the opportunity to accelerate the carcass chilling through innovative techniques.

Boning - hot or cold

Rangeland Goat can be harder to bone compared to farmed goat, lamb and mutton. Given the lower meat to bone ratio, the preference for bone in product for many markets, bone out rangeland goat products may not be commercially viable. For meatier goats (Boer + Kalahari reds) hot boned products which are aged in the bag are an option to increase tenderness and reduce shrink. Goat meat tenderises when aged in a Cryovac bag providing options to hot bone and still have a tender product (Abhijith et al. 2021). For premium goat meat products, the type of chilling and how they are aged will influence eating quality. Eating quality research is required to validate the ability to bone hot and age in the bag or alternatively to rapid chill, bone and age in the bag.

Carcass breaking

The majority of carcass breakdown (6 way) is done using a bandsaw. The accuracy of the cut is determined by the manual operator. The older rangeland goats' bones are much harder than ovines or bovines and research is required into saw blades which don't blunten or can be changed easily and more frequently than the current saws used in meat processing plants.

The Scott's automated primal machine (LEAP III) is used to break down lamb carcasses. Research trials are required on understanding the blade's ability in the LEAP III system to cope with goat bones. The purchase and installation of the system will not be economical for goats alone however if used in conjunction with lambs could provide a viable automation option.

Interviews with technology providers have identified an automated machine which breaks down carcasses into major cuts based on a carcass scan. The technology provider would consider co-investment in developing equipment for goats providing there was a market for the technology and a positive return on investment for both the technology provider and the processor.

Dicing equipment

Goat is often sold as a diced product with bone in. Dicing equipment needs to be able to cut through hard bone and be able to be easily cleaned and remain hygienic throughout the day.

There are a range of dicing systems available globally. In some markets diced leg and shoulder command a premium, ribs are a separate product, while in other markets the entire carcass is diced. In Australia bandsaws were used with frozen product however this created major workplace health and safety risks with most plants in Australia now not dicing due to labour cost and worker safety.

Slicing equipment

There is a range of technology available to thinly slice product for retail sale. Value-adders in the red meat industry already using these systems for portion cutting. The cuts thinly sliced would be produced for hot pot style products and be predominantly bone out chilled cuts.

- The key consideration for this is, should we pre portion cut in Australia and what is the impact on the shelf life of chilled product?
- The cost and volume of each system will impact on the final decision as to what systems, if any is chosen for the purposes of thinly sliced goat products.

A new product which will be considered is rolled or thinly sliced products for hot pot. This is a common product with lamb and beef and is of interest for Southeast Asian consumers. This offers the opportunity to value-add and create a retail and restaurant ready product. There are several products available which will require testing. This provides an opportunity to value-add flap which is often difficult to sell.

Boning equipment – Chining

Goat racks and cutlets have been identified as value-added products which are of interest to food service and gourmet at home cooks. To enable racks and cutlets to be prepared the rack would need the chine bone removed to enable a knife to separate the cutlets for consumption.

There are several systems currently available for chining lamb racks. However, these systems would need testing with goat products. The following options require investigation:

- Manual operator in a bandsaw, there are no issues with the cutting the bone however testing done on lamb shows there is considerable meat left on the bones.
- The BLM Frenching machine currently used for lamb would require testing on goat products.
- Scott's standalone chining machine provides the highest yield recovery for chining on lamb however is untested with goat carcasses. Potentially the chining machine will require a harder set of blades to ensure their longevity.

Boning equipment – Loin deboner

Three commercial loin deboners are available. 2 remove the eye muscle and one removes eye muscle and tenderloin. For meatier goats, loin deboning could be considered if there is customer demand.

Boning equipment – Leg deboner

A semi-automated leg deboner is available for use in sheep and lambs. This leg deboner will need to be tested to see if it can be modified to be used on goats. For meatier goats this could be an option for rolled leg roast or diced goat meat.

Packaging equipment

A chilled product needs a vacuum sealed package. In-market testing reviews of packaging types is required including skin packaging and vacuum sealed bags to understand which packaging is appropriate for which cut and market based on customer and consumer preferences.

Vacuum seal technology will enable products to be aged in the bag, extend shelf life of chilled products, and provide option of retail ready packs for domestic customers and airfreight options to international customers. Shelf-life testing will be required to understand the shelf life on each product as chilled product could be exported chilled or frozen as necessary.

4.4 Technologies

Technologies which are currently used in red meat industry which have applicability to goat processing have been identified and described in this section.

Rinse and Chill (RCT®)

The naturally low glycogen levels found in goat carcasses can decrease the eating quality of the meat. Rinse and Chill® technology from MPSC (<https://mpscinc.com>) displaces the blood in the vascular system. The use of the chilled electrolyte solution has benefits in beef and sheep carcasses including supporting temperature pH decline to hit the window for tenderness, increased shelf life due to reduced microbial activity from improved blood removal, improved meat colour and increase in saleable meat yield however it has not been researched for its impact on goats.

Spectrometry

Using fluorescence spectroscopy blue light scanners are used to check for chlorophyll which is typically present in faecal matter and ingesta as an indicator of E. coli and other bacteria due to contamination. Veritide (www.veritide.com) have two commercially available systems however additional development is being undertaken for an automated carcass scanning system which would be of interest to the processing sector to increase shelf life.

Similar to the system commercialised by Veritide there are other technologies in earlier R&D stages which can identify contaminants depending on wave lengths and colours chosen.

Objective Measurement Technologies

There are no objective measurement technologies used on goats in Australia, which the researchers are aware of. Dual-energy X-ray Absorptiometry (DEXA) in theory provides carcass composition however processing plants with DEXA's installed in Australia are using it to provide their automation systems with skeletal structures (bone locations) for precision cutting.

Market research has indicated the muscle to bone ratio is important to customers and consumers. The value of objective measurements in the early stage of the industry development will help identify animals with a high muscle to bone ratio (lean meat yield) and for appropriate conformation for retail cuts (size, shape). Goat producers are seeking feedback on which animals to select as breeding stock.

In the future there is a potential for Intramuscular Fat (IMF) to be of interest, particularly for the meaty breeds which are cut and cooked like lamb.

Meat colour will become an interest for chilled products on retail shelves. Typically, the line of product all the same colour is more important than a particularly 'colour shade' when on the retail shelf.

From the consumer perspective, the feedback to the researchers has been the flavour profile, fat type and quantity are more critical than the colour. Research and development is required to develop objective measurements for the 'strength' of flavour profile as this will influence market acceptance, recipe application and consumer preferences – similar to wine and cheese where some people and dishes prefer a strong flavour and other people and cuisines require a mild flavour.

In summary, the traits which are important to the producer, processor and consumer need to be identified to understand which objective measurement data points are required at different points in the chain. Based on the eating quality attributes and carcass traits which require measuring, this will determine the applicable objective measurement technologies.

Markets for by-products

Goat by-products including horns, goat lungs, heart and other products like oesophagus are prized for 'natural' and free range product attributes and are in high demand from dog treat companies. Drying technology needs to be considered where possible for goat horns and offal products.

Pet food and pet treat companies are interested to purchase chilled or frozen blocks of single product lines from 2kg to 20kg. Plate freezers offer the opportunity to create naked blocks of single product lines to sell to customers making or manufacturing pet food and pet treats.

5. Conclusion

There is potential to grow both the volume and value of goat meat exports from Australia. Traditional goat consumers and non-traditional consumers offer potential to grow product volume sales from a low base in high value markets including Japan, Korea, Taiwan and North America.

By better meeting the consumer needs and processing into ready to cook and ready to eat products there is opportunity to further grow the value of the product. The Australian goat meat industry has potential to develop high value differentiated products with increased product and packaging sophistication from a base where 80% of the product exported is whole and 6 way cut carcasses.

The barriers to achieving an increase in value and volume of goat meat sales include:

- Understanding what consumers and market segments value,
- Alignment of carcase types, products, packaging and branding to align with consumer needs,
- Carcase and cut differentiation to align with consumer eating experiences,
- Cost effective processing, value-adding and packaging equipment to deliver product specifications required,
- Development of new supply chain linkages, distribution channels and customer base to expand existing markets and develop new markets and
- Marketing and promotional activities aligned with new product development, packaging and branding to target market segments.

5.1 Key findings

The goat meat industry is relatively immature reflected by:

1. Limited data collection specifically on goat meat production by government departments and agencies
2. Lack of HAM code standard product specifications for goat meat
3. Limited goat meat specific processing equipment and objective measurement technologies
4. Lack of understanding of product attributes, packaging, price and purchase methods new and existing domestic and international customers value.
5. Limited to no information shared with goat producers on carcase specifications, market requirements and what carcase traits the producers should select for.
6. Limited goat specific handling facilities, registered animal health products, transport companies, knowledge on confined feeding and handling to minimise stress.

Processing of product into cubes and cuts in Australia will increase access to the Southeast Asian market and Australian domestic consumers. With the easing of prices Taiwan, Korea and China have increased the import volumes of Australian goat meat. Additionally, Korea is also looking for a lean meat alternative to dog meat for traditional recipes.

The goat industry is in its infancy and does not have technology which has been adapted and applied specifically to support processing. Other large goat producing and consuming countries have developed cubing and slicing equipment, therefore it is possible to develop automated value-

adding options in Australia to service the Southeast Asian and Australian markets with ready to cook options.

Trade access barriers which need to be addressed are contaminants (hair) and for boned out product all bone dust, bone chips and cartilage near the bone needs to be removed for export to the United States of America. The sale of bone in product reduces the need to be hypervigilant on bone dust and bone chips.

Accurate descriptions of goat meat and its associated attributes are critical to maintain and develop markets.

Flavour and aroma are complex attributes of goat meat. These sensory attributes are affected by species, age, fatness, and anatomical location, gender, diet, and method of cooking. Consumers can easily detect the aroma and flavour of meat and can grade the acceptability of these attributes (Webb 2014 p35).

Clear branding and product descriptions are needed to differentiate rangeland, meaty goats with grain assisted finishing and dairy goat meat. The AUS-MEAT Language Alternative category/cipher to identify carcasses offers an opportunity to brand and value-add product as consumers seek out Capretto, Capra and Bucks based on their flavour profiles.

The **development of objective measurement technology** to (1) grade carcasses to align carcasses types to product and consumer specifications and (2) provide feedback to producers for selection of desired animal traits is necessary to continue to develop and professionalise the industry. Producers with managed herds and improved bucks are looking for market signals and pricing feedback based on Objective Measurement Technology as many are fine wool or beef producers who have diversified into goats.

New market development requires:

1. Market and customer differentiation:
 - a. Flavour profile intensity: e.g. 1 star = young and mild, 5 stars = mature entire male
 - b. Tenderness profile: matched to recommended cooking style and cut type,
 - c. Fat profile: if free range has different fat profile to grainfed pasture raised animals.

Chemical composition analysis is required on the fat type and the flavour profile (fatty acid composition) to help ascertain what flavour profiles the different consumers are interested in for the different recipes and cooking methods.

2. Ability to cost effectively deliver different processed product and cuts for different customer bases.
3. Processing techniques and supply chain costs to be on a price parity with lamb for roasts and beef for stews for western palettes.
4. Development of fresh browned skin on cubed product which can command a price premium.
5. Product testing on quality differentials. For example, can new freezing techniques like snap frozen peas work for cubed meat to enable distribution outside of local supply chains.
6. Consumer and market research to understand how the goat carcasses and products should be differentiated based on provenance and eating quality attributes. This requires understanding what the consumer values and is willing to pay for.

7. Marketing and promotional activities to increase the volume and value of domestic and international markets through social media influencers, importers, chefs, cooking demonstrations and recipe development to support products and cooking styles aligned with flavour profile.

5.2 Benefits to industry

Goat meat is currently a commodity product with limited value-adding, product and market segmentation making it open to the boom and bust of commodity cycles. There is an opportunity to increase the value of goat meat supply chain in Australia through product and market differentiation. Similarly to where sheep meat was 30 years ago, the goat industry with the required investment in research, development and marketing across the entire chain can move from a commodity supply chain to a market-orientated, consumer focused value chain.

There is a \$100-\$140-million-dollar* uplift per year in export value if the 2022 average goat meat export price of \$12.28 per kilogram is maintained into the future, compared to the average price of \$7.38 per kilogram for January-June 2023. The \$100 million dollar uplift is based on 2022 volumes, the \$140 million dollar uplift is based on 2023 export volumes year to date. Additionally, new product development, further processing packaging and branding will further increase the value and volume of goat exports.

Goats are becoming an integral part of rangeland production systems, together with beef and or sheep as an income diversification strategy and land management tool. Producers who have diversified into goats are looking to develop their goat meat business in alignment with market requirements and product specifications as per wool microns and beef carcass grading and pricing grid specifications. Taking a whole of chain approach from producer to processor to consumer provides opportunities to identify and undertake whole of chain and point specific interventions to uplift the entire chain and develop value-added products.

6. Future research and recommendations

The future research and recommendations have been developed from a whole of supply chain perspective with the view to increase overall carcase value, increase consumer demand, increase consumer satisfaction, reduce complaints and provide additional value to the customer and consumer which they are willing to pay for. Market segmentation and differentiation based on what the customer and consumer are willing to pay for requires product development and branding. This product development and branding is undertaken at a processor level where carcasses need to be graded and matched to products and brands based on inherent attributes of the animal and carcase including age, weight, sex, dentition, meat to bone ratio and fat composition.

6.1 Critical goat supply chain issues

In Queensland there is a shortage of small stock kill space

Producers with less than 100 goats to sell or who would like to toll process are not able to access kill space easily. Goats are being transported from Queensland to Bourke for processing. Representatives from The Queensland Goat Producers Incorporated have phoned and surveyed abattoirs and processing plants in Queensland to understand what kill space is available to understand who can process goats, the space available and are seeking solutions for the current processing constraints for smallstock in Queensland.

Feedback from processing plants

Goat producers have diversified from fine wool / beef production / cropping and are used to receiving market signals, pricing grids based on quality specifications and working with buyers / agents /processors to obtain price premiums where it is of interest and economically viable to do so.

Some producers were taken back to find the meaty, fattier goat they were breeding were not what the customer base buying frozen six-way from Australian processors were wanting, instead they were looking for lean meat for use in curry. Research undertaken as part of this project identified there is an opportunity for these meatier fattier goats to be marketed to a consumer segment looking for goat meat that is more suited to the grilling and roasting cooking methods than low and slow.

The growth and professionalisation of the goat producers are also not fully understood by some processing plants' personnel who are under the assumption the product is all un-managed whereas many producers are managing goats in one form or another.

Supply chain alignment is urgently needed to help goat producers understand what to select for and which processing plants are wanting what type of goats for their different market channels. Uplifting the entire chain is required to improve market differentiation and capture additional value through better meeting the needs and wants of customers and consumers. Improved connection and information sharing is required between producers and processors to ensure the intrinsic value of the project aligns with what the consumer is prepared to pay for.

Recommendations: (1) Support processors to identify their customer requirements and share this information with the producer and (2) support processors to develop differentiated markets and products based on carcase attributes and cook by cut attributes.

Opportunities for value-adding

Whole small carcasses can command a price premium however this isn't communicated to producers who are often paid the same amount per kilogram irrespective of animal type and marketability. A processor explained the cost to process the smaller carcase balanced out the price premium so they couldn't afford to pay more for the smaller animal despite receiving price premiums. Rangeland does are extremely fertile and kid twice per year. An opportunity exists, if the producer knows he can sell the kids the ability to turnover stock quickly and build a business which focuses on quick stock turnover.

Recommendation: Processors understand costs of production for different products and the ability to then bring a line of product (animals) in which would facilitate efficiencies. Use of a confined feeding system may support this where runs of animals with similar specification are processed in lots together. This requires producers and processors understanding their costs of production and working together to achieve price premiums.

Legislation and data collection doesn't support professionalisation of the goat industry

In several state jurisdictions goats are regarded as pest animals and are not listed as part of 'farmed livestock'. The lack of data collection of how many goats are being managed and how many producers have goats restricts investment in the entire industry from transport providers, input suppliers, processors, marketers and exporters.

Recommendation: industry to work with State and Federal governments and departments to improve the status of the goat industry from a pest harvesting industry to a recognised primary production industry.

6.2 Recommendations:

1. Scope an industry wide plan to further develop the goat industry in Australia. Topic areas include:
 - a. Possibility for separation of the goat data (from sheep data) recorded at State, Federal government organisations and departments.
 - b. Develop specific HAM codes for goat meat as currently sheep meat codes are used.
 - c. Support increased record keeping and data granularity within the industry including producers, processors and service providers to help with data-based decisions at an enterprise.
 - d. Review the pest status implications and work with industry and State Governments to support mustering of feral goats and put them 'behind wire' to be managed.
 - e. Development of confined feeding and feedlot guidelines
2. Work with service providers including truck drivers and lairage workers on low stress goat handling techniques.
3. Continue to support peer to peer learning activities between goat producers. A key discussion point was fencing between producers interviewed – what was necessary, how to minimise escapees and requirements to check for animals with horns stuck.

4. Strengthen relationships and connectivity between producers, processors, exporters, importers and consumers to build win-win solutions addressing:
 - a. Fluctuating supply,
 - b. Understanding seasonal demand,
 - c. Processing capacity and processing requirements,
 - d. Product specifications and cut types for different market segments and
 - e. Price and margins required by each.
5. Undertake program to develop branding based on consumer value propositions:
 - a. For example: Capra, Rangeland mild, Rangeland strong, Grain fed
 - b. Cuts to cooking technique:
 - Roasting and BBQ
 - Slow and low
 - Curry / Stew (wet cooking)
6. Undertake research to value-add goat including:
 - a. Preparation of retail ready cuts and diced product,
 - b. Trial of technologies which offer opportunity to extend shelf life to export chilled goat products.
 - c. Eating quality implications from interventions such as electrical stimulation, RCT[®], age in bag at a commercial scale for cut by cook type,
 - d. Ready to eat products (sous vide) for retail and food service,
 - e. Supply chain development for whole of carcase utilisation – whole of industry linkages to value-adding opportunities including medicinal, nutraceutical, dog treats and dog food.
7. The “Australian rangeland goat” brand attributes are that of a lean, natural product. The goat as a browser with minimal impact on marginal pastoral enterprises is anticipated to have a low carbon footprint. Research is needed to understand and validate the impact of goats from an environmental and carbon footprint perspective in a mixed species pastoral / rangeland operation. There is an untapped opportunity to market goat meat as an important ecological component of the Australian landscape, as a controller of woody weeds and invasive weed species while cohabiting with native wildlife with a relatively low carbon footprint per kilogram of meat produced.

The list of key data to facilitate industry analysis and planning identified by Clark and Ronning (2013) from the “Goatmeat industry RD&E strategy 2012 benefit cost analysis including recommendations on collection of industry data” arguably remains relevant today. Refer to Appendix A for the list of key data to facilitate industry analysis and planning which will help support industry decision making, provide industry insights and support government, research and development investment in the Australian goat industry.

6.3 Future Research and development activities

Project title: Development of automated goat processing equipment

Project summary:

Currently there is limited value-adding of goat carcasses in Australia beyond frozen 6 way. Different processing companies have trialled boned out product and bone in legs and shoulders however the low carcass and cut weights compared to lamb makes manual processing in Australia uneconomical for high volume commodity markets.

There is an opportunity with a technology provider to develop automated goat processing equipment which breaks splits the carcass in half and enables easier breaking down for further processing. Racks, ribs, legs and shanks can be separated easily, enabling the rest of the carcass to be diced/cubed or alternatively cutting the carcass as '6 way'. The technology exists in another species for carcass scanning and then breakdown into a number of cuts according to carcass shape and size. The cubing/dicing equipment would require a staged process that needs developing to link to packaging equipment to automate the entire process with carcasses going in and cubed goat in a sealed bag the final product at the end of the conveyor belt.

Development of the scanning technology is required as currently the prototype for another species includes an x-Ray scanner and can operate which meets the requirements of smallstock processing plants in Australia. Research is required to understand if cheaper scanning options such as using an RGBD camera will provide an image the equipment can work with. Objective measurement (OM) feedback on carcasses is requested by producers – can the RGBD camera provide OM feedback without the need to invest in additional carcass scanning equipment.

Advantages of the system include removal of manual labour, improved worker safety, options to create cuts outside of 6way by removal key primal cuts and increased shelf life as handling is minimised. Research is required to understand if the accuracy of the cutting lines for hot / accelerated chilled/cold carcasses to determine the carcass treatment requirements prior to further processing carcass into cuts. The research undertaken also should consider how the technology fits in with value-adding opportunities which will require carcass sortation off the slaughter floor.

Prior to investing in development of the automated goat processing equipment the technology provider requires a value proposition identifying the market opportunities and ROI calculations undertaken for meat processors and an understanding of the willingness of meat processors to engage and purchase the equipment which would be suitable for goats, hogget and mutton.

Project title: Understanding flavour profile preferences and presentation in international and domestic market segments per cooking style to create branded segmented products

Project summary:

Different piecemeal research and in country interviews have identified specific flavour profile and fat preferences based on cooking style and consumer segment. To better meet consumers requirements and create a value-added non-commoditised product in market consumer taste testing is required in major markets including USA, Taiwan, Korea and China. The in-market testing needs to include the presentation and processing of the goat products: chilled, frozen, thinly sliced, cubed, skin on, browned, skin off, bone in cuts ready to cook, ready to eat products, skin pack, cryovac, boxed and the market channel for each type retail, wholesale, food service. Shelf life trials are required for each of the different product lines.

Branded segmented products: Different cooking styles, recipes and techniques prefer different ages, sexes and animal types. The lean, rangeland, entire male is a flavour revered by Caribbean cooks and chefs. Barbeque and roast recipes are better suited to a younger goat with a high intramuscular fat such as a Boer. Matching the fat and the flavour profile based on age, sex, farming system to the customer and creating a branded product with universal branding the consumer will recognise is important to grow and develop the Australian goat industry. Recipes, butcher shop and chef engagement as well as the use of micro bloggers and influencers will help raise the profile of the branding.

Project title: Development of carcass grading system, pricing grid and market terminology linked branded segmented products

Project summary:

While processors can grade carcasses to different target markets and manage the prices internally, producers are seeking feedback and guidance on selection requirements to better meet consumer segments. Selection for meat to bone ratio based on visual appearance is occurring however a formal system of carcass grading, feedback and pricing grids need to be developed and linked in with market segment requirements and market demand. The Queensland producers have shifted across from fine wool and beef to include goats in their enterprise and are used to receiving feedback and having pricing grids, while other producers who have limited exposure to pricing grids will require sensitisation. Research is required to understand if there is a correlation from live muscle scanning to carcass characteristics, what carcass traits should be selected for and relative heritability of each trait. A carcass feedback system which provides details on condemned carcasses and other husbandry issues is required to help inform producers. Given goats are regarded as low value 'fillers' by most smallstock processing plants, developing an efficient system will be required.

Project title: Whole of carcase utilisation – market development

Project summary:

Goat processing is not considered a core business for many smallstock processors in Australia, with research indicating there are opportunities to support smallstock processors with better connections to increase the sale price of hides, offal, horns, hooves, ears and other byproducts. In some markets such as pet food goat products are preferred to sheep however consistency of supply and market connections are needed to help capture increased value for the supply chain. Research is needed to identify markets opportunities and develop supply chain linkages to better access these opportunities as an industry.

Project title: Development of collaborative goat value chain to manage supply fluctuations and support industry development

Project summary:

Within Queensland there is limited smallstock processing capacity and limited toll processing options. During the 2020-2021 drought producers noticed that goats were thriving while cattle and sheep were holding or losing weight. The predator proof fencing combined with the 2022 wet season and an interest in producers including goat and sheep as a diversification strategy stock numbers have increased. The bottleneck in the Queensland industry is now processing capacity.

There are a group of producers who have invested in fencing, improved genetics and rotational grazing and have goats as an integral part of their enterprise who are looking for longer term business and supply relationships. Research is needed to understand the feasibility in having producers guarantee supply each week to a processing plant to facilitate the development of long-term contracts for the supply of goat meat. While many goat producers are opportunistic harvesters the goat producers involved in the trial will be goat producers who see goats as an integral part of their business. A trial period is required to understand the producers' ability to adhere to supply contracts. Research is also needed to understand if toll processing is required or if a specific pricing grid and supply contract will provide the outcomes producers require.

Issues to address in the research include fluctuating supply, understanding domestic and international seasonal demand linked to festivals, processing capacity and processing requirements, product specifications and cut types for different market segments and price and margins required by each entity in the value chain.

Project title: Improve eating quality in goats through use of technology eg Rinse and Chill Technology (RCT) ® and in bag aging

Project summary:

Goats have a relatively low muscle glycogen level, despite trials being undertaken to raise the plane of nutrition pre-slaughter the research showed little difference. RCT® vascular rinse can help restore glycogen depleted muscles in bovines, therefore research is required to understand the influence it may or may not have in goat carcasses to help prevent cold shortening which is exacerbated by small carcass weight and limited subcutaneous fat levels.

Small trials have shown in bag aging has improved tenderness. Additional trials are required at a commercial level to understand the degree to which aging in the bag influences tenderness for different primal cuts and the impact on chilled and frozen product eating quality.

7. References

- Abhijith, A., Warner, R.D., Ha, M., Dunshea, F.R., Leury, B.J., Zhang, M., Joy, A., Osei-Amponsah, R. and Chauhan, S.S., (2021). Effect of slaughter age and post-mortem days on meat quality of longissimus and semimembranosus muscles of Boer goats. *Meat Science*, 175, 108466.
- AUS-MEAT Limited. (2005). AUS-MEAT Language, Accessed online 31 July 2023, https://www.aussiebeefandlamb.me/downloads/Handbook_of_Australian_Meat_7th_Edition-English.pdf
- Clark, M. and Ronning, D. (2013). Goatmeat industry RD&E strategy 2012 benefit cost analysis including recommendations on collection of industry data, Meat and Livestock Australia, Accessed online 14 July 2023 https://www.mla.com.au/contentassets/d9890ff3e175486dba88416408a3f820/b.goa.0074_final_report.pdf
- Chestnut Meats. (2023). Spanish goat diced on the bone 1.5 inch pieces, Accessed online 9/6/2023 <https://chestnutmeats.co.uk/product/frozen-spanish-goat-on-bone-1-kg/>
- Commonwealth of Australia. (2002). Meat Hygiene Assessment, Objective methods for monitoring of processes and product 2nd Ed., Australia. Accessed online 14/06/2023 https://www.agriculture.gov.au/sites/default/files/sitecollectiondocuments/aqis/exporting/meat/elmer3/index/methods-microbiological-test-meat/meat_hygiene_assessment_2nd_ed.pdf
- Department of Regional NSW. (2022). Goat industry data collation and tracking, industry update 2021/22, Department of Primary Industries, NSW Government Accessed online 8/6/2022 https://www.dpi.nsw.gov.au/_data/assets/pdf_file/0011/1443827/Industry-Update-2021_22_Goat-Data-Collation-and-Tracking_report.pdf
- Ekanem, E., Mafuyai-Ekanem, M., Taguegne, F., Singh, S., & Favors, D. (2013). Goat meat consumer preferences: implications for goat meat marketing in metropolitan Nashville, Tennessee area. *Journal of Food Distribution Research*, 44, p1-9, Accessed online 12 July 2023, https://www.google.com/url?sa=i&rct=j&q=&esrc=s&source=web&cd=&ved=0CAIQw7AJahcKEwiQ2oTww12AAxUAAAAAHQAAAAQAw&url=https%3A%2F%2Fageconsearch.umn.edu%2Frecord%2F158770%2Ffiles%2FJFDR%252044_1_%2520GoatMeat.pdf&psig=AOvVaw16XEVWYLB4lb4kuKnvPrkS&ust=1689400348907659&opi=89978449
- FAO. (2023). FAOSTAT Accessed online 25/5/2023 <https://www.fao.org/faostat/en/#data/QCL>
- Ferguson, C. (2010). The Australian Rangeland Goat Management and Opportunities, Nuffield Australia, NSW. Accessed online 24/04/2023 https://www.nuffieldscholar.org/sites/default/files/reports/2010_AU_Christine-Ferguson_The-Australian-Rangeland-Goat-Management-And-Opportunities.pdf
- Graigfarm (2023). Free range goat, Accessed online 6 May 2023 <https://www.graigfarm.co.uk/collections/goat>
- Ibrahim, M., Onyango B., Pattanaik N., and Liu X. (2018). Current Trends, US Immigration Policies, and Marketing Strategies for Goat Meat. *Journal of Food Distribution Research* 49, no. 1: 70-77. Accessed online 12 July 2023 bearworks.missouristate.edu/articles-coa/406/

- Lofthouse, T. (2015). Automated goat head browning, Western Meat Exporters, Meat and Livestock Australia, Accessed online 12 July 2023, <https://www.mla.com.au/research-and-development/reports/2015/automated-goat-head-browning/>
- Maresca T. (2023). As farms close, calls grow for dog meat ban in South Korea, UPI, accessed online 9 June 2023 https://www.upi.com/Top_News/World-News/2023/03/10/dog-meat-ban-farm-HSI-closure/4591678452767/
- MLA. (2016). Australian goat industry summary 2016, Meat & Livestock Australia, Accessed on 30 June 2023 https://www.mla.com.au/globalassets/mla-corporate/mla_australian-goat-industry-summary-20162.pdf
- MLA. (2021). Goat production at highest level in 2.5 years. Meat & Livestock Australia, Accessed online 8 May 2023: <https://www.mla.com.au/news-and-events/industry-news/goat-production-at-highest-level-in-2.5-years/>
- MLA. (2023). Global snapshot: Goatmeat. Meat & Livestock Australia, Accessed online 6 May 2023 https://www.mla.com.au/globalassets/mla-corporate/prices--markets/documents/trends--analysis/goat-industry-summary/2023-mla-ms_global-goatmeat_f5.pdf
- MLA. (2023a). Over the hooks report, Meat & Livestock Australia, Accessed online 9 August 2023 <https://www.mla.com.au/prices-markets/oth/>
- MLA. (2023b). National Slaughter, National Livestock Reporting Service, Accessed online 9 August 2023 <https://www.mla.com.au/prices-markets/slaughter/>
- Office for National Statistics (2021). Population of the UK by country of birth and nationality: year ending June 2021, Accessed online 10/06/2023 <https://www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/internationalmigration/bulletins/ukpopulationbycountryofbirthandnationality/yearendingjune2021>
- Parker, A., Nogueira, D, Fitzpatrick, L. (2014). Meat goat producer survey, Meat & Livestock Australia. Accessed online 12 July 2023, www.mla.com.au/contentassets/9255bfa5625544c6ad4db1f0ccce854a/b.goa.0073_final_report.pdf
- Pophiwa, P., Webb, E. C., & Frylinck, L. (2020). A review of factors affecting goat meat quality and mitigating strategies. *Small Ruminant Research*, 183, 106035.
- Star, M., Rolfe, J. & Lyons, B. (2021). Local consumer demands and domestic supply of sheep and goat meat, Rural Economies Centre of Excellence Accessed online 24/05/2023 <https://www.ruraleconomies.org.au/media/1365/retail-insights-august-final.pdf>
- Tshabalala, P. A., Strydom, P. E., Webb, E. C., & De Kock, H. L. (2003). Meat quality of designated South African indigenous goat and sheep breeds. *Meat Science*, 65(1), 563-570.
- World Integrated Trade Solution (2023). Export of Fresh, chilled or frozen goat meat by country 2021. Accessed 16 May 2023 <https://wits.worldbank.org/trade/comtrade/en/country/AUS/year/2021/tradeflow/Exports/partner/ALL/product/020450>
- Webb, E. C. (2014). Goat meat production, composition, and quality. *Animal Frontiers*, 4(4), 33-37

World Integrated Trade Solution. (2019). *Tariffs applied on imports of Meat; of goats, fresh chilled or frozen from Australia by country - Year: 2018*. Accessed online 6 May 2023 from <https://wits.worldbank.org/tariff/trains/en/country/ALL/partner/AUS/product/020450>

8. Appendix

Appendix A: Key data to facilitate industry analysis and planning

Data item	Description
Goat population	<ul style="list-style-type: none"> Rangeland and agricultural population Percentage of population in each state/territory Historical time series and five year forecast A forecasting model that links rainfall, rangeland feed base and goat supply
Production	<ul style="list-style-type: none"> Annual turnoff – historical and forecast Value, volume and carcase weights Gross value of production (GVP) estimates to demonstrate industry's importance to government
On-farm data	<ul style="list-style-type: none"> Cost of production data for rangelands Cost of production for a range of farming situations Cost of wild dogs, disease and parasites Benchmarks on performance (e.g. what is the value of incorporating goats in a Dubbo enterprise - cost of production, gross margin visa vie enterprise alternatives, non-financial benefits like weed control, etc.) Alternative production systems (e.g. Economics of Feedlotting goats, genetic improvement in semi wild rangelands) Data on the genetic makeup of the Australian goat population and the link between genetic improvement, production and profitability
Supply chain	<ul style="list-style-type: none"> Description of links in major supply chains (domestic, export) Number of businesses and capacity of key links (e.g. industry processing capacity especially for small lots) Prices at various points along the supply chain Volumes being directed to each supply chain Economic descriptions of alternative supply chains The cost of supply chain losses as a result of poor handling (mortality and morbidity)
Number of goat producers	<ul style="list-style-type: none"> Rangeland Agricultural production
Markets	<ul style="list-style-type: none"> Exports by volume and value (NB this is already available) Domestic consumption Routine market reporting for 'indicator' products Data on market trends (e.g. changes in overseas consumption and key price thresholds, domestic consumption preferences, etc) Product form (primal cuts, value add, live animals, etc.) Brand development
Human capacity	<ul style="list-style-type: none"> Number of researchers working in the field Value of goat research by MLA and others Training and skill level of producers Young farmers entering goat production Number of producers and other members targeted with RD&E messages and number who have changed practices as a result.

Source: Clark and Ronning 2013

Accessed online 14 July 2023

https://www.mla.com.au/contentassets/d9890ff3e175486dba88416408a3f820/b.goa.0074_final_report.pdf

Appendix B: HAM codes

Goat meat HAM code 4640 can be goat carcass skin on, skin off or carcass pieces according to the 7th Edition which limits data analysis and record keep at plant and for the industry.

GOATMEAT

GOAT CARCASS - SKIN ON / SKIN OFF - 4640

Carcass Skin On or Skin Off includes all parts of the body skeletal musculature and bone, extending to and including the hock joint (tarsus) and knee joint (carpus), all cervical vertebrae and up to five coccygeal vertebrae.

Carcass trim must comply with all government hygiene regulations that passes a carcass fit for human consumption and with the Australian meat industry agreed minimum trim requirements.

For further details of the minimum trim standard definition for Goatmeat carcass see page 110 or visit the AUS-MEAT web site.

Points requiring specification:

- Carcass can be prepared as agreed between the buyer and seller skin on or skin off.
- Variations to minimum trim standard definition (customer agreed variation).

OPTION - CARCASS PIECES:

- Carcass cut into more than 2 (two) pieces will be described as: **Carcass Pieces**.
- Carcass cut into 6 pieces are described as: **Carcass Pieces 6 way cut**.
- All primal cuts must be retained with the possible exception of the Tenderloin.

GOAT CARCASS
SKIN ON



GOAT CARCASS
SKIN OFF



CARCASS PIECES or
6 WAY CUT



GOATMEAT PRIMAL CUTS

- Goatmeat primal cuts are referenced to the same specification and cut code numbers as Sheepmeat.
- To purchase Goatmeat primal cuts use the Sheepmeat Cut Code Number reference and associated rib number where applicable and stipulating that the product is sourced from Goat.

Comparison of Goat and Sheep cut code searches on AUS-MEAT website under Cut Code Search & Translation

GOAT Cut Code Search Results (11)

Item	Bone	Cipher	Filename	Suffix	Language
GOAT CARCASE	BONE IN	4640		W	
GOAT CARCASE SKIN ON BROWN	BONE IN	4640W			
CARCASE DAMAGED (SKIN ON)	BONE IN	4641			
GOAT CARCASE	BONE IN	4642			
GOAT CARCASE TELESCOPED	BONE IN	4645			
GOAT SIDE	BONE IN	4650			
CUBED PIECES	BONE IN	CUBP 5037			
DICED GOATMEAT	BONELESS	5251			
MINCED GOATMEAT	BONELESS	MCE 5261			
BONELESS GOAT CUTS	BONELESS	5800			
TESTES AND PIZZLE	OFFAL	7131			

Source: www.ausmeat.com.au/members/meat-industry-standards/cut-code-search-translation/.
 Accessed online 1 August 2023

Cut codes currently used in the export data for goat meat

Cut code	Goat cut code search		Sheep cut code search		
	Item	Bone	Item	Bone	Cipher
4640	Goat carcase	bone in	na		
4645	Goat carcase telescoped	bone in	na		
4800	na		Leg chump on	bone in	LEG
4801	na		Leg chump on - aitch bone removed	bone in	LEG
4805	na		Leg chump off - aitch bone removed	bone in	LEG
4820	na		Leg chump off	bone in	LEG
4860	na		Loin	bone in	LON
5020	na		Neck	bone in	NKS
5036	na		Assorted cuts	bone in	AC
5037	Cubed pieces	bone in	na		
5199	na		Assorted cuts	boneless	AC
5201	na		Carcase	boneless	FC

Source: www.ausmeat.com.au/members/meat-industry-standards/cut-code-search-translation/.
 Accessed online 1 August 2023.

Appendix C: HAM codes and cooking method per cut

AUSTRALIAN GOAT CUTS

1 Goat Leg HAM 4801
Easy carve leg roast Leg knuckle mini roast

2 Goat Chump HAM 4790
Chump chop Goat rump

3 Goat Tenderloin HAM 5080
Fillet/tenderloin

4 Goat Shortloin HAM 4880
Boned and rolled loin roast Loin chop Eye of Shortloin/Backstrap

5 Goat Rack HAM 4932
Frenched cutlet Frenched rack of lamb (8 rib)

6 Goat Forequarter HAM 4972
Forequarter chop Forequarter rack (4 rib) Forequarter boned and rolled

7 Goat Shoulder HAM 4995
Easy carve shoulder roast Boned and rolled shoulder

8 Goat Eye of Shoulder HAM 5151
Neck fillet roast

9 Goat Shank HAM Fore 5030/Hind 5031
Fores Shank Hind Shank

10 Goat Neck HAM 5020
Neck chop

11 Goat Breast and Flap HAM 5172
Ibibs

GOAT

LEGEND

- Stir-fry
- Barbecue
- Oven Roast
- Pan-fry
- Hotpot/Casserole

TRUE AUSSIE GOAT

www.trueaussiegoat.com

NOTE: carcass primal cut name codes are the same as sheepmeat. When ordering, please specify if it is goatmeat or sheepmeat.

https://www.mla.com.au/globalassets/mla-corporate/mla_australian-goat-industry-summary-20162.pdf

Appendix D: Yield calculation

3 carcasses – crossbred, supplementary fed. Average carcase weight 13 kilograms. Range 11.8 – 13.8kg. Carcase breakdown and calculations by Greenleaf Enterprises.

Yield calculations (averaged)	kg	%
Whole FQ unsplit, sh/br/neck on, not tipped	4.494	38%
B/In oyster cut shd shank on, tip on	2.653	22%
B/In oyster cut shd shank on tipped	2.249	19%
Rib cage (meat retained - for cubing)	2.173	18%
Waste	0.063	0%
Foreshank tips	0.110	1%
Whole mid		
4" CFO cutlet ready (scapular removed)	1.088	9%
Scapular	0.071	1%
Trim	0.048	0%
Breast & flap (could be cubed?)	0.953	8%
Boneless flap meat (trim?)	0.135	1%
Waste	0.029	0%
Waste (kidney fat)	0.110	1%
Chine & Feather	0.214	2%
Bone in shortloin 4" tail	1.088	9%
HQ pair untipped flank retained	3.664	31%
Long cut leg flank retained	3.540	30%
Hindshank leg tips	0.124	1%
Chump off leg aitch bone retained, flank retained, tip on	2.881	24%
Chump off leg aitch bone retained, flank removed, tip off	2.736	23%
Trim from leg (flank)	0.070	1%
Bone in chump flank retained (could be cubed)	0.806	7%
Bone in chump flank removed	0.665	6%
Flank (from bone in chump - trim)	0.136	1%
Waste	0.047	0%

Appendix E: MLA Update – Goats May 2023

Australian goatmeat – summary table

Volume – tonnes shipped weight (swt)		2022		2021		5-year average (2017–2022)		change 2022 vs 5-yr av.	
			% out of total		% out of total		% out of total	%	in tonnes swt/A\$
Total		21,831	100%	19,046	87%	19,460	100%	12%	2,371
Storage	Chilled	1	0%	5	0%	13	0.1%	-92%	12
	Frozen	21,830	100%	19,041	87%	19,446	100%	12%	2,384

Source: DAFF

Value – in A\$ '000								change 2022 vs 5-yr av.	
								%	in A\$ '000
Total		260,771		242,077		212,963		22%	47,807

Source: ABS/IHS Markit

Australian goatmeat exports – volume (tonnes swt)								change 2022 vs 5-yr av.	
								%	in tonnes swt/A\$
US		12,505	58%	12,589	66%	12,549	64%	-0.3%	-44
South Korea		3,757	10%	2,128	11%	1,912	10%	96%	1,845
Taiwan		2,150	9%	1,869	10%	2,193	11%	-2%	-43
Canada		1,339	6%	1,279	7%	1,060	5%	26%	279
Trinidad and Tobago		976	2%	439	2%	773	4%	26%	203
Other		1,104	16%	3,527	19%	973	5%	14%	132

Source: DAFF

Australian goatmeat exports – value (A\$ '000)								change 2022 vs 5-yr av.	
								%	in tonnes swt/A\$
US		152,929	59%	167,585	69%	143,691	67%	6%	9,238
South Korea		51,475	20%	27,835	11%	23,914	11%	115%	27,561
Taiwan		16,825	6%	14,748	6%	15,381	7%	9%	1,443
Canada		16,567	6%	17,353	7%	12,304	6%	35%	4,263
Trinidad and Tobago		11,247	4%	5,458	2%	8,234	4%	37%	3,014
Other		11,727	4%	9,096	4%	9,439	4%	24%	2,288

Source: ABS/IHS Markit

Australia live goat exports total								change 2022 vs 5-yr av.	
								%	in tonnes swt/A\$
Total volume in head		4,869		12,018		10,721		-55%	-5,852
Total value A\$ '000		3,862		4,770		5,691		-32%	-1,829
Malaysia	volume in head	2,276	47%	7,393	62%	6,089	57%	21%	1,304
	value A\$ '000	1,172	30%	2,468	52%	2,218	39%	11%	250

Source: DAFF (volume), ABS/IHS Markit (value)

Source: MLA 2023