Final report

Goat Data Collation and Tracking

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Abstract

A critical requirement for a viable, long-term goat industry is accurate and reliable supply, population and processing data. The Goat Industry Data Collation and Tracking project has considerably improved the industry's access to reliable data and its capacity to quantify, forecast and explain industry changes. The project collated data from existing sources, developed forecasting and modelling processes, and integrated industry intelligence. From the outset, the project has engaged the industry, building capacity and confidence to use the outputs for decision-making and foresee supply issues. Major outputs include accurate reporting of goats supplied for processing from each region in Australia, refined supply and population modelling and establishment of the National Goatmeat Supply Forecasting Committee. The project has supported the industry's development by informing supply-chain and market development, strategic planning and the evaluation of challenges and opportunities.

Executive summary

Background

This project was designed to improve decision-making and strategic planning across all sectors of the goatmeat supply chain by providing access to reliable data and supply forecasts. The industry requires information for strategic planning and the evaluation of challenges and opportunities. A lack of access to data was limiting the industry's development.

Objectives

The project aimed to:

- Establish processes to collate and report reliable and accurate data
- Project supply and population changes
- Coordinate and support a supply Forecasting Committee

Methodology

To deliver these objectives:

- Data was collated from existing sources, including the National Livestock Identification System (NLIS), levy and aerial surveying data
- Modelling was used to quantify supply (time-series forecasts and a supply response model) and population trends (Bayesian state-space model and Integral Projection Models).
- A Forecasting Committee used the collated data and modelling combined with their industry knowledge to explain trends and forecast supply
- Key messages were communicated to the industry using reports, newsletter articles, and presentations

Results/key findings

Major achievements include:

- A significant change in the availability of supply, processing and population data to support decision making
- The development of methods to accurately report the number of goats supplied for processing from each region in Australia
- Industry specific supply (time-series and supply response) and population (an integral projection model transformed into a dynamic, web-based application) models, which are used to support the Forecasting Committee's decision making
- The coordination of an effective National Goat Forecasting Committee

Benefits to industry

The Forecasting Committee and the processes that support it have significantly increased the industry's capacity to predict and understand supply and population trends, enhancing the goatmeat sector's strategic planning. Key messages were formulated and communicated to industry. The industry's capacity to anticipate and respond to supply challenges has been dramatically improved.

Future research and recommendations

The Australian goatmeat industry is innovative and developing rapidly, making production, supply, and demand dynamic. Constant change and progress mean that continuing investment is needed to collate and report data, explain industry trends, and forecast changes.

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1. Background

The value of goat exports from Australia was $298.6 million in 2021/22. Global trends provide a positive outlook for goat consumption, but Australia can only continue to develop opportunities in key markets by addressing challenges such as the high volatility of goatmeat supply.

At the outset of this project, the goatmeat industry had insufficient information to guide decision-making and strategic planning. Basic information such as population estimates and the numbers of goats supplied from each state and region were unavailable to industry. The industry's lack of capacity to project supply and set production targets limited strategic planning. The entire goatmeat supply chain in Australia required information for decision-making. Data reporting, modelling and industry-specific processes were needed to forecast supply and support industry development. There was also a need to build confidence in the data and the capacity to use this data for decision-making.

2. Objectives

The project objectives were:

Objective 1- Report to the goatmeat industry annually:

- The number of goats supplied for processing from each NLIS region
- The number of active suppliers (all states)
- Number and location of active depots
- The number of properties with managed herds (NSW only)
- The estimated proportion of managed goats (according to Nation Vendor Declaration)
- Goat population estimates (NSW, SA and Qld)
- Average carcase weight

Objective 2- Report to the goatmeat industry quarterly:

- The number of goats supplied for processing from each state
- The number of goats processed in each state
- The proportion of goats entering the supply chain via a depot
- The proportion of goats entering the supply chain via direct consignment.

Objective 3: Coordinate and support the national Forecasting Committee and Stakeholder Panel. · Aim to forecast the number of goats supplied for processing (on a quarterly and financial year basis) to achieve a forecast estimate within +/- 10% of the actual total.

Objective 4: Modelling of various scenarios undertaken to make informed recommendations regarding changes to industry practice and the forecasted impact of those changes.

Objective 5: Conduct population model analysis, development and evaluation.

Objective 6: Establishment of a cost-effective, efficient and sustainable forecasting model/system for the long term.

3. Methodology

Data sources

Integrity Systems Company (ISC) - National Livestock Identification System (NLIS) *data*

The project established a data access and use agreement with ISC to source unpublished NLIS data, which was collated to generate supply information. The data provided de-identified records of individual mob-based movements between two locations, including:

- Source PIC[1] (first 6 digits identified)
- Source Goat Depot (Yes/No)
- Destination PIC (first 6 digits identified)
- Destination Goat Depot (Yes/No)
- Destination PIC account (e.g. processor, goat depot)
- Movement date
- Upload Type (e.g. Mob based movement onto PIC, Mob based kill)
- Identification of sale yard movements /Saleyard In Out (Yes/No)
- Number of animals in mob
- Bred on Source PIC (Yes or No)

The data access agreement also included a request for aggregated data, including the number of unique source PICs. ISC provided quarterly downloads of the NLIS data 15 days after the end of each quarter to the project team.

Department of Agriculture, Fisheries and Forestry (DAFF) – Slaughter Levy Data

The Department of Agriculture Fisheries and Forestry, previously the Department of Agriculture Water and Environment, provided slaughter levy data to Meat and Livestock Australia (MLA) for use in this project, with a delay of 1.5 months following the completion of the quarter. The lag time was necessary to allow processors to lodge their returns. Processors must submit monthly returns within 28 days after the end of each month (DAFF 2023).

NSW DPI BIOMAP database – Stock and Land Returns

The Land and Stock Return data were sourced from the NSW Government BioMap database. In NSW, producers complete Annual Land and Stock Returns, which are essentially a 'farm census' that provides information about livestock numbers across the state. Producers include all livestock over six months of age held on the property (30 June 2021), including pets, regardless of whether owned or agisted (LLS 2023). While submitting annual returns is a statutory requirement, some landholders do not submit returns (BioMap 2022).

Aerial survey data

To collate and report goat population estimates, the project team accessed aerial survey data from government agencies in NSW, Qld and SA. In these states, aerial surveys are conducted annually to estimate kangaroo populations and other species are also recorded, including goats. Queensland's aerial survey data for goats was not available in 2022.

Other publicly available data

[1] A Property Identification Code (PIC) is an eight-character code allocated by the Department of Primary Industries (DPI) or an equivalent authority in each state or territory to identify a livestock-producing property. Producers must have a PIC to move livestock on and off a property – it forms the basis of Australia's food safety and traceability programs (ISC 2023).

The project also utilised a range of publicly available data, which was used to report information on price, exports and production. These data sources included:

- MLA's National Livestock Reporting Service (NLRS) –
- MLA Market Information – Australian goatmeat exports (data source: DAFF)
- MLA Market Information – Australian goatmeat slaughter (data source: ABS)
- MLA Market Information – Australian goatmeat production (date source: ABS)
- Department of Agriculture Fisheries and Forestry (DAFF) – All Livestock exports

3.1 Objective 1 Report data annually

3.1.1 The number of goats supplied for processing from each NLIS region

For each NLIS region in Australia, the number of goats supplied to abattoirs was collated in Excel using ISC data and mapped using ArcGIS. The process involved identifying a movement to a processor and determining the consignment's region of origin. A transfer to an abattoir was recognised if the movement had i) a processor (i.e. PROC) 'Destination PIC type', or ii) a destination PIC that belonged to an abattoir (e.g. 3AB… in Vic), but the movement was only reported by a depot 'Movement off PIC'. The consignment's original location was determined by the 'Source PIC'. The first digit of a PIC identifies the state (N = NSW; Q = Qld; S = SA; W = WA; M = Tas; T = NT). Another two digits in the PIC determine the NLIS region, where these digits occur in the PIC sequence varies depending on the state and entity. The change in regional goat supply between years was also calculated and mapped to examine variation over time and identify growth areas.

3.1.2 The number of active suppliers (all states)

ISC data was used to quantify the number of active suppliers in each state, i.e., properties that had moved goats off-farm. The number of unique producer 'Source PICs' represents the number of active suppliers. A producer PICs is one that is not otherwise identified as a depot, processor or other entity..

3.1.3 Number and location of active depots

The number of active depots was calculated by tallying the number of unique depot PICs recorded in the NLIS database. Under the NLIS regulation, operators of NSW goat depots must be registered with the NSW Department of Primary Industries (DPI, 2018). Although the list of registered depots is not available publicly, the project team was able to compare the number of depots calculated using the NLIS data with the registered list.

3.1.4 The number of properties with managed herds (NSW only)

The project team accessed Stock and Land Return data from the NSW DPI BIOMAP database, collating data from 2017 to 2022. The data set provided the number of goats reported on each holding, allowing the number of holdings with goats and the total number of goats to be collated by Local Government Area, Local Land Services Region and Rural Lands Protection Board Region. Herd demographics were also aggregated, including the number of herds with ten or fewer goats and those with 1,000 or more goats.

3.1.5 The estimated proportion of managed goats (according to NVD reporting)

The project team reviewed the capacity of the NLIS database's 'Bred on source PIC' data to reflect managed goat numbers and changes over time. When movements are uploaded to the ISC's NLIS database, producers are asked, 'Have the stock been bred by the vendor' (Yes/No). For each movement, the 'Bred on source PIC' data is either 'Yes', 'No' or blank. It was assumed a blank entry meant that the question was not answered. The percentage of goats consigned for processing with a recorded 'yes', from those that provided a response was calculated and mapped to examine this data.

3.1.6 Goat population estimates (NSW, SA and Qld)

In NSW, goat abundance estimates were calculated from aerial survey data collected by the NSW Department of Planning and Environment in conjunction with kangaroo abundance monitoring. Dr Steven McLeod led the analysis of this data to estimate the goat population and provided updates to the Forecasting Committee.

In Qld, Dr Tony Pople, Qld Department of Agriculture and Fisheries, collaborated as a project stakeholder providing data to the project team and presenting updates to the Forecasting Committee. Goat abundance and density in the Mulga lands, Mitchell grass downs and Brigalow belt bioregions of Qld were available from 1983 to 2021. However, the Queensland Department of Environment did not record goats on their 2022 aerial surveys for kangaroos. The reasoning was that goats were so numerous in southwest Queensland that aerial survey observers would be distracted from counting kangaroos, their taxa of primary interest (T. Pople, personal communication, September 12, 2022).

For several surveyed regions in SA, Dr Amanda McLean, SA Department of Water and Environment, analysed the aerial survey data and provided goat abundance estimates to the project team.

NSW Aerial Survey Method Summary

- Fixed wing aircraft
- Flight height is 250 ft
- The surveying method was Mark Recapture Distance Sampling. This method:
    - is widely used for estimating density or abundance when the detection of animals is not certain
    - allows continuous assessment of probability of detection to better estimate abundance
    - takes into account factors that affect detection, which improves precision and accuracy
- Block transect layout (*Figure 1*). Surveys of 20 x 50 km blocks; each block ~ 160 km transects
- The observer recorded the species, distance class and the size of the group. For each observation, the time and location, using a GPS, are automatically recorded
- Survey area 2 x 300 m strips
- The species and the number observed are recorded
- <5 % of land under the survey transects are National Parks or Nature Reserves
- Surveying in winter (June-August)
- Surveys do not distinguish between managed and unmanaged goats

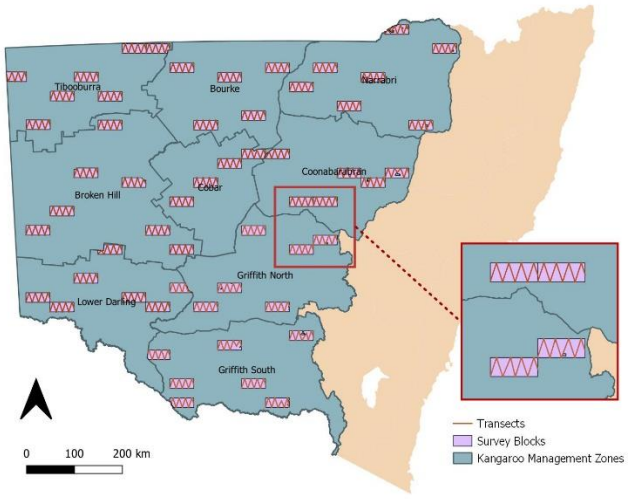

Figure 1 Aerial survey blocks flown in NSW to estimate kangaroo and goat abundance

Queensland Survey Method Summary

- Helicopter surveys estimate kangaroo abundance in five commercial harvest management zones (Figure 2). Goats, feral pigs and emus are counted, along with kangaroos
- Aerial surveys are conducted over 22 fixed monitoring blocks, covering an area of 136,000 km²
- Surveying blocks range in size from 5,000 to 10,000 km^2
- Blocks flown since 1991 are shaded in . Additional blocks flown since 2003 are unshaded. Paired blocks flown in alternate years are indicated with letters. The remaining blocks are flown annually
- In each helicopter survey block, between two to eight east-west running 50–90 km transect lines have been placed systematically 10 km apart
- The surveys used line transect sampling, and the data are analysed using the program DISTANCE. Detection functions are determined for each survey block across years, and these provide a correction for the number of goats seen
- Figure 3 shows the area to where goat density in survey blocks is extrapolated to estimate numbers in the Mulga lands, Mitchell grass downs and brigalow belt bioregions (T. Pople, personal communication, April 4, 2023).

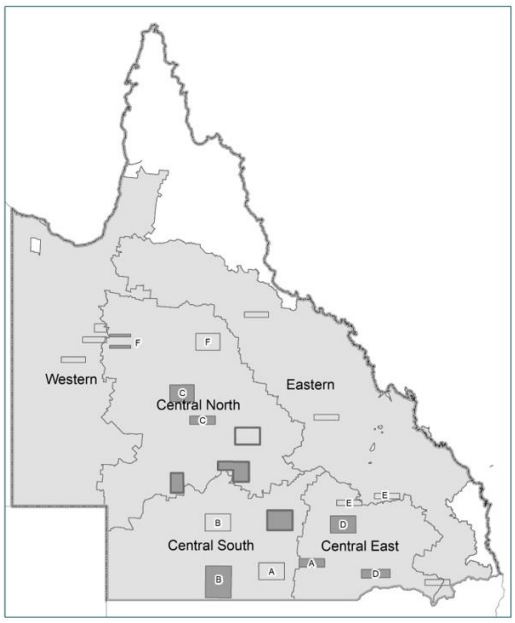

Figure 2 Helicopter survey blocks flown in Qld to estimate kangaroo and goat abundance

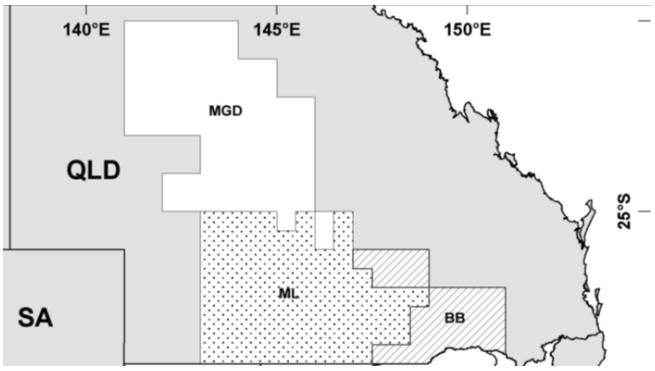

Figure 3 Area to where goat density in survey blocks is extrapolated to estimate numbers in the mulga lands (ML), Mitchell grass downs (MGD) and brigalow belt (BB)

South Australian Aerial Survey Method Summary

- Fixed-winged plane and two observers (either side of the plane)
- Strip surveying – 200 m fixed strip
- Core areas are flown each year (South Flinders, Eastern Districts, North East Pastoral), with sub-regions surveyed on a three- year rotation (Gawler Ranges, Kingoonya, Maree- inside dog fence, North Flinders Ranges)
- Differences in habitat type are not accounted for in the analysis, and no correction factor is applied. A constant density of goats across the landscape is assumed when developing density and population estimates per sub-region. Data is grouped into 2 km^2 units
- Observers are looking primarily for kangaroos, while they do count other species, the kangaroos are their priority, and they won't count other species if they don't have time

3.1.7 Average carcase weight

In order to report the average carcase weight of goats processed in each state, the project team searched for data sources. There were no datasets available that directly recorded individual carcase weights. A carcase weight estimation was obtained by dividing production (tonnes cwt) by the

slaughter totals. This method is also used by MLA and NSW DPI's Insights and Industry Analysis team to report carcase weight estimations. Australian Bureau of Statistics (ABS) data, obtained from the MLA statistical database, was used for consistency.

3.2 Objective 2 – Report data quarterly

3.2.1 The number of goats supplied for processing from each state

The number of goats supplied for processing from each state was determined and reported every quarter using the method outlined in section 3.1.1, except PowerBI was used to graph yearly, quarterly or monthly time-series for each state. The total number of goats processed according to the NLIS data was compared to the DAFF levy data totals to evaluate and refine the accuracy of the data and collation methods.

3.2.2 The number of goats processed in each state

The number of goats processed in each state was collated from the 'levy' data reports provided by DAFF. For each state, PowerBI was used to collate and present this information as yearly, quarterly and monthly time-series graphs.

3.2.3 The proportion of goats entering the supply chain via depot, direct consignment, or saleyard

The proportion of goats entering the supply chain via a depot, direct consignment or saleyard was determined using ISC data. An excel spreadsheet was used to categorise the source of movements to a processor and to collate the number of goats consigned via a depot, direct consignment or saleyard. A move from a depot was identified if the source PIC belonged to a depot (i.e., SourceGoatDepot = Y). A movement from a saleyard was identified if it occurred through a saleyard (i.e., SyInOut = Y). Other movements were assumed to be direct consignments from properties.

3.3 Objective 3 Coordinate and support the national Forecasting Committee and Stakeholder Panel

3.3.1 Forecasting Committee

The National Goatmeat Supply Forecasting Committee met annually to estimate the number of goats that would be supplied for processing in the coming year. The Committee consists of six representatives (Table 1) from various supply chain sectors.

The project team supported the Forecasting Committee by developing a forecasting process tailored for the goatmeat industry and facilitating the Committee meetings. At each meeting, the team informed the Committee's estimates by:

- Delivering a comprehensive analysis of supply and processing data
- Providing modelling that quantified projected supply for the coming year and a detailed review of the previous year's forecasts against actual processing figures
- Providing population estimates and projecting the NSW population one year into the future
- Organising presentations from specialist stakeholders on topics, including export markets and population changes

This information was integrated with the Committee's industry intelligence and knowledge to formulate the forecasts. The Forecasting Committee also received quarterly reports that provided supply, processing and export updates, as well as a review of their forecast estimates against actual processing data. The Committee reviewed the performance of the estimates and adjusted key messages if supply circumstances changed during the year.
. The Committee scrutinised the project's data reporting and provided feedback about the data's usefulness and reliability for decision-making, which was used to improve the reporting.

Table 1 National Goatmeat Forecasting Committee representatives

John Blore	Depot Operator and goat producer – Silverton Goats and Belmont Station, Broken Hill NSW
Susan Howard	Goat Producer and NSW Farmers goat Committee representative – Moonavale Station, Wilcannia NSW
Rick Gates	Depot Operator and goat producer – Gates goats; Burndoo Station, Wilcannia NSW
Paul Mannion	Goat producer and contract musterer – Nundora Station, Broken Hill NSW; Mannion Goating
Campbell McPhee	Processor - Managing Director, Western Exporter, Charleville Queensland
Rob Newton	Depot Operator and goat producer– Summerville Station, Bourke NSW

3.3.2 Forecasting

Supply modelling was conducted to support the forecasting process. Niall Cummings, NSW DPI's Senior Analyst- Data and Insights, generated the analysis and provided updates to the Forecasting Committee.

Data Sources

The time series forecasts and supply response model required data on goat slaughter, over-the-hook prices, and climatic data. DAFF provided slaughter data using levies data. Over-the-hook prices were sourced from MLA. Climactic data was originally sourced from VegMachine, a project that used satellite imagery to track changes in the Australian rangelands. In 2022, data from VegMachine was not available, and vegetation data was sourced from Geoscience Australia's DEA Land Cover (Landsat), and rainfall data was sourced from the Bureau of Meteorology.

Time Series Forecasts

Time series models were used to generate forecasts of goat slaughter that could be presented to the Committee for consideration, consistent with Objective 3. Goat slaughter forecasts were presented for the next financial year. Multiple statistical methods were used for the forecasts, listed below.

- Holt-Winters (Exponential smoothing)
- Autoregressive integrated moving average (ARIMA)
- Centred Moving Average (5 quarter moving average)

A simple average of the above methods was also calculated. Forecast accuracy has been shown to increase by using an average of different forecast methods (Hyndman and Athanasopoulos 2021).

Data were partitioned into a training set and a test set (which contained the final year of observations). Forecasts were generated using the training set, then compared against the test set before they were presented to the Committee.

In 2022, the method was changed to train the models on all available data due to a trend break that would have generated forecasts that were not credible. The time series forecasts of goat slaughter were generated each year using the 'forecast' statistical package in R.

Supply Response Model

The supply response model shows how goat slaughter is affected by factors such as price or weather. It is a model of how producers respond to factors that influence the profitability of goat production. Changes in the goat price, green vegetation or rainfall have some influence on future goat slaughter.

The supply response model was estimated using linear regression, and the model specification was an autoregressive distributed lag model. The supply response model was implemented using R statistical programming language.

3.4 Objective 4: Modelling of various scenarios undertaken to make informed recommendations regarding changes to industry practice and the forecasted impact of those changes

The supply response model (described in section 4.3) and the Integral Projection Model (IPM) (described in section 4.4) both allowed the comparison of alternative scenarios. This presented an opportunity to develop scenario planning tools to support forecasting and decision-making.

Two tools were developed and refined in consultation with the Forecasting Committee to assist the industry with scenario planning.

- A Goat Supply Forecast Scenario Tool based on the supply response model was developed in Excel. This tool allowed users to enter scenarios for the goat price or rainfall in western NSW and examine how these alternatives are forecasted to influence supply.
- Shiny, an R package developed by RStudio, was used to transform the IPM into a dynamic, web-based application. This new Goatsim tool enables users to simulate the dynamics of both unmanaged and managed goat populations while investigating various management alternatives.

3.5 Objective 5: Conduct population model analysis, development and evaluation

In 2020 and 2021, a Bayesian state-space model fitted to time series was used to predictthe size of the population one year into the future. In 2022/23, an IPM was developed for projecting population changes. IPM are individual-based models that combine vital rates as a function. Integral Projection Models combine separate functions of growth rate, fecundity, recruitment and survival to predict the dynamics of a population by scaling-up individual level observations to population level dynamics. IPMs require demographic data, including growth, reproduction and survival rates. The methods used to develop the IPM are described in Appendix 2.

Objective 6: Establishment of a cost-effective, efficient and sustainable forecasting model/system for the long term

At the start of the project, there was an expectation to establish a project legacy that reduced the direct cost of providing the information and resources to the goatmeat sector. Ultimately, MLA and the project team would like to set up an approach that delivers the information without investing time or resources.

The project team explored options for automating the data reporting and documented the limitations and trade-offs associated with a set-and-forget, zero-investment approach. The project team developed recommendations to maintain the data reporting and forecasting after the completion of the project. The team consulted with GIRDAC and MLA during the development of the recommendations.
Table 2 outlines the main activities the project team have completed to progress the implementations of the recommendations.

Table 2 Actions the project team have completed to progress a proposal to continue Goat Data Collation and Tracking

Date	Action
20/12/2022	Attended a preliminary meeting with MLA about B.GOA.0131 project's completion and recommended next steps
7/02/2023	Provided MLA and GIRDAC with a project proposal document– MDC funded budget
9/02/2023	Presented the project proposal to GIRDAC
3/03/2023	Attended a meeting with MLA – feedback from GIRDAC presentation and feedback
11/04/2023	Provided MLA and GIRDAC with an updated preliminary project proposal document– levy funded budget
11/04/2023	Received feedback from MLA and a request to progress a full project proposal
14/06/2023	Submitted a full project proposal to MLA

4. Results

Objective 1 and 2

4.1 Objective 1 report the goatmeat industry annually:

4.1.1 The number of goats supplied for processing from each NLIS region

Access to the NLIS database and the collation methods developed and refined in this project have greatly changed the industry's capacity to quantify regional supply. Before the project, the industry was unable to quantify supply from each state on an annual basis. The project has enabled monthly, quarterly and yearly tracking and mapping of supply from each NLIS region. The number of goats supplied for processing from each NLIS region in Australia over the last two financial years are shown in **Error! Reference source not found.** and 5.

The mapping shows key production regions. For example, the top five production regions in 2021/22 were Cobar, Bourke, Wilcannia, Broken Hill and Balonne, each supplying over 100,000 goats for processing (ISC 2022).

In addition, comparing regional supply between years has identified production growth areas. For example, supply growth was highest in the Cobar and Balonne regions between 2020/21 and 2021/22 (Figure 6). Both these regions increased turn-off by more than 50,000 goats year-on-year, a 27% increase for Cobar and a 103% increase for Balonne. Most other leading production regions also

recorded substantial supply increases compared with the previous year, including Broken Hill (46%), Hillston (67%), Wilcannia (12%) and Paroo (28%). There were also several regions adjacent to the main production areas where supply expanded substantially, albeit from a lower total number, such as Longreach (91%), Murray (69%), Maranoa (84%) and Goondiwindi (457%) (ISC 2022).

The data were also used to track where goats from each regions were sent for processing. In 2021/22, goats supplied from the Broken Hill region were processed in Vic (77%) or SA (23%). Goats supplied from the Bourke region were processed in Vic (33%), Qld (32%), NSW (22%) and SA (13%). Goats sourced from the Cobar region were mainly processed in Vic (93%), with the remainder processed in NSW (4%), Qld (3%) and SA (<0.5%) (ISC 2022).

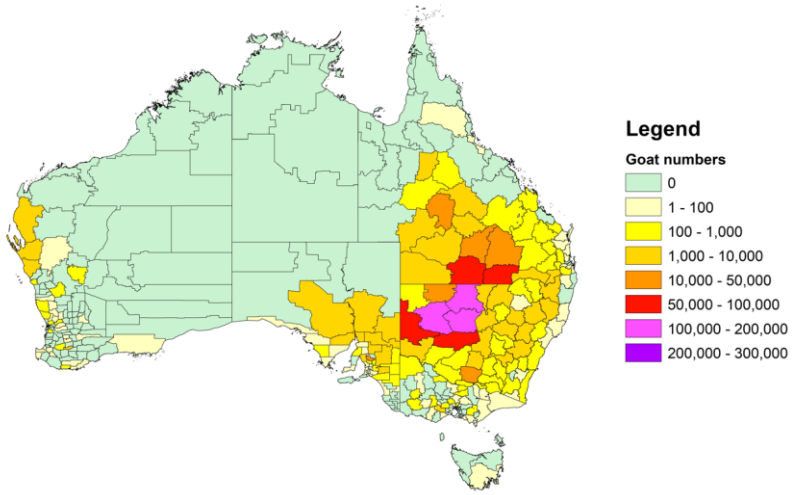

Figure 4 The number of goats supplied for processing from each NLIS region in the 2020/21 financial year (Data source: ISC)

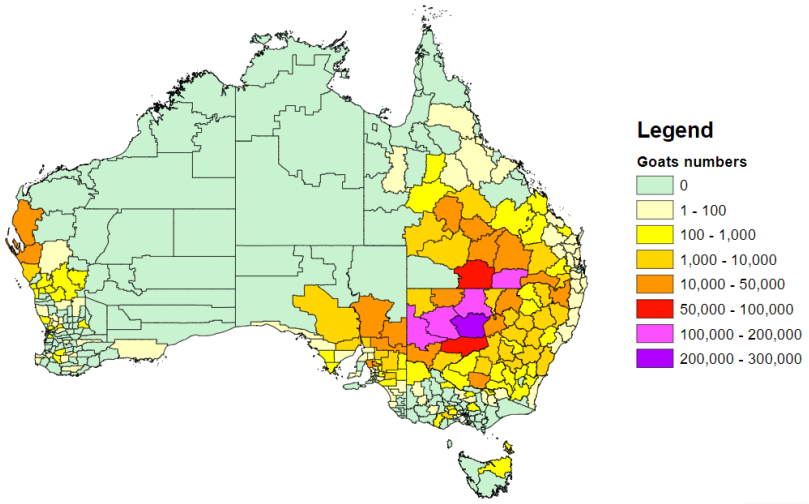

Figure 5 The number of goats supplied for processing from each NLIS region in the 2021/22 financial year (Data source: ISC)

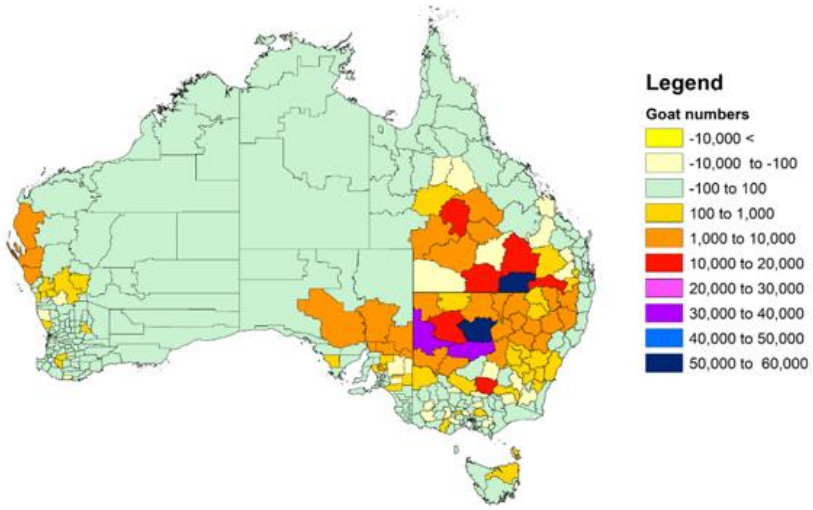

Figure 6 The change in the number of goats supplied for processing from each NLIS region between 2020/21 and 2021/22 (Data source: ISC)

4.1.2 The number of active suppliers (all states)

In all states, the number of active suppliers, represented by the number of unique producer PICS, decreased between 2019/20 and 2020/21 (Table 3). This decline aligned with the reduced number of goats supplied in 2020/21 compared to the previous year. The number of active supplies increased between 2020/21 and 2021/22 as supply rebounded from the low level in 2020/21.

While the project team and the Forecasting Committee monitor the number of active suppliers for any major changes, the information doesn't heavily influence supply forecasts. Understanding the actual number of goats supplied is more critical than the number of suppliers.

Table 3 The number of active supply properties (unique producer PICS) per state (Data Source: ISC)

Financial Year	NSW	Qld	SA	WA	VIC
2019-20	2087	643	354	139	696
2020-21	1432	566	286	99	222
2021-22	1601	606	357	115	131

4.1.3 Number and location of active depots

The number of active depots can be reported using the NLIS data, and the numbers have been reasonably stable (Table 4Table 4 The number of active depots (unique depot PICS) per state (Data Source: ISC). The data indicated that there was 36 active depots in 2021/22. In NSW, there were 30 active depots totalled using the NLIS data. The NSW DPI's list of registered depots totalled 35. However, some registered depots may not have traded goats in 2021/22.

Table 4 The number of active depots (unique depot PICS) per state (Data Source: ISC)

Financial Year	NSW	Qld	SA	WA	VIC
2019-20	27	1	3	0	0
2020-21	29	4	3	0	0
2021-22	30	3	3	0	0

4.1.4 The number of properties with managed herds (NSW only)

The Stock and Land Return data showed the number of managed goats reported in NSW has increased from 263,206 in 2017 to 523,761 in 2022 (Figure 7). While the totals were reasonably static from 2017 to 2020, reported goat numbers more than doubled from 2020 to 2022. Over the same period, the number of holding running goats increased from 2,864 to 3,269 (Figure 8).

While it is broadly acknowledged that the data under-reports the total number of managed goats and holdings with goats, it has helped understand trends. The increase in managed goats aligns with anecdotal reports of a significant shift into semi-managed or managed enterprises during the 2020/21 financial year and the increase in goat supply (Atkinson *et al.* 2022). However, it may also represent an attitudinal shift, with producers more willing to report managing goats as the viability and value of goatmeat increased.

The Stock and Land Return data also helped to understand the industry's structure. For example, an analysis of the 2022 NSW Stock and Land Return data showed 65% of holdings managed ten or fewer goats, while only 4% had 1000 or more goats. This demographic information, presented on a regional basis, has been used for targeting extension activities and biosecurity planning.

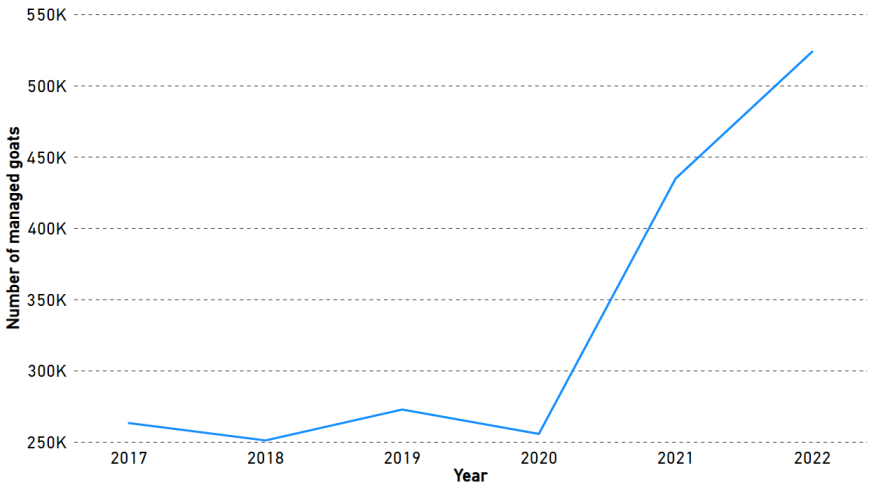

Figure 7 The number of managed goats reported in Stock and Land Returns from 2017 to 2022 in NSW (Data Source: BioMap 2022)

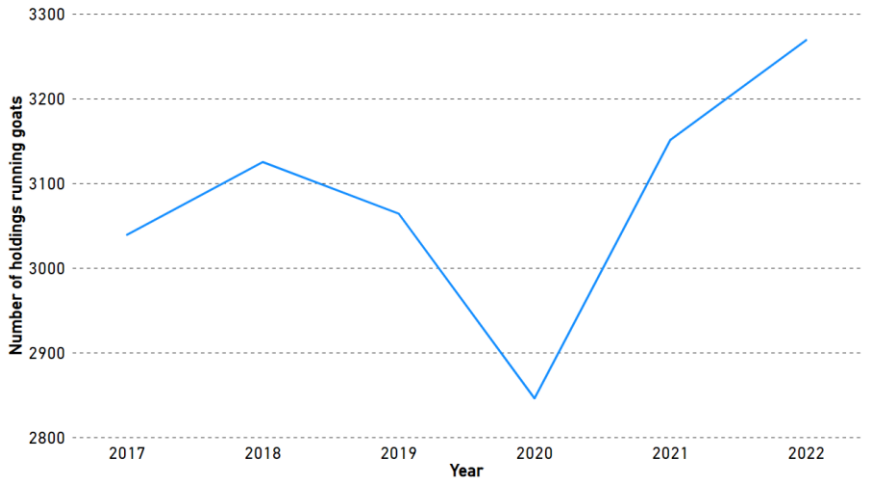

Figure 8 The number of holdings that reported running goats in Stock and Land Returns from 2017 to 2022 in NSW (Data Source: BioMap 2022)

4.1.5 The estimated proportion of managed goats (according to NVD reporting)

The project team aggregated the 'bred on source' by region (Figure 9) to test its capacity to reflect the proportion of managed goats marketed for processing. This approach was tested because no reliable datasets report managed goat numbers in Australia. However, the project team and the forecasting committee had low confidence in using this data to estimate the proportion of managed goats. There was uncertainty about the assumption that the producer's responses to the question could reflect managed goat production. Another issue was that there were no reliable benchmarks to compare the data against to ensure the outputs represent managed goats.

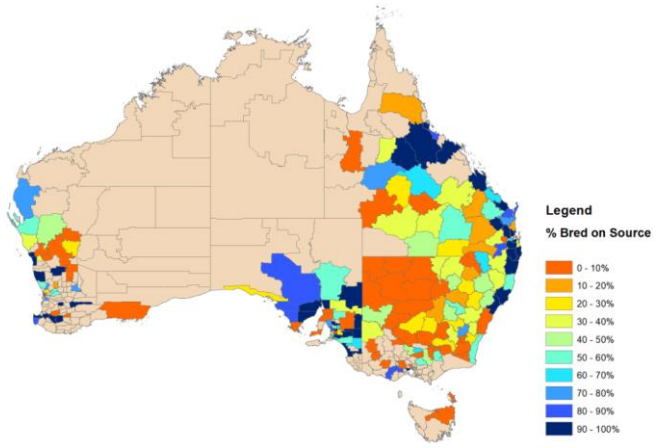

Figure 9 The percentage of goats sent to processing during 2021/22 that were 'bred on source'

4.1.6 Goat population estimates (NSW, SA and Qld)

Understanding goat population trends is vital for projecting supply, particularly when those estimates can be complemented with industry intelligence to understand producer's decisions about the retention and sale of animals in harvest and managed enterprises.

The most recent estimates of goat abundance suggest that there are over 9 million in the surveyed zones of NSW (8.77 M), Qld (0.88 M) and SA (0.15 M). In NSW, goat numbers have recovered strongly after the population declined during the 2018-2019 drought (Table 5). Overall numbers in Qld have risen sharply since 2019, driven by a 46% rise in the estimated goat abundance in the Mulga bioregion (Table 6). Between 2019 and 2021, the goat numbers increased in South Australia's North East Pastoral and South Flinders sub-regions, while the population decreased in the Eastern Districts and North Flinders (Table 7).

The aerial surveying was conducted at no cost to the goatmeat industry. This project has utilised this resource to provide a key indicator of population trends. While the aerial survey methods are designed to estimate kangaroo abundance, they reasonably indicate how goat populations change over time. Generally, the aerial survey analysis reported population changes in line with the Forecasting Committee's perceptions of goat abundance.

Table 5 The estimated number of goats in each Kangaroo Management Zone of NSW from 2020 - 2021. (Data Source: Office of Environment and Heritage)

	2020				
Kangaroo Management Zone	**Estimate**	**se**	**cv**	**lcl**	**ucl**
Bourke	922,680	207,950	0.23	589,630	1,443,800
Broken Hill	1,134,200	279,630	0.25	699,650	1,838,500
Cobar	1,196,500	246,500	0.21	790,910	1,810,000
Coonabarabran	72,566	27,101	0.37	35,104	150,010
Griffith North	78,491	94,609	1.21	12,198	505,050
Griffith South	0	0	0	0	0
Lower Darling	842,370	204,720	0.24	523,350	1,355,900
Narrabri	148,070	72,918	0.49	58,614	374,060
Tibooburra	23,160	23,177	1	4,344	123,460
Total	4,418,000	554,760	0.13	3,454,800	5,649,700

	2021				
Kangaroo Management Zone	**Estimate**	**se**	**cv**	**lcl**	**ucl**
Bourke	1,242,300	204,380	0.16	892,590	1,729,100
Broken Hill	1,540,000	313,420	0.2	1,029,100	2,304,500
Cobar	1,681,700	319,050	0.19	1,146,200	2,467,300
Coonabarabran	36,234	19,664	0.54	13,041	100,680
Griffith North	166,560	74,745	0.45	70,477	393,650
Griffith South	0	0	0	0	0
Lower Darling	621,250	140,550	0.23	397,200	971,670
Narrabri	284,660	118,880	0.42	127,510	635,480
Tibooburra	1,294,900	293,680	0.27	826,710	2,028,200
Total	6,867,600	619,780	0.09	5,750,600	8,201,700

	2022				
Kangaroo Management Zone	**Estimate**	**se**	**cv**	**lcl**	**ucl**
Bourke	1,444,183	255,576	0.18	1,013,285	2,058,321
Broken Hill	1,776,620	286,288	0.16	1,289,701	2,447,372
Cobar	1,896,751	361,502	0.19	1,290,577	2,787,640
Coonabarabran	79,345	43,702	0.55	28,207	223,198
Griffith North	330,328	124,795	0.38	158,522	688,336
Griffith South	-	-	0.00	-	-
Lower Darling	1,396,421	250,725	0.18	977,595	1,994,682
Narrabri	290,695	114,319	0.39	135,846	622,053
Tibooburra	1,556,534	386,766	0.25	953,350	2,541,352
Total	8,770,876	756,831	0.09	7,402,783	10,391,804

se- standard error; cv- coefficient of variation; lcl-Lower confidence level; ucl- upper confidence level

Table 6 The estimated number of goats in the Brigalow belt, Mitchell grass downs and Mulga lands bioregions of Qld from 2019 to 2021. (Data Source: Department of Water and Environment)

Bioregion	**2019**	**2020**	**2021**
Brigalow Belt	147,077	122,302	109,205
Mitchell grass downs	38,751	38,751	37,702

Mulga lands	432,858	665,165	733,144
Total	618,686	826,218	880,051
se	305,878	441,011	418,696

se- standard error

Table 7 The estimated number of goats in each pastoral zone sub-region of South Australia (uncorrected count data) from 2019- 2021. (Data Source: Department of Water and Environment).

Region	**2019**	**2020**	**2021**
Eastern Districts	12,079	11,617	11,529
Gawler Ranges	48,560	-	-
North East Pastoral	54,403	44,387	68,869
North Flinders Ranges	16,455	-	10,066
South Flinders	6,603	9,385	9,711
Grand Total	107,403	167,071	147,466

4.1.7 Average carcase weight

The estimated average carcase weights calculated for each state are presented in Table 8. The simple estimation method indicates changes in carcase weight over time. However, access to individually measured carcase data linked to regional supply data would provide more comprehensive information about carcase weight.

Table 8 Estimated average carcase weight for each state per quarter (Data source MLA/ ABS)

Date	**Australia**	**NSW**	**Qld**	**SA**	**Vic**	**WA**
1/06/2019	13.9	14.1	14.6	12.5	14.0	14.0
1/09/2019	14.9	14.5	16.5	13.5	14.6	14.7
1/12/2019	15.5	14.7	17.1	13.8	15.4	15.8
1/03/2020	8.7	11.0	9.3	7.4	8.7	9.7
1/06/2020	26.9	28.8	30.7	21.0	25.7	29.5
1/09/2020	17.4	14.3	18.7	14.8	17.3	9.5
1/12/2020	16.8	13.1	16.4	16.7	17.2	13.4
1/03/2021	17.1	16.7	18.2	15.9	17.0	16.5
1/06/2021	17.0	15.1	18.6	15.6	16.5	28.6
1/09/2021	17.0	17.4	18.0	15.3	16.8	18.2
1/12/2021	17.0	14.4	17.8	15.2	17.0	12.5
1/03/2022	16.5	12.0	17.9	14.3	16.6	16.6
1/06/2022	15.5	12.6	16.8	15.3	14.7	16.1
1/09/2022	16.7	12.8	17.4	15.6	16.6	13.7
1/12/2022	19.1	16.4	17.8	15.6	20.3	15.3

4.2 Objective 2 Report to the goatmeat industry quarterly

4.2.1 The number of goats supplied for processing from each state

A challenge for the goat industry is the high volatility of goatmeat supply. The supply time-series graphs presented for each state show large annual and seasonal variations in supply (Figure 10 – 14).

These changes in supply were reported and examined in the published quarterly and annual reports on the project's web page. The supply information was valued and used extensively by the Forecasting Committee and industry.

From 2016 to July 2022, the industry's capacity to supply goats primarily determined the number of goats processed. Only during the 2022/23 financial year has the capability of processing and markets to absorb increases in supply been a major consideration.

A considerable number of goats move across state borders to be processed. The NLIS data was also used to understand and quantify these movements. In 2021/22, NSW delivered a substantial proportion of the goats processed in Vic (97%), Qld (20%) and SA (36%) (Table 9). Western Australia was the only state that did not source goats from another state (ISC 2022). This information was also important for informing traceability and biosecurity planning.

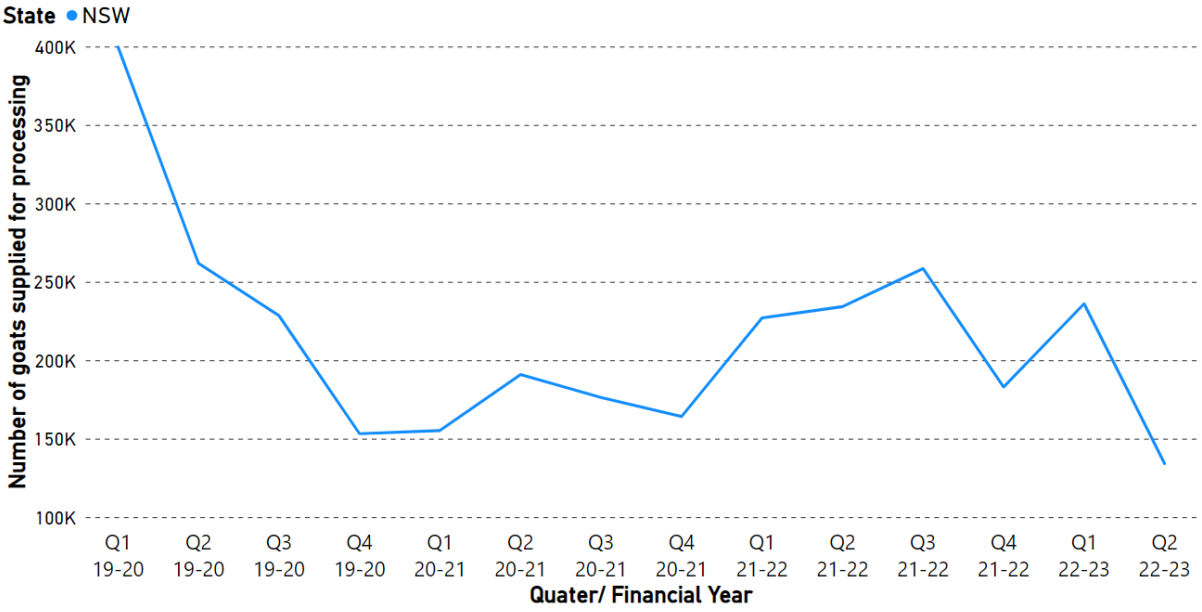

Figure 10 The number of goats supplied from NSW for processing – July 2019 to December 2022 (Data source: ISC)

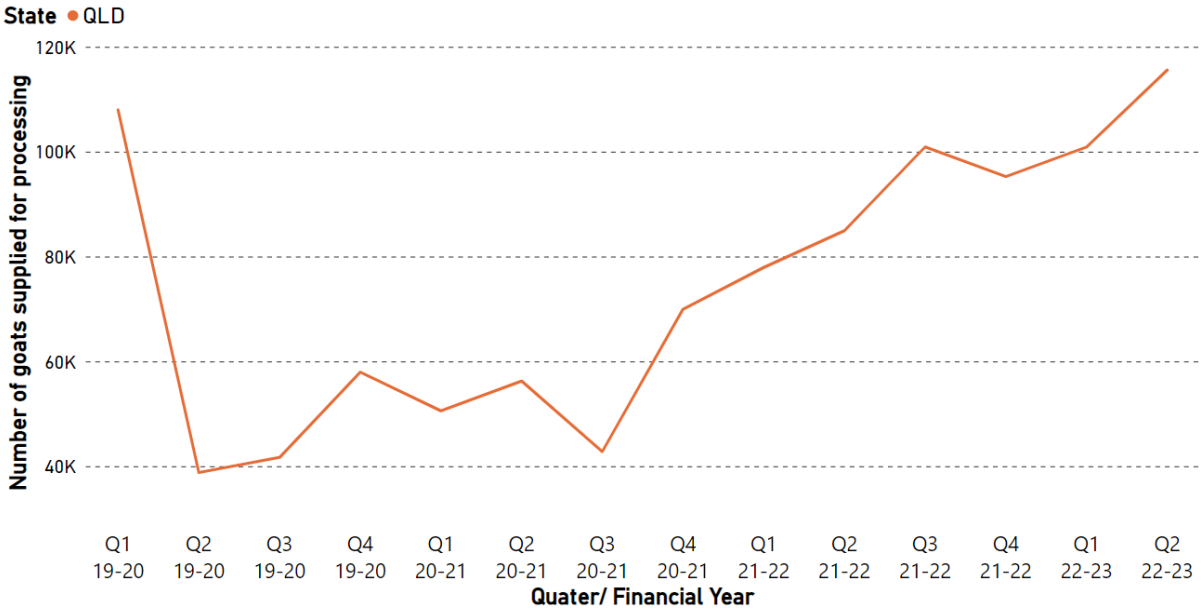

Figure 11 The number of goats supplied from Qld for processing – July 2019 to December 2022 (Data source: ISC)

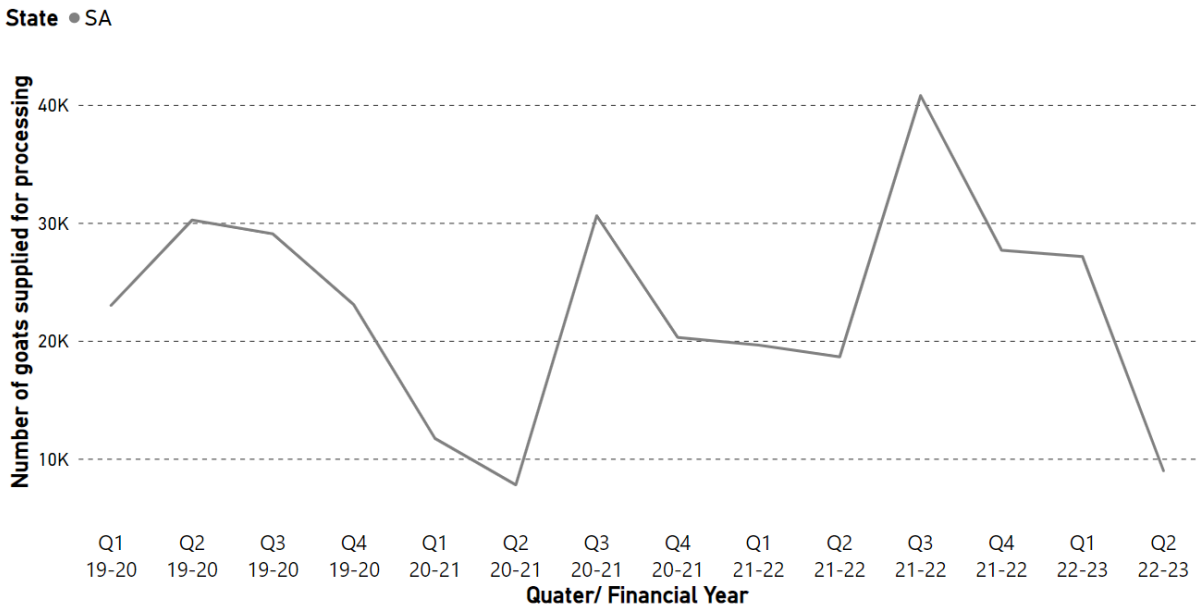

Figure 12 The number of goats supplied from SA for processing – July 2019 to December 2022 (Data source: ISC)

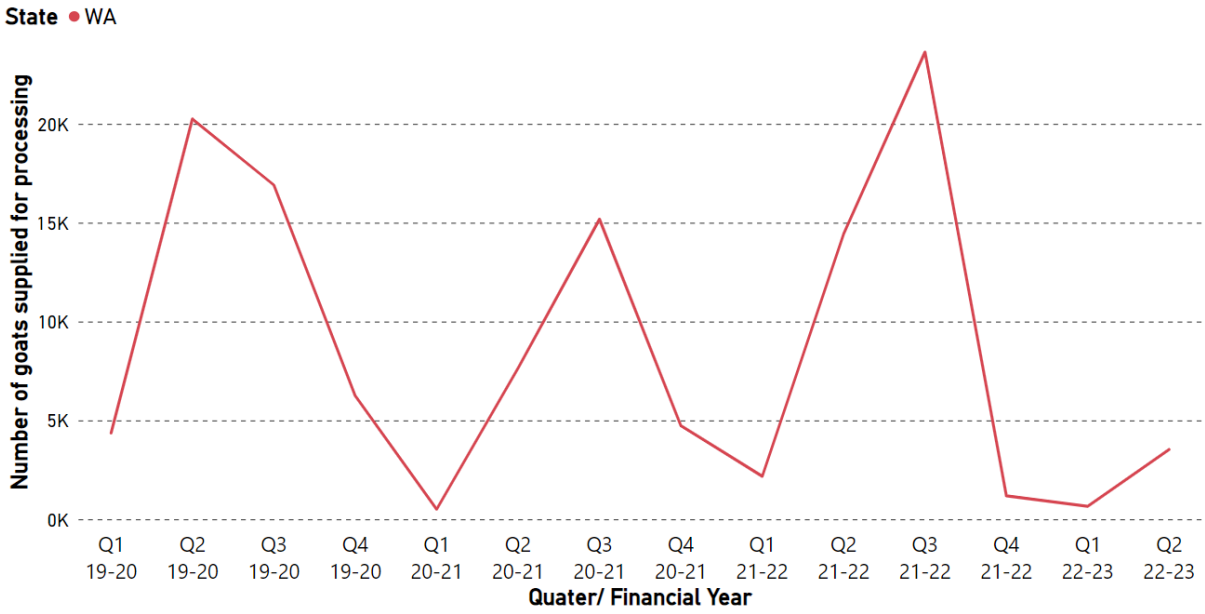

Figure 13 The number of goats supplied from WA for processing – July 2019 to December 2022 (Data source: ISC)

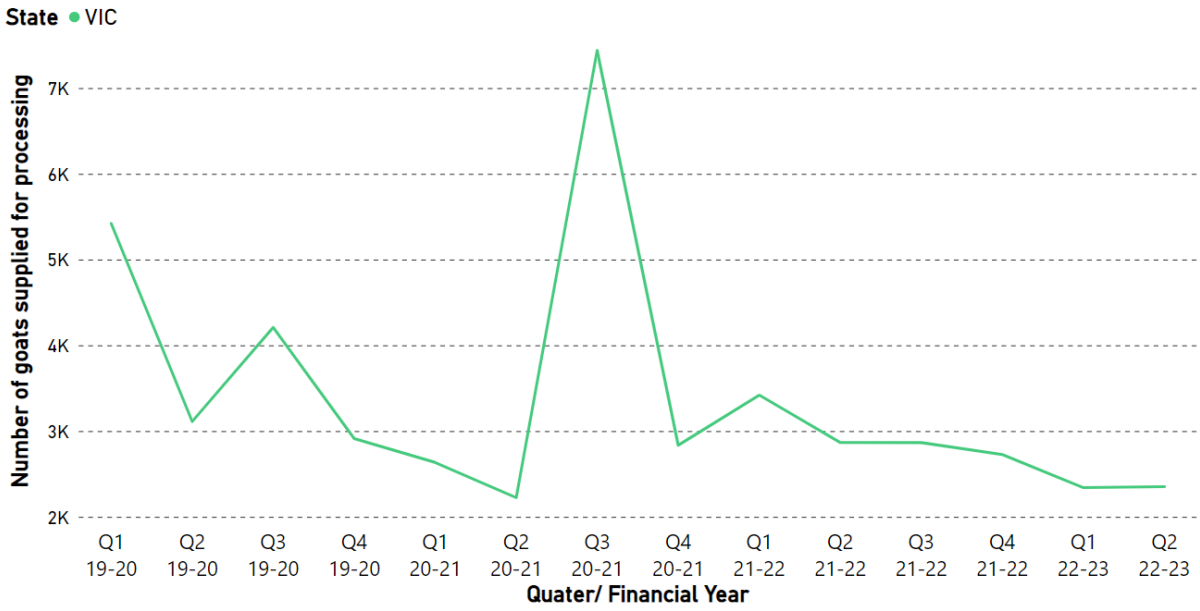

Figure 14 The number of goats supplied from Vic for processing – July 2019 to December 2022 (Data source: ISC)

Table 9 The percentage of goats slaughtered in each state which are sourced locally and from other states during the 2021/22 financial year (Data source: DAWE)

		Processing State				
		Vic	**Qld**	**SA**	**NSW**	**WA**
Supply State	**NSW**	97	20	36	98	
	Qld	<0.5	80	3	<2	
	SA	1		54	<0.5	
	Vic	1.5		1		
	WA	<0.5		6		100

4.2.2 The number of goats processed in each state

The number of goats processed in each state from quarter one 2019/20 to quarter two 2022/23 are presented in Figure 15 to 19. The Forecasting Committee considered the DAFF slaughter 'levy' data the most reliable source of processing data because the businesses pay a levy based on the data they report, and this reporting is audited.

Theoretically, the total number of goats supplied to processing from each state presented in section 4.2.1 should equal the sum of the goats processed in each state. While the totals from each data set closely align, they do not exactly match because the methods used to collect and collate the data are different. The variance is not causing any major issues for reporting supply and processing trends because the relationship is reasonably consistent.

The project team made considerable refinements to narrow the discrepancy between the NLIS and Levy data. Major improvements were achieved by working with ISC staff to include 'Killinfo' and 'CarcaseFeedback' data to complete the data set and refining the collation process to account for movements to processors only reported as 'Depot movements off PIC'. While options to address further the ongoing discrepancies between the two data sets have been exhausted in this project, a review of the reasons for differences may inform practical improvements to industry reporting and traceability.

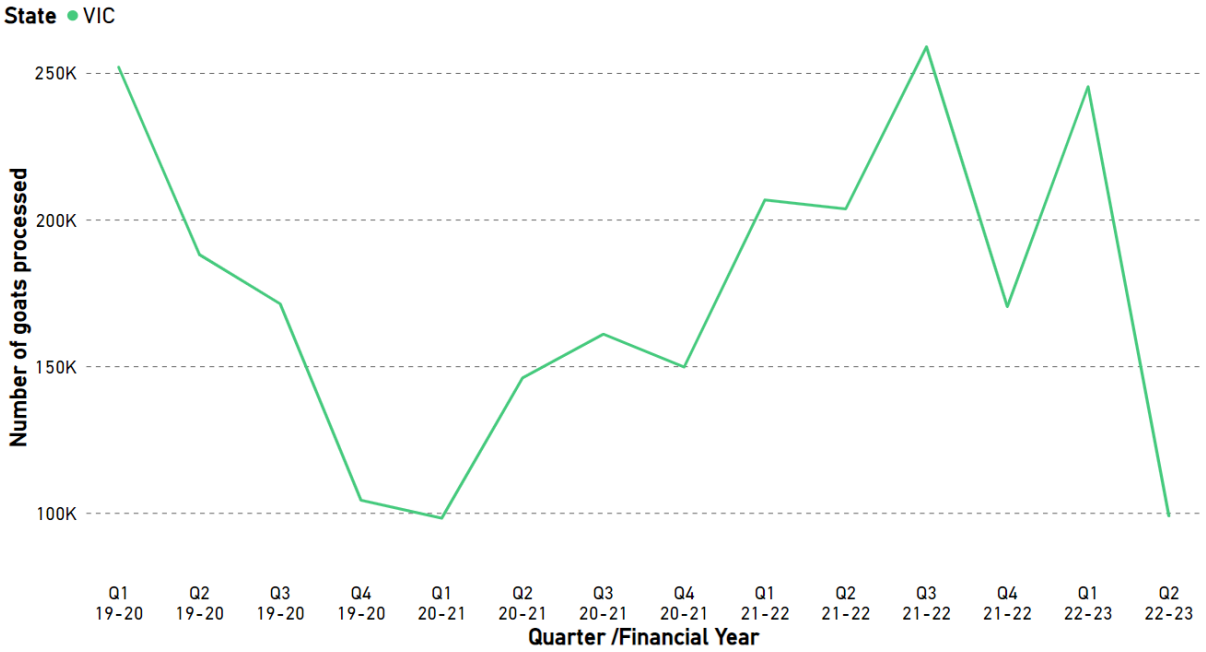

Figure 15 The number of goats processed in Vic from July 2019 to December 2022 (Data source: DAFF)

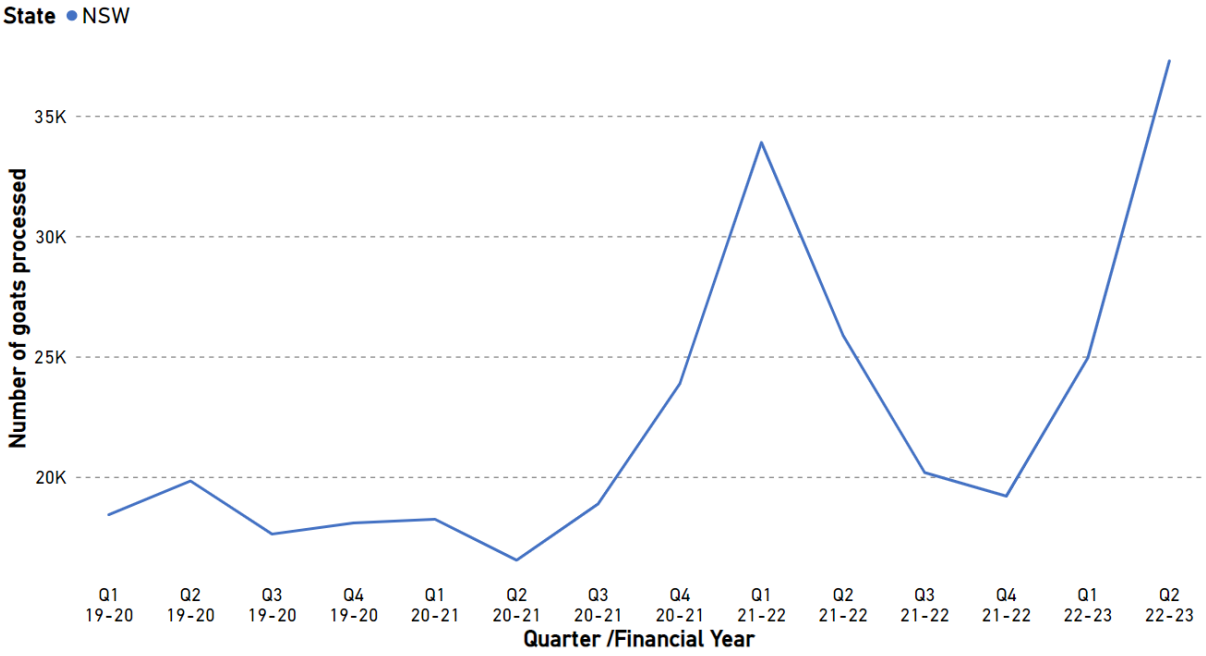

Figure 16 The number of goats processed in NSW each from July 2019 to December 2022 (Data source: DAFF)

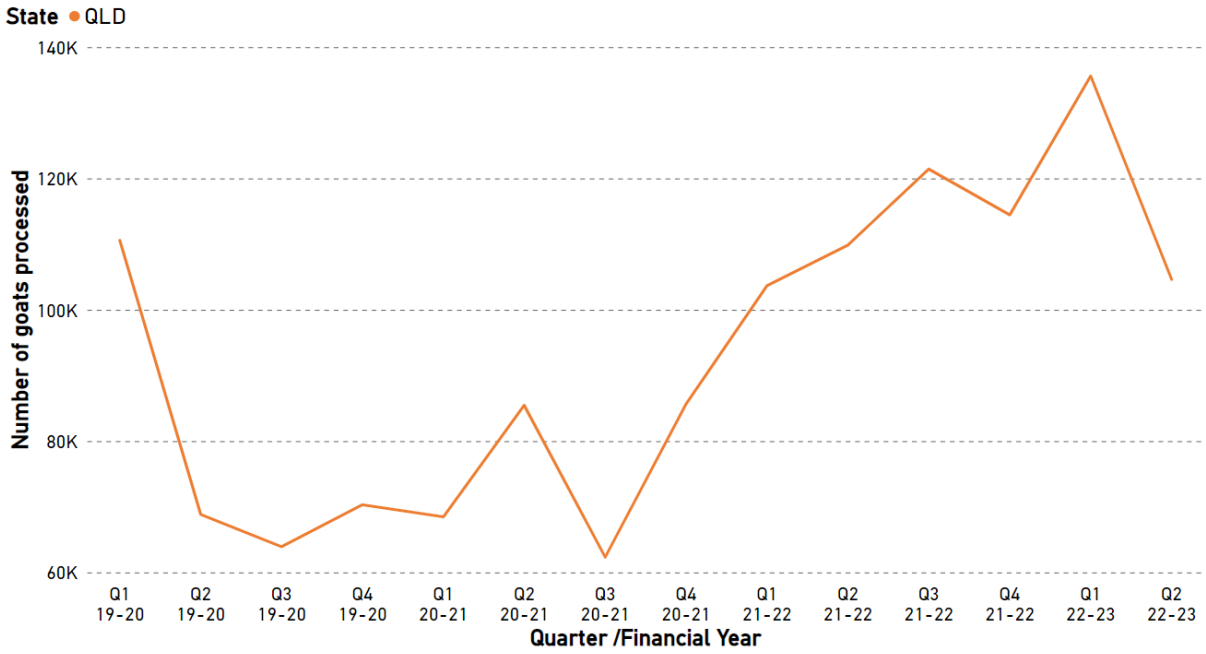

Figure 17 The number of goats processed in Qld from July 2019 to December 2022 (Data source: DAFF)

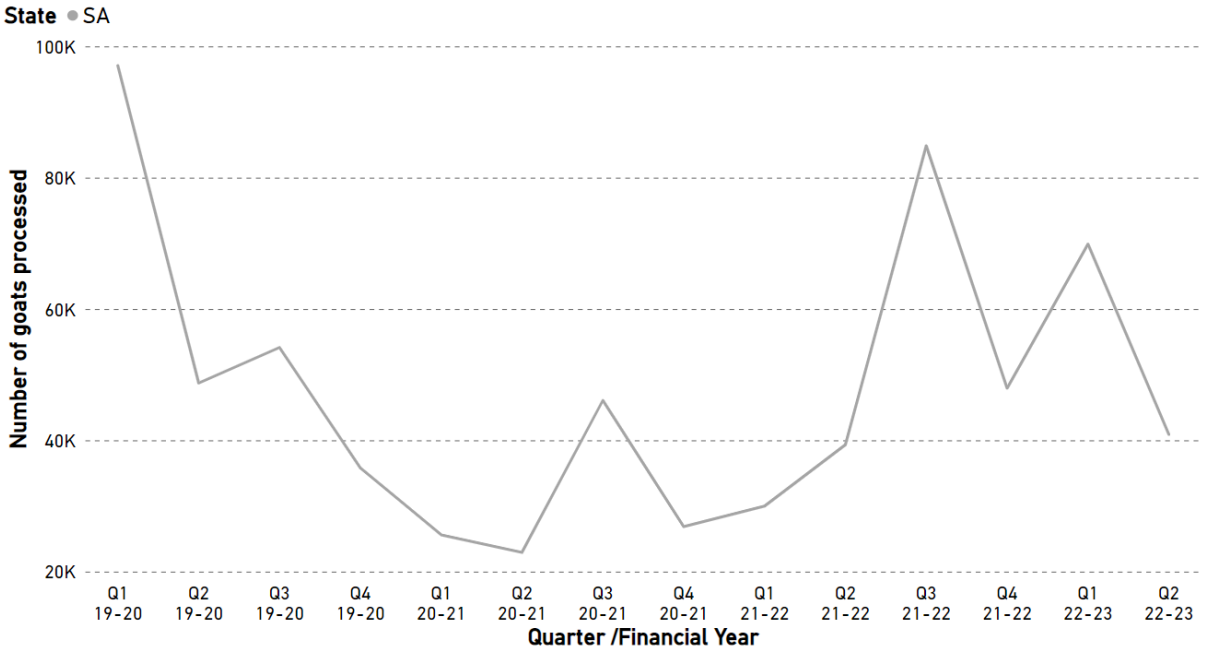

Figure 18 The number of goats processed in SA from July 2019 to December 2022(Data source: DAFF)

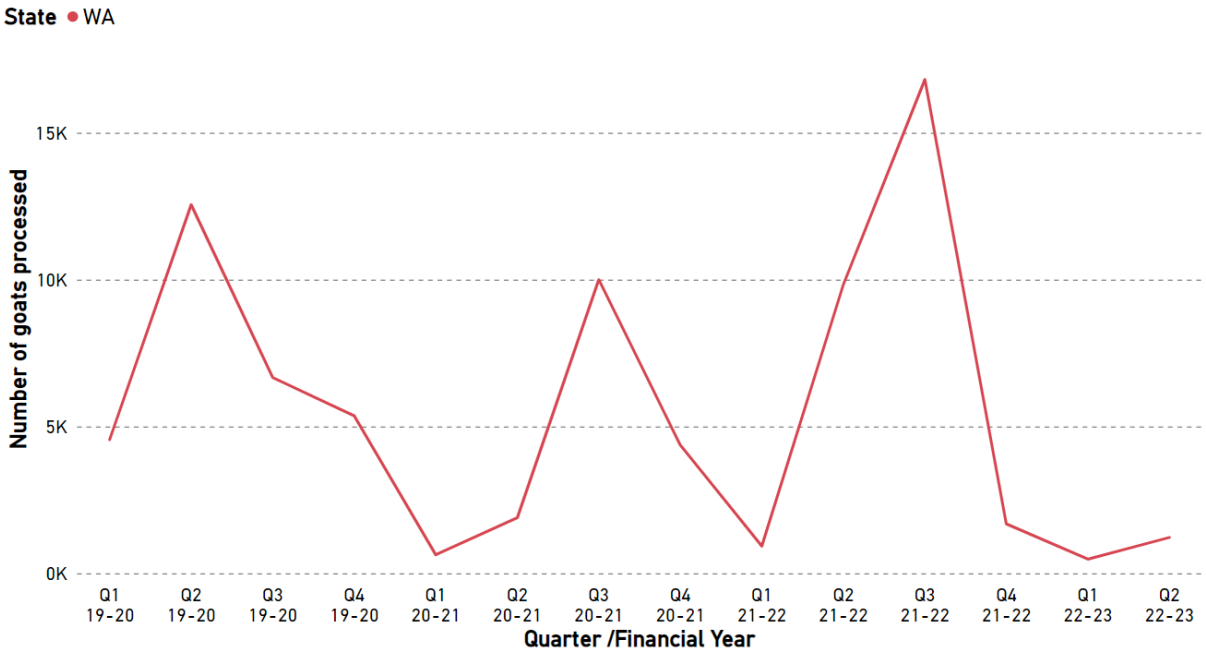

Figure 19 The number of goats processed in WA from July 2019 to December 2023 (Data source: DAFF)

4.2.3 The proportion of goats entering the supply chain via depot, direct consignment or saleyard

Goat movements to processing occur directly or via a depot or saleyard. In 2021/22, most goats (63%) were sent off-farm directly to processors. Depots play a more critical role in the goatmeat supply chain than saleyards, with relatively few movements (<0.5%) occurring through a saleyard. In particular, depots play a significant role in NSW and SA. During the 2021/22 financial year, NSW producers sent 53% of goats via a depot. Similarly, 43% of goats coming from SA were sent to a depot before slaughter. In Qld and WA, the proportion of goats supplied directly to processors was 98% and 100%, respectively (Figure 20 to 23).

While the proportions of goats consigned via each option have been reasonably stable during the project, a major change could indicate a shift in marketing preferences, supply chain relationships or the size of consignments. The Forecasting Committee reviewed the proportion of goats sent to a processor via a depot, direct consignment, or saleyard to track any early indicators of these major changes. The results aligned well with the Forecasting Committee's understanding of the supply chain movements in each state. The results further demonstrate the ability to track supply chain flows using NLIS data. This information also informed traceability and biosecurity planning.

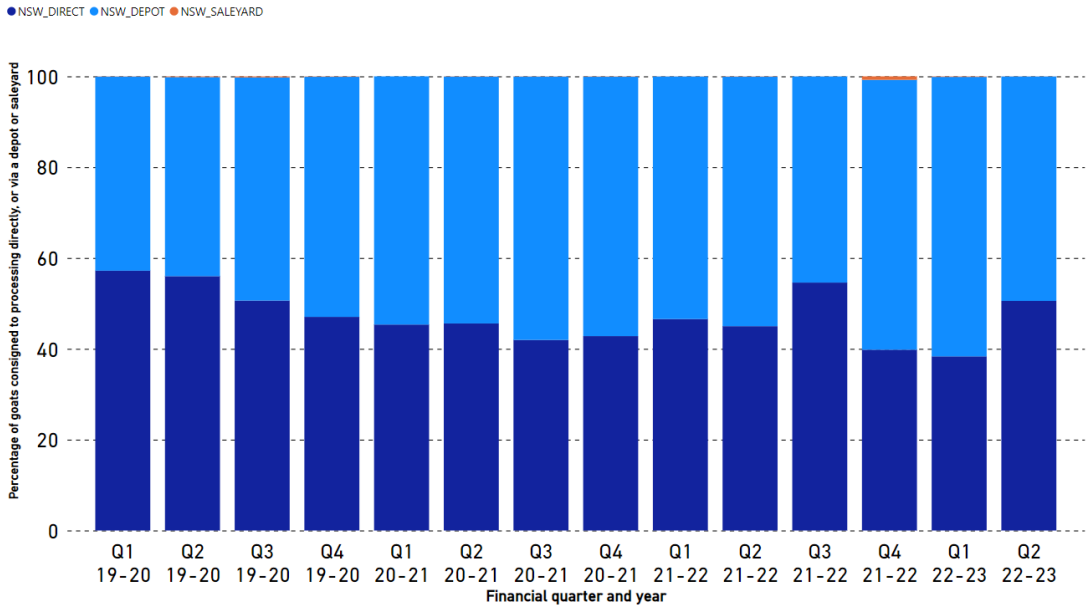

Figure 20 The percentage of goats consigned from NSW to processing directly, or via a depot or saleyard (Data Source: ISC)

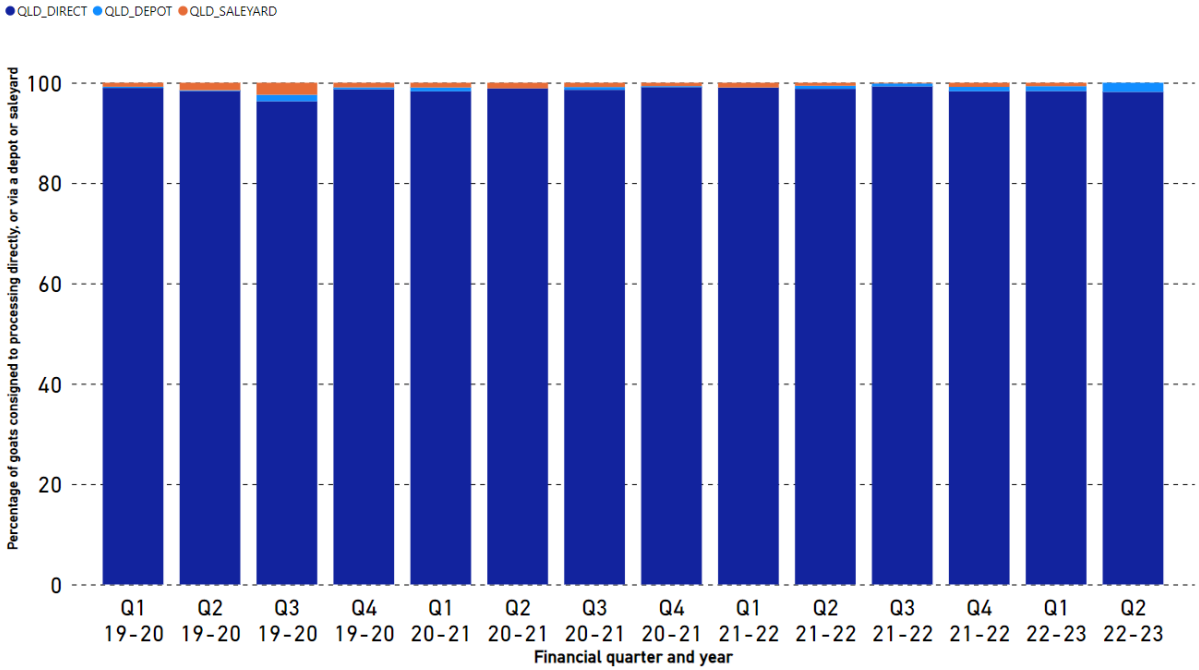

Figure 21 The percentage of goats consigned from Qld to processing directly, or via a depot or saleyard (Data Source: ISC)

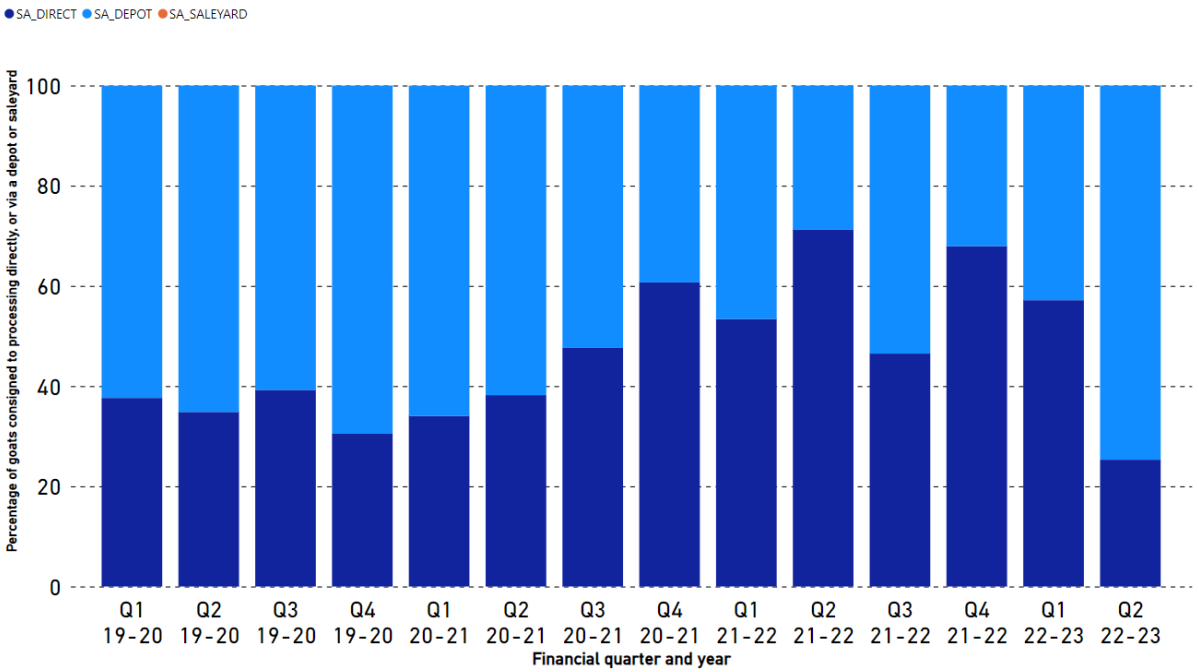

Figure 22 The percentage of goats consigned from SA to processing directly, or via a depot or saleyard (Data Source: ISC)

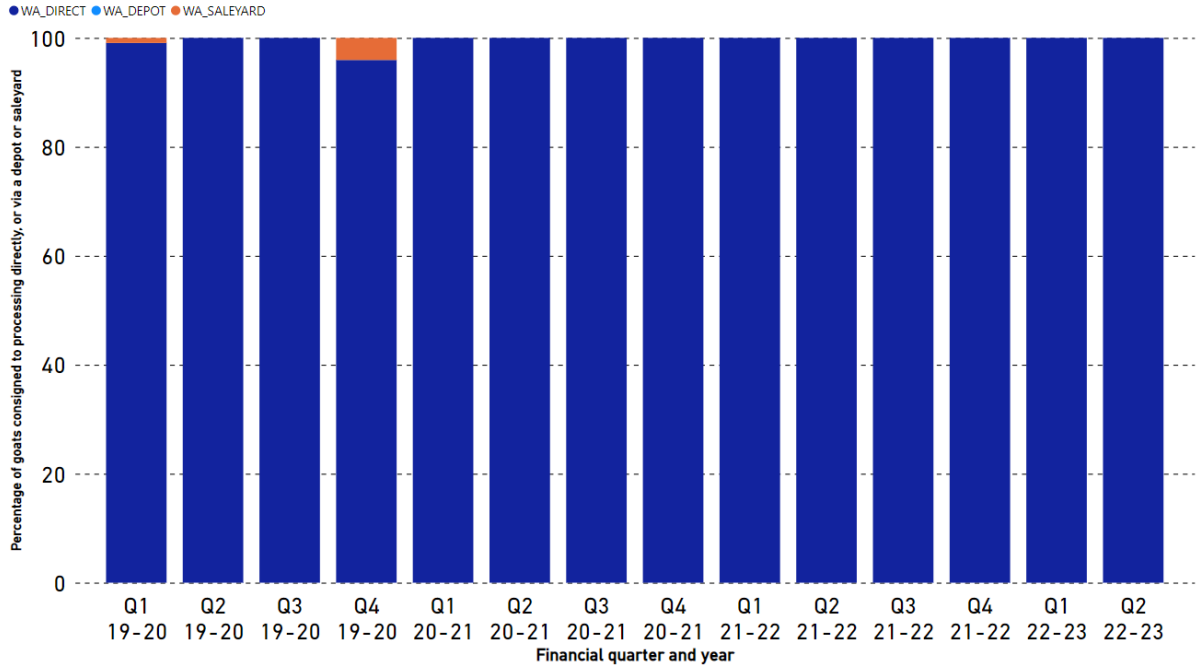

Figure 23 The percentage of goats consigned from WA to processing directly, or via a depot or saleyard (Data Source: ISC)

4.3 Objective 3: Coordinate and support the national Forecasting Committee and Stakeholder Panel Industry Supply Forecasting

Since its inception in 2016, the Committee has significantly increased its capacity to predict and understand supply and population trends, enhancing the goatmeat sector's strategic planning. In two of the last three years, the Forecasting Committee has achieved the objective of projecting supply within 10% of actual processing figures (Figure 24).

The Forecasting Committee estimated that the industry would supply 1.41 million goats for

processing nationally in the 2019/20 financial year, which was a projected 12% reduction from 2018-19. This forecast estimate was within 2% of the actual total (1.38 million).

The Committee forecasted that 1.32 million goats would be supplied for processing in 2020/21 but a review of the forecast against processing figures showed that realised supply was overestimated by 24%. Although the Committee and NSW DPI's modelling overestimated supply in 2020-21, the Forecasting Committee successfully anticipated and explained the factors that constrained supply during the year. The Committee had foreseen that herd-building would occur but underestimated the extent to which does were retained in NSW and Qld.

The Committee projected that the industry would supply at least 1.44 million goats for processing in the 2021/22 financial year (10% error), a good result given the uncertainty regarding supply recovery last year.

For this financial year, the Committee projects that the industry has the potential capacity to supply 2.3 million goats for processing, a 50% increase from the previous year. However, the Committee is closely monitoring several factors and trends associated with their 2022/23 projection, including the capacity of processing and markets to absorb the projected increase in supply, price and the impact of wet weather.

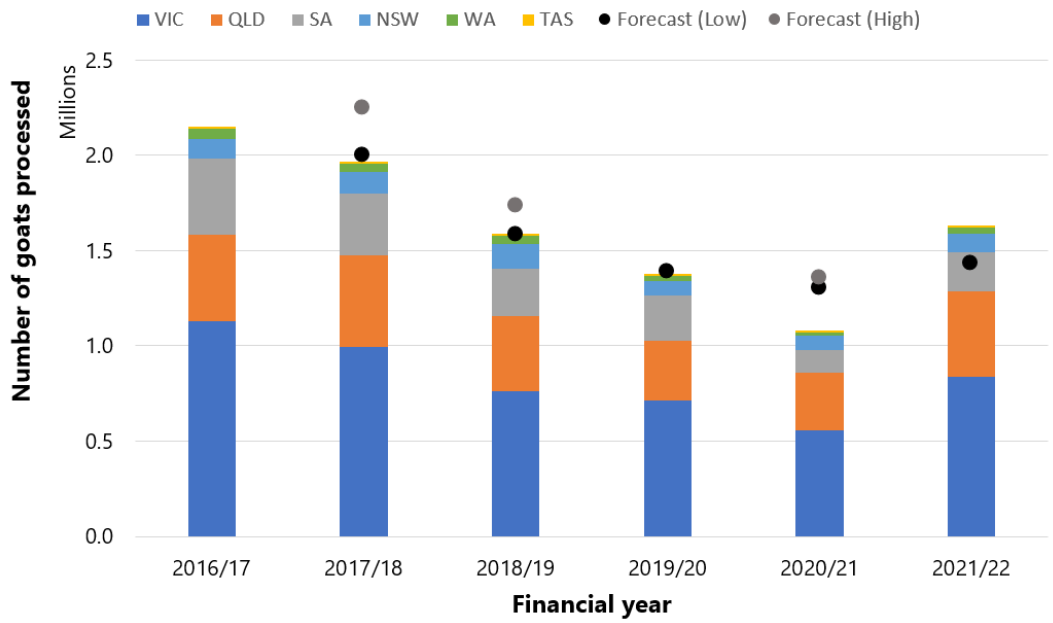

Figure 24 Number of goats processed per financial year (2016-17- 2021-22) compared with forecast estimates (Data Source: DAFF)

Time Series Forecasts - Accuracy

In most years, the ARIMA model had the lowest forecast error of the different forecasts generated, as shown in Table 10, while the Exponential Smoothing model had the highest. This suggests that the ARIMA model is a good fit for forecasting goat slaughter. However, forecast errors were higher when analysing quarterly forecasts. The volatility of the slaughter data is an ongoing problem for statistical modelling. The results highlight the importance of integrating the Committee's forecast with the supply modelling.

Table 10 Summary of time series forecasts and forecast errors by year and method

	Forecast ('000 head) and Forecast Error (%) by Year

Method	2018-19	2019-20	2020-21	2021-22
Exponential Smoothing	1,934 (23%)	1,680 (23%)	1,284 (21%)	809 (48%)
ARIMA	1,767 (12%)	1,434 (5%)	1,751 (65%)	1,535 (2%)
Moving Average	1,920 (22%)	1,525 (11%)	1,353 (28%)	1,257 (20%)
Average	1,874 (19%)	1,546 (13%)	1,463 (38%)	1,200 (23%)
Actual (Levy)	**1,571**	**1,368**	**1,059**	**1,562**

Supply Response Model - Estimates in 2022

Table 11 below shows the estimated model from the presentation to the Goat Forecasting Committee in 2022. Changes in goat slaughter can be explained in part by historic goat slaughter levels, seasonality, expected price (making the assumption that recent prices will continue into the next quarter), rainfall and whether the region is in drought. These can be categorised into trend variables, seasonal variables and external factors.

Table 11 Regression output of the Supply Response Model

	Variable	Type Of Variable	Coefficient	Standard Error
Output	Goat supply			
Inputs	Goat supply (3 month lag)	Trend	0.3	0.094
	Goat supply (12 month lag)	Trend	0.4	0.088
	June quarter dummy variable	Seasonal	-65,574	24873.405
	Goat price (3 month lag)	External factor	350.5	221.419
	Goat price (6 month lag)	External factor	-474.4	226.362
	Bourke Rainfall	External factor	-509.9	151.084
	Drought (binary variable)	External factor	-59,788.8	26283.677
	Intercept		281,689	66,766.862

***Model fit:** Adjusted R-squared: 0. 724
Note: Not all variables are significant at all standard levels of significance. The Goat price (3 month lag) was not statistically significant. But the variables jointly significant (together they help explain variation in goat supply).

The model estimates compared against the DAFF levy slaughter data are shown in Figure 25. Confidence intervals are shown in blue. It shows that the supply response model has been a good fit for the data, except for the period between 2015 and 2019, partly overlapping with the 2018-2020 drought. In this period, there was increased volatility in the quarterly slaughter numbers.

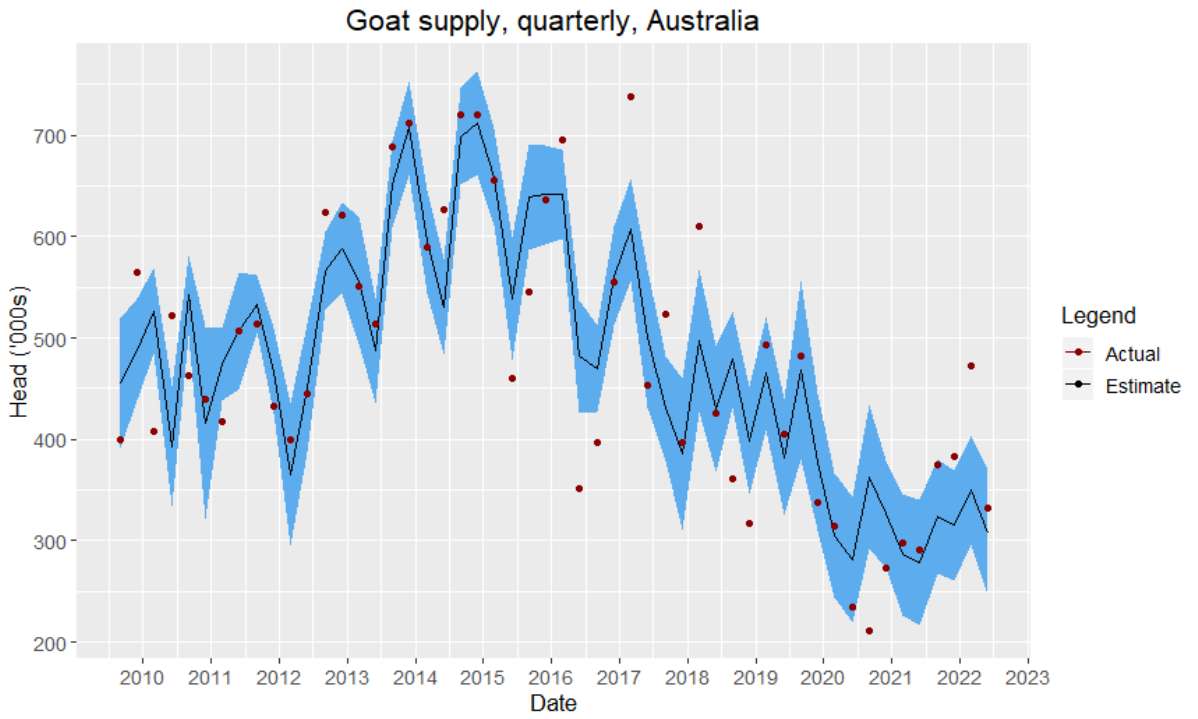

Figure 25 Supply Response Model Estimates, Confidence Intervals and Actual Goat Slaughter

4.4 Objective 4: Modelling of various scenarios undertaken to make informed recommendations regarding changes to industry practice and the forecasted impact of those changes.

Understanding and predicting population and supply trends requires appreciating the decisions producers make within their enterprises, especially those that influence herd size and structure. Their decisions change over time in response to factors such as price, market specification, seasonal conditions, profit from alternative enterprises and access to labour.

The goat supply forecasting tool (described in section 3.4 and attached as Appendix 1) and the Goatsim (described in Appendix 2) both allow comparison of alternative scenarios. If the Forecasting Committee is maintained, these tools should be applied to support the decisions of the Committee.. The application of the Goatsim model should be conducted with the support of the developer to allow ongoing testing of the tool across a range of scenarios to ensure its suitability for broader industry applications.

4.5 Objective 5: Conduct population model analysis, development and evaluation

The Bayesian State model results plotted against the actual aerial survey observations are presented in Figure 26. There was a large increase in the estimated number of goats from 2020 (4,418,000; range 3,454,800 - 5,549,700) to 2021 (6,867,600; range 5,750,600 -8,201,700). The projected population size for 2022 was 6,879,700 while the observed total was 8,770,876 (range: 7,402,782 – 10,391,804).

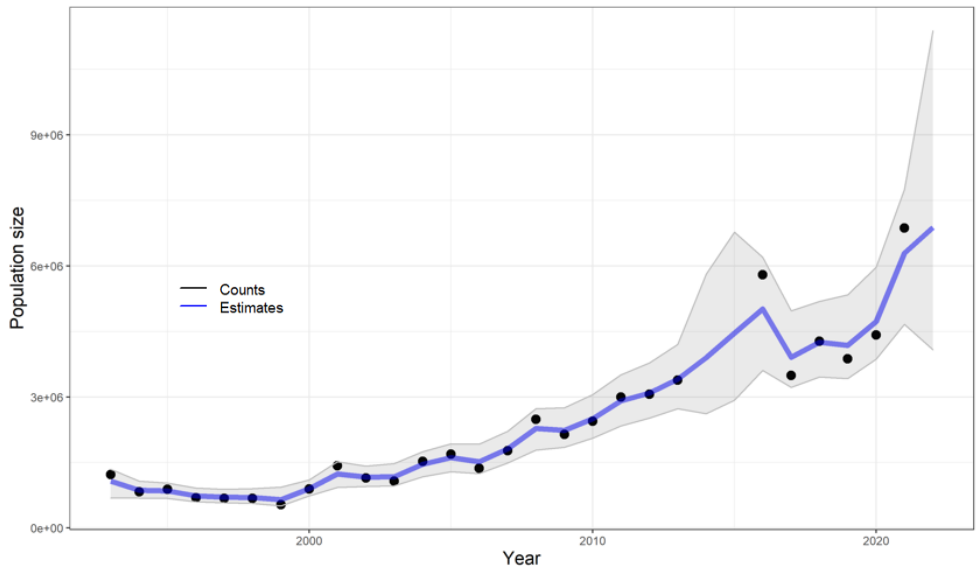

Figure 26 Plot of estimated population size (based on Bayesian state-space model of aerial survey data for years 1993-2019) and the predicted population size for 2022. (McLeod, unpublished; Data Source: Department of Planning, Industry and Environment).

Although the Bayesian state-space model provided a prediction of population size, the model could not consider the influence of age, sex or size structure on the dynamics of goat populations. Consequently, only a limited set of alternative management scenarios (i.e. those that treat all individuals as equal) could be examined. Although this model was appropriate as a first step, a move to the IPM approach was needed to explore a broader range of strategies required to meet the requirements of the Committee.

The IPM model's development and application are detailed in Appendix 2, including an example of how to run a scenario. A limitation of the model's development was the relative lack of research information on unmanaged and semi-managed goat populations in Australia. Nevertheless, data from other goat populations was used to complete the modelling. As more research is conducted, the models can be refined so that their predictions are more accurate and representative. The Forecasting Committee inputted feedback during model development, including reviewing the model's parameters and identifying scenarios they would be interested in investigating.

The IPM approach is best suited to the industry's requirements. The model can be used to estimate the impact of environmental conditions and industry actions (e.g., estimating sustainable harvesting rates, forecasting the impact of carcase weight increases/decreases or processing more/less does etc.) on the production, sustainability and profitability of alternative management strategies.

Objective 6: Establishment of a cost-effective, efficient and sustainable forecasting model/system for the long term.

While the objective of this project was to report data, as confidence increased and the process of integrating industry knowledge from the Forecasting Committee evolved during the project, so did the team's capacity to discuss and explain trends in the data. This capacity enhanced reporting beyond the presentation of quantitative data.

Although the project made significant improvements to the accuracy, efficiency and automation of data reporting, a set-and-forgot system for the long term is unrealistic, and it would lose the value of integrating the Forecasting Committee's knowledge with the quatitative data. The maintenance of data reporting and forecasting requires the manual manipulation of data before collation (e.g.,

identifying and accounting for movements to processors only reported by depots), specialist skills to annually update supply and population models, and the organisation and facilitation of Committee meetings.

The project team utilised PowerBI to present data to reduce the time needed to update reports and avoid data handling errors. However, the quarterly updates still need to be obtained and formatted correctly to update the outputs. Access to data requires maintenance of data use agreements, and sometimes reminders to the data suppliers are necessary to ensure timely access to the data for the most recent quarter.

The project team was unable to identify suitable opportunities for private or alternative funding sources. A Forecasting Committee is fundamental to industry development and the entire supply chain requires equitable access to information, making the commercialisation of the outputs unworkable.

The proposed continuation of the Goat Data Collation and Tracking Project will deliver timely and accurate supply, processing and export data integrated with industry intelligence to explain trends and refine the sector's capacity to forecast changes. The proposed deliverables include:

- Coordinate the National Forecasting Committee and facilitate three meetings
    - Aim to forecast the number of goats supplied for processing (on a quarterly and financial year basis) to achieve a forecast estimate within +/- 10% of the actual total.
- Extend and maintain data use agreements with ISC, DAWE, LLS, South Australian Government
- Adjust collation methods in line with data set changes, e.g., NLIS data will change to include both mob-based and individual animal movements
- Collate production, supply, processing and export data
- Provide updated supply forecasting modelling to integrate with industry forecasting
- Apply the new Integral Projection Population model, including ongoing application to determine the implications of industry practices (e.g., retaining does, varying turn-off weights, reduced harvest effort)
- Progress innovative options for more flexible and automated reporting
- Publish quarterly (3) and annual (1) industry update reports each year
- Present key messages to industry and stakeholders to inform on-farm management, policy and project development, and industry planning
- With industry, review the structure of the Forecasting Committee and develop a detailed succession plan.

5. Conclusion

The project achieved its objectives of improving the goatmeat industry's access to reliable data and its capacity to forecast population and supply changes. Major outputs included accurate reporting of goat numbers supplied for processing from each region in Australia and the establishment of an effective National Goatmeat Supply Forecasting Committee. Access to the NLIS data and the collation methods developed in the project allowed supply chain flows to be understood, quantified and tracked. From the array of new data presented to the industry, supply and processing data was the most used and valued. The industry's engagement in the project built capacity and confidence to interpret data, explain trends and forecast supply. The integration of the Forecasting Committee's industry knowledge was essential to explain trends and formulate key messages. Development of the goat supply forecasting model and Goatsim population model will support decision-making into

the future. Both tools have scope for further development as they continue to be used by the Forecasting Committee. The Australian goatmeat industry is innovative and developing rapidly, making production, supply and demand dynamic. Constant change and progress mean that continuing investment is needed to collate and report data, explain industry trends, and forecast changes.

5.1 Key findings

The Goat Data Collation and Tracking project has supported the industry's development by informing supply-chain and market development, strategic planning and the evaluation of challenges and opportunities. The project's major achievements include:

- Accessing data (including NLIS, Levy, aerial survey and Stock and Land Return) through establishing and maintaining data use agreements with several organisations.
- Refining data collation methods to improve the accuracy and timeliness of reporting
- Establishing the National Goatmeat Supply Forecasting Committee
- Developing supply and population forecast models using continuous innovation and improvement
- Integrating data and industry intelligence for strategic decision making
- Reporting and explaining supply, processing and export trends to the industry
- Delivering key messages to industry through published reports and presentations

5.2 Benefits to industry: Informing policy, planning and project development (exotic animal disease preparedness, traceability and eID implementation, and policy reviews).

This project engaged industry from the outset through the formation of the Forecasting Committee. This engagement has built capacity and confidence to use the outputs. Hence, the information generated in the project is being actively used for decision-making.

The project has supported the industry's development by informing supply-chain and market development, strategic planning and the evaluation of challenges and opportunities. It has provided critical support for the industry to understand and address the supply challenges.

Access to collated industry data is critical for supply forecasting and fundamental for a range of other policy and planning activities that underpin the sector's development. Examples of where the projects information has informed important activities include:

- NSW DPI's recent planning for exotic animal disease preparedness and the implementation of eID for sheep and goats. For example, Trudie Atkinson used the project information to write a document titled – 'Goat Movement Analysis 2021/22 – Information to assist FMD preparedness and goat eID implementation'. This document provided policymakers with detailed industry and supply chain information for strategic planning
- At the request of MLA and GICA, the team have provided data and information to inform the SA review of goat management regulations
- Information from the project was used to quantify production from western NSW and the economic importance industry to the regional economy to build a case for the recently announced $1.2 million investment by the NSW Government for the 'Going Ahead with Goats' project

Table 12 outlines a list of publications and presentations delivered to the industry during the current contract. These outputs showcased the project and communicated key messages to the industry

Table 12 List of project publications and presentations (June 2021-March 2023)

Date	Title	Publication/ Industry Event
June 2021	Improving goat productivity and profitability in the rangeland	MeatUp, Broken Hill
June 2021	Supply and industry update	NSW Farmers Committee Meeting, Broken Hill NSW
Oct 2021	Supporting and tracking the development of the Australian goatmeat industry	Shaping Our Future - The Australian Rangelands Conference, Longreach NSW
Dec 2021	Industry update- 2020/21	Goat Industry Data Collation and Tracking web page
Dec 2021	Industry update- Quarter one 2021/22	Web page
Dec 2021	Goat supply: the only way is up	Goats on the move newsletter
Feb 2022	Goat Research, Development and Adoption: projects and future priorities	Agforce board meeting
Mar 2022	Goatmeat supply trends	Going Ahead with Goats, Bourke NSW
Mar 2022	Data-driven decision making	Goat Production Field Day, Collie NSW
Mar 2022	Industry update- Quarter two 2021/22	Web page
May 2022	Goat R,D&A update	South Australia Livestock Research Council regional committee meeting
Aug 2022	Industry update- Quarter three 2021/22	Web page
Nov 2022	Supply growth: a wrap of 2021–22 and outlook for 2022–23	Goats on the Move newsletter
Nov 2022	Goatmeat supply and processing and export trends	Goat Workshop, Nyngan NSW
Nov 2022	NSW DPI goat industry update	NSW Farmers Committee Meeting, Broken Hill NSW
Dec 2022	Industry update- 2021/22	Web page
Dec 2022	Industry update- Quarter three 2021/22	Web page
Mar 2023	Trends to watch in 2023	Goat Production Field Day, Collie NSW
Jun 2023	R, D & A update	NSW Farmers Goat Biennial General Meeting
Jun 2023	Project sets industry up for the future	Goats on the Move newsletter

5.3 Future research and recommendations

Ongoing access to data, supply forecasting and population modelling that is integrated with industry intelligence is fundamental and critical to support industry development. Examples of challenges that the industry faces in the next three years, include:

- Processing and export market expansion in line with growing supply

- Industry development, including the transitions from unmanaged to managed production systems
- Improving traceability for market assurance, including the implementation of individual electronic animal identification
- Exotic disease preparedness, e.g., Foot and Mouth Disease

Actions that will assist the industry to address these challenges and support accelerated industry development include:

- Maintain the National Goatmeat Forecasting Committee, including reviewing the structure and developing a succession plan.
- Continue to collate production, supply, processing data, reporting key messages to industry, investigating the applications of dashboards for more timely, dynamic and flexible reporting. As supply increases, the industry will need expanded access to market data and information.
- Validate the Goatsim population model with the Forecasting Committee by modelling scenarios that reflect current practice and management decisions and examining the impact on herd size and yield. This should be done before Goatsim is made more broadly available to industry.
- Produce time-series forecasts for the industry to assist producer decision-making and planning
- Conduct further refinement of the supply response model, utilising current econometric techniques and investigating the role of competing livestock systems and price volatility.
- Engage the industry in routinely using NLIS data for industry's benefit and to maintain confidence in the reliability of the data for tracking supply and traceability as the system integrates individual animal movements.

6. References

Atkinson, T., Mcleod, S., Cummings, N., Smith, W. and Turnbull, G. (2022). Goat Data Collation and Tracking- Industry Update 2021/22. NSW Department of Primary Industries.

Beutel T., Trevithick, R., Scarth, P. and Tindall D. (2019) VegMachine.net. online land cover analysis for the Australian rangelands. The Rangeland Journal, 41, 355–362 https://doi.org/10.1071/RJ19013

BioMap (2022). LLS Stock and Land Return Data - Collated by the MLA and NSW DPI project - Goat Data Collection and Tracking project (B.GOA.0131). NSW Government BioMap database. NSW Department of Primary Industries. Last accessed August 2022. https://biomap.dpi.nsw.gov.au/

Bureau of Meteorology (2022), Climate Data Online, Bourke Airport AWS, accessed September 2022, http://www.bom.gov.au/jsp/ncc/cdio/weatherData/av?p_nccObsCode=139&p_display_type=dataFile&p_startYear=&p_c=&p_stn_num=048245

DAFF (Department of Agriculture, Fisheries and Forestry) (2023). Unpublished data 2022. Collated by the MLA and NSW DPI project - Goat Data Collection and Tracking project (B.GOA.0131).

DAFF (Department of Agriculture, Fisheries and Forestry) (2023). Livestock slaughter levies. Last accessed March 2023. Livestock slaughter levy - DAFF (agriculture.gov.au)

Dillon, J.L. and Anderson, J.A. 1990, The Analysis of Response in Crop and Livestock Production, 3rd edn, Pergamon Press, Oxford, England.

Geoscience Australia. (2022) DEA Land Cover, accessed September 2022. https://www.dea.ga.gov.au/products/dea-land-cover

Hyndman, R.J., & Athanasopoulos, G. (2021) *Forecasting: principles and practice*, 3rd edition, Texts: Melbourne, Australia. OTexts.com/fpp3. Accessed on September 2022.

ISC (Integrity Systems Company) (2023b). Property Identification Code. Last accessed April 2023. Property Identification Code (PIC) | Integrity Systems.

ISC (Integrity Systems Company) (2023b). Unpublished data 2021. Collated by the MLA and NSW DPI project - Goat Data Collection and Tracking project (B.GOA.0131).

LLS (Local Land Services 2023). Lodge my annual Stock and Land Return. Last accessed March 2023. Lodge my Annual Land and Stock Return - Local Land Services (nsw.gov.au)

Meat & Livestock Australia (2022), Over the Hooks report, accessed September 2022, https://www.mla.com.au/prices-markets/oth/

MLA (Meat & Livestock Australia (2022). Global Snapshot. Meat and Livestock. Last accessed August 2022. https://www.mla.com.au/globalassets/mla-corporate/news-and-events/documents/2022-mla-ms_global-goatmeat-published-article.pdf

NSW DPI (2022). Goat Industry Data Collation and Tracking- Industry update- 2020/21. NSW Department of Primary Industries, December 2021. Last accessed August 2022.

NSW DPI (2018). NLIS for goat depot quick guide operators. NSW Department of Primary Industries, October 2018. Last accessed August 2022. https://www.dpi.nsw.gov.au/__data/assets/pdf_file/0004/837688/NLIS-for-goat-depot-operators-quick-guide.pdf

7. Appendix

7.1.1 Goat Supply Forecast Scenario Tool

7.1.2 Goatsim: an online app for modelling management scenarios for managed and unmanaged goats in the rangelands of NSW