REPORT: PHASE I

SOUTH AFRICA MOHAIR CLUSTER

SUSTAINABILITY INSTITUTE projects

UNDERSTANDING SUSTAINABILITY OF MOHAIR VALUE CHAIN IN SOUTH AFRICA

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EXECUTIVE SUMMARY

South Africa is a key player in the global mohair production industry, and contributed 53% of global production in 2016. Given the important role of mohair production, in the IPAP 2016/17 - 2017/18, the Minister of Trade and Industry, Dr Rob Davis, named the Mohair Cluster among the clothing and textile sectors that would be promoted to enhance its competitiveness. To support the renewed interest for demand driven interventions, increased mohair production, and the promotion of overall competitiveness, this report presents a Mohair Primary Production Echelon Model (MoPPEM). The model was developed using the System Dynamics approach, to identify, *visualize and quantify the major components of the mohair production value chain, including an assessment of their interrelations, as described by industry stakeholders*.

The key messages and insights from the MoPPEM include the following:

General / overall insights

- Desirability of farming will improve if the boom and bust cycle of the mohair industry is stabilised. In times of unstable price, new farmers are the ones with high likelihood to leave the business or have the most significant financial loss. Creating a conducive environment to stabilise the price would be essential to support the young primary producers and those new to the industry.

- Broad-Based Black Economic Empowerment (B-BBEE) in mohair industry focuses on the Kapaters. MoPPEM was developed in such a way that Kapaters and Breeding Goats are represented separately. Going forward, this will provide the opportunity for future exploration on the role of B-BBEE in the mohair value chain.

- Mohair price appears to be on the rise. However, a decline in Angora goat production would lead to the erosion of the cost advantages that the primary producer obtains from scale of operation. Thus, the unit price change may not be necessarily proportional to the change in unit production cost.

Elke jaar is 'n maer jaar' (Every year is a lean year) scenario insights

- A long period of drought would drive the Angora primary producers out of business, which in turn may result in extinction of the industry. It is crucial to identify measures to make intensive farming profitable.

Genetic oriented scenario insights

- A genetic programme has the greatest long-term influence on Angora goat production relative to other scenarios and any other model parameter examined. Hence, a genetic programme represents an important leverage point for Angora goat production. A genetic programme is not a quick fix. Positive outcomes from such a programme can only be reaped after continuous, diligent farming over several years.

Total value addition scenario insights

- Extra income from meat, skin or related activities can contribute to improving the mohair quality without necessarily relying on mohair price. This is because mohair quality increases due to increase in demand per supply fraction. The demand per supply fraction is influenced by the carrying capacity as well as income from value adding related activities - meat and skin.

Population vulnerability scenario insights

- There are short-term vulnerabilities in the mohair industry that can have lasting effects on the sustainability of production. These vulnerabilities include predators, fires and theft. It is crucial for the industry as a whole to anticipate and manage these risks.

PHASE I REPORT CONTEXT: UNDERSTANDING THE SUSTAINABILITY OF THE MOHAIR VALUE CHAIN IN SOUTH AFRICA

This report presents the work carried out for, and the results of, Phase I of the Mohair Value Chain project, an initiative commissioned by the South Africa Mohair Cluster, which *brings together stakeholders in the mohair industry, in order to identify opportunities and facilitate efforts to ensure competitiveness and sustainability in the South African mohair industry*.

The project utilises System Dynamics modelling to *develop a shared and collective understanding from different stakeholders in the mohair industry*. The project Phase I developed the Mohair Primary Production Echelon Model (MoPPEM), to *visualize the major components of the mohair value chain and how they are related to one another, as described by industry stakeholders.* The purpose of MoPPEM is to identify coordinated intervention points for long-term industry sustainability.

The Phase I report is presented in five sections; the first section highlights the context of the mohair industry in South Africa; the second section outlines why System Dynamics is appropriate to understanding the complexity of the mohair value chain; the third section provides a description of the Mohair Primary Production Echelon Model (MoPPEM); the fourth section presents MoPPEM results; and finally, the fifth section presents a proposal for Phase II of the Mohair Value Chain project, with the purpose to explore the design of implementation projects.

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Stakeholder Engagement Workshop Participants
See Appendix C for complete list of participants

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Report Reviewer
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PART I: UNDERSTANDING MOHAIR INDUSTRY IN SOUTH AFRICA

This section provides an overview of the mohair industry in South Africa. Insights include the similar boom and bust dynamics the mohair industry shares with commodity market cycles. The nature of stakeholder interconnectedness within the mohair value chain is also revealed.

1 UNDERSTANDING MOHAIR INDUSTRY IN SOUTH AFRICA

1.1 <u>Overview of Mohair Industry</u>

In 2010, the Department of Trade and Industry (the dti) launched the Clothing and Textile Competitiveness Programme managed by the Industrial Development Corporation (IDC), to revive the dwindling textile and clothing industry (Department of Trade and Industry, 2010). Over the past few years, locally made clothing has often been replaced with imported clothing, resulting in massive factory closures and job losses. While the Clothing, Textile, Footwear and Leather contributes only 1% of South Africa's GDP, it is one of the most labour intensive sectors (Fibre Processing & Manufacturing Sector Education and Training Authority, 2014). The recent focus of the Industrial Policy Action Plan (IPAP) has been to establish new sources of competitiveness and long-term sustainability of clothing and textiles.

The mohair industry has a unique niche market (Lowry, 2014) that can contribute to South Africa's competitiveness. The minister of Trade and Industry, Dr Rob Davis, named the Mohair Cluster among the clothing and textile sectors that would be promoted to enhance competitiveness (Department of Trade and Industry, 2015) and "develop sustainable long term practices to improve fibre quality and value addition"(Department of trade and Industry, 2017). The Angora goat primary production activities, mainly concerned around producing mohair, are a significant part of the mohair industry. Other related value chain sectors in Angora primary production, namely, skin and carcass, are yet to be fully explored by the mohair industry.

South Africa is a key player in the global mohair production industry[1]. The country is the world largest producer of mohair, and accounted for 53% of global production in 2016 as illustrated in Figure 1 (Absa Agribusiness, 2017, Mohair SA., 2012).

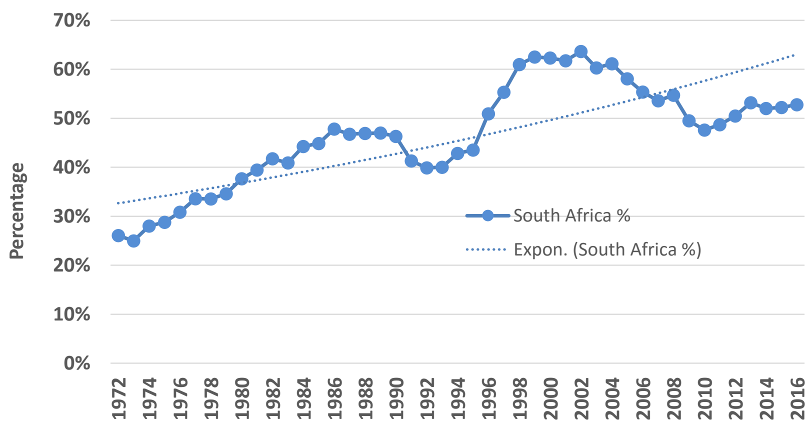

Figure 1: South Africa production as a percentage of world mohair production, 1972 -2016
Source: Mohair SA. (2012)[2]

Although the share of South African production has been trending upwards since 1972, the total quantity of mohair produced has been declining. Figure 2 shows that, globally, mohair production increased from 1972, peaking in 1988. Thereafter gradual decrease in production is observed.

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[1] South African Mohair is produced in 17 districts, namely: Willowmore, Aberdeen, Graaff-Reinet, Cradock, Middelburg, Tarkastad, Bedford, Adelaide, Grahamstown, Somerset East, Pearston, Jansenville, Steytlerville, De Rust, Beaufort West, Oudtshoorn and Uniondale (Department of Forestry and Fisheries, 2015)
[2] Data from 2013-2016 was sourced directly from Deon Saayman, Managing Director, Mohair SA

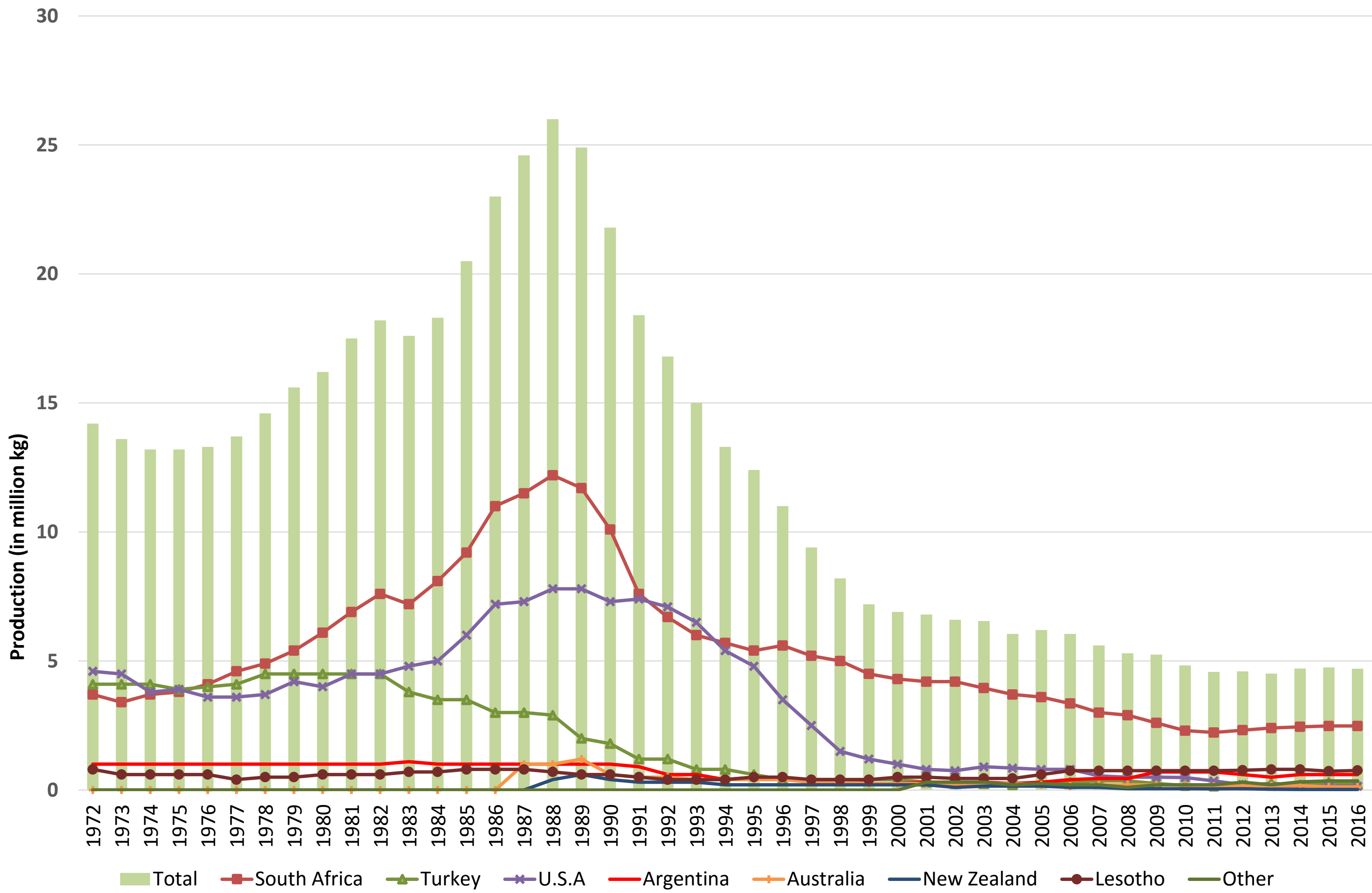

Figure 2: Global mohair production, 1972 -2016
Source: Mohair SA. (2012)[3]

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[3] FAO also reported Mohair data until 1993. See the link: http://www.fao.org/docrep/v9384e/v9384e04.htm [accessed 9 October 2017]; Data from 2013-2016 was sourced directly from Deon Saayman, Managing Director, Mohair SA

A similar trend is observed in South Africa mohair production and the population of Angora goats (Figure 3), although the goat production peaked in 1989, a year after mohair peak production. The global decline in mohair production is attributed to decline in consumer demand due to increased production of synthetic fibre such as polyester, acrylic and nylon (FAO, 2009). Other factors[4] in the South Africa mohair industry include: volatile mohair price, lack of skills in the sector, loss of knowledge in primary production, lack of traceability of mohair produced, and lack of awareness of the benefits of mohair products. As shown in Figure 4, price fluctuations were more noticeable between 1969 and 1993 than in recent years. Appendix A provides a full list of these factors, which were identified and consolidated during the Mohair Value Chain project capacity building workshop.

The fluctuations in Angora goat production, mohair production and mohair prices (Figure 3 and Figure *4*) is indicative that the mohair production industry exhibits behaviours commonly observed in commodity market cycles. Commodity markets are volatile and their volatility fluctuates over time (Sterman, 2000). The volatility also represents the interactions of all the parts in the mohair supply chain, and their diversity suggests that they originate internally within segments of the industry.

The renewed interest for demand driven interventions to increase mohair production as well as the drive to be more competitive as an industry implies the need to balance mohair availability, mohair price and local value adding activities. This would ultimately increase both the viability and profitability of the mohair industry. Coordinated efforts and interventions from all the different stakeholders in the mohair value chain are required for long-term industry sustainability (see section 1.3).

[4] The factors were identified and consolidated during the Mohair Value Chain Project Capacity Building Training held on 12-14 June 2017.

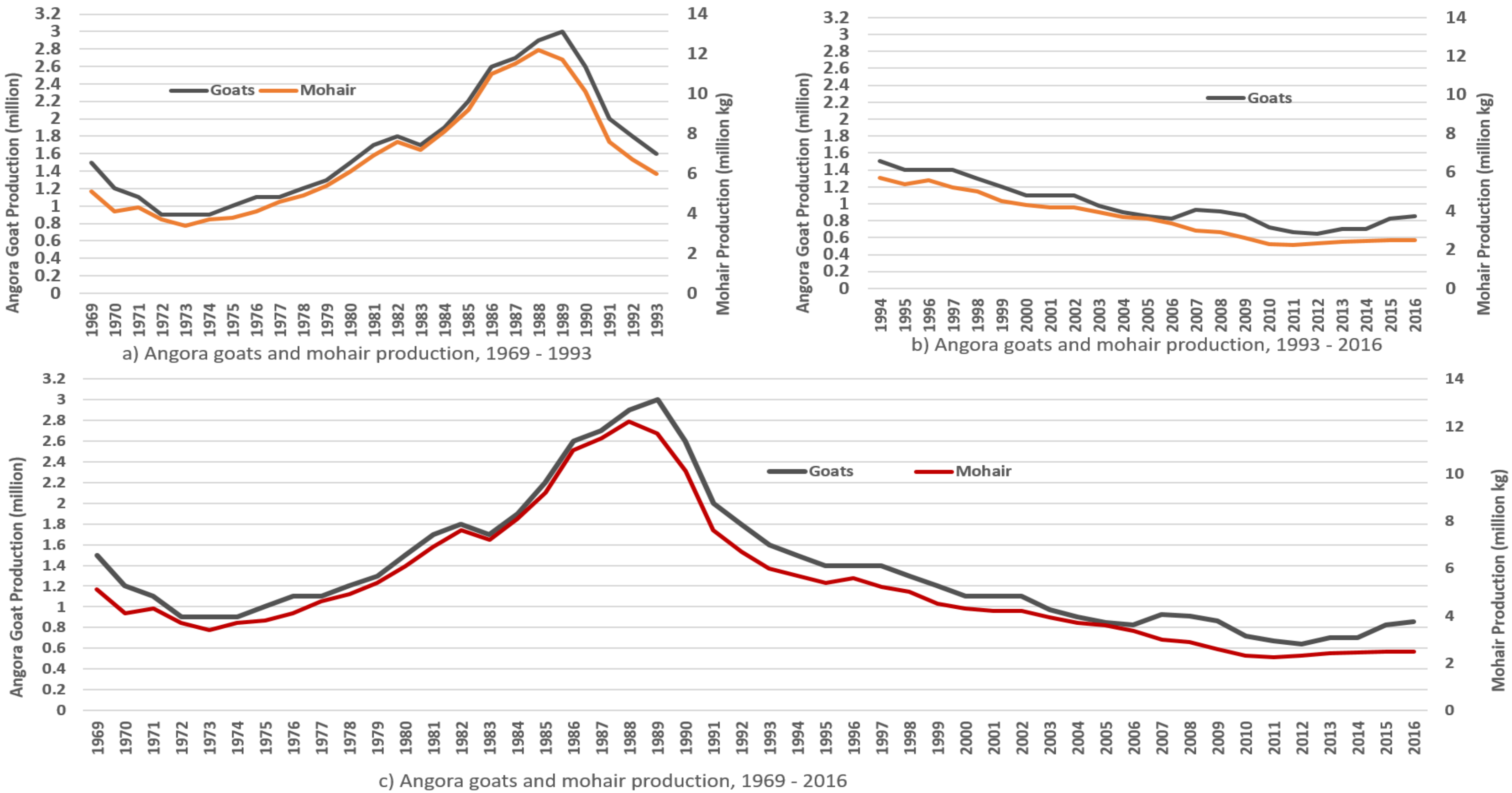

Figure 3: Goat and mohair primary production in South Africa, 1969 -2016
Source: Mohair SA. (2012)[5]

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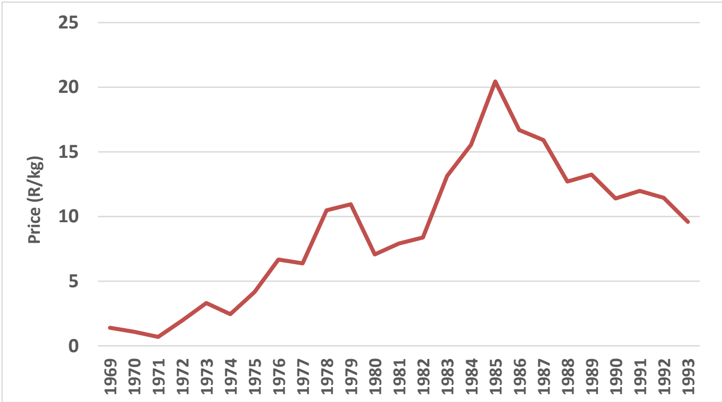
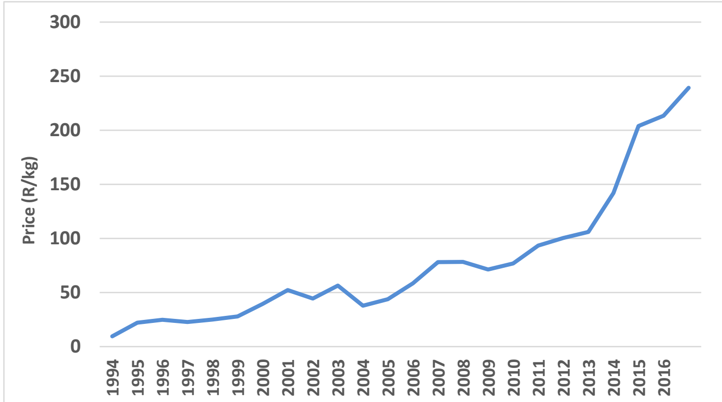
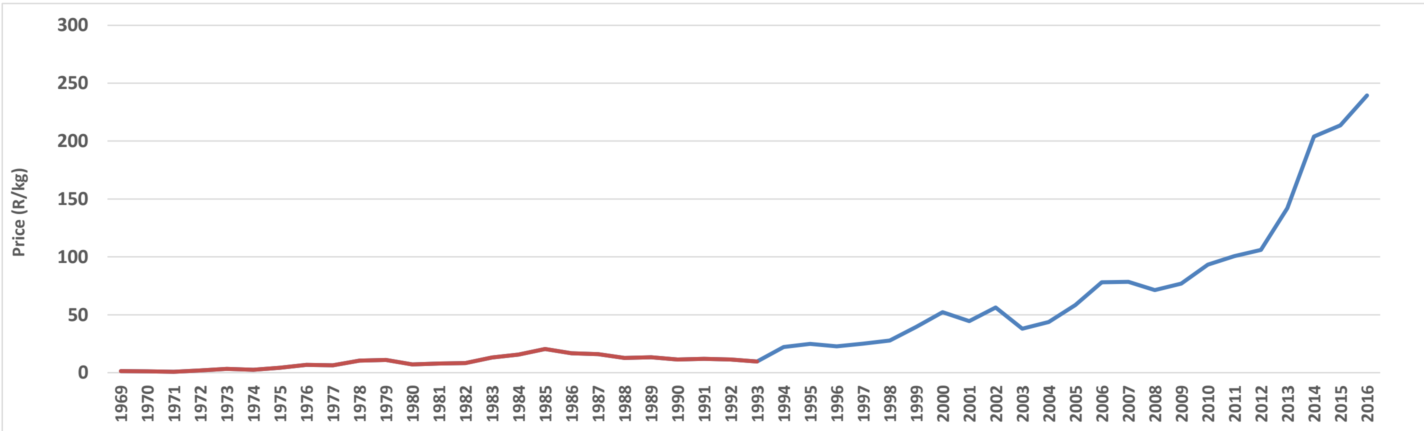
[5] Data from 2013-2016 was sourced directly from Deon Saayman, Managing Director, Mohair SA



a) Mohair price, 1969 -1993



b) Mohair price, 1994 - 2016



C) Mohair price, combined graphs: 1969 - 2016

Figure 4: Mohair price, 1969 -2016
Source: Mohair SA. (2012)[6]

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[6] Data from 2013-2016 was sourced directly from Deon Saayman, Managing Director, Mohair SA

1.2 **Mohair Industry Sustainability**

Value in manufacturing is generated through activities and interactions between the various stakeholders, both upstream and downstream (Ueda et al., 2009). When promoting competitiveness, all three pillars of sustainability should be considered: economic, environmental and social sustainability. This implies that the desired goal(s) for sustainable sector development should be made explicit. Currently, there are five editions of sustainable mohair industry guidelines, focusing on the pre-farm gate (see latest edition de Beer, 2017). For the purpose of this project, Capacity Building Workshop[7] participants elicited their understanding of sustainable mohair value, as presented in Figure 5.

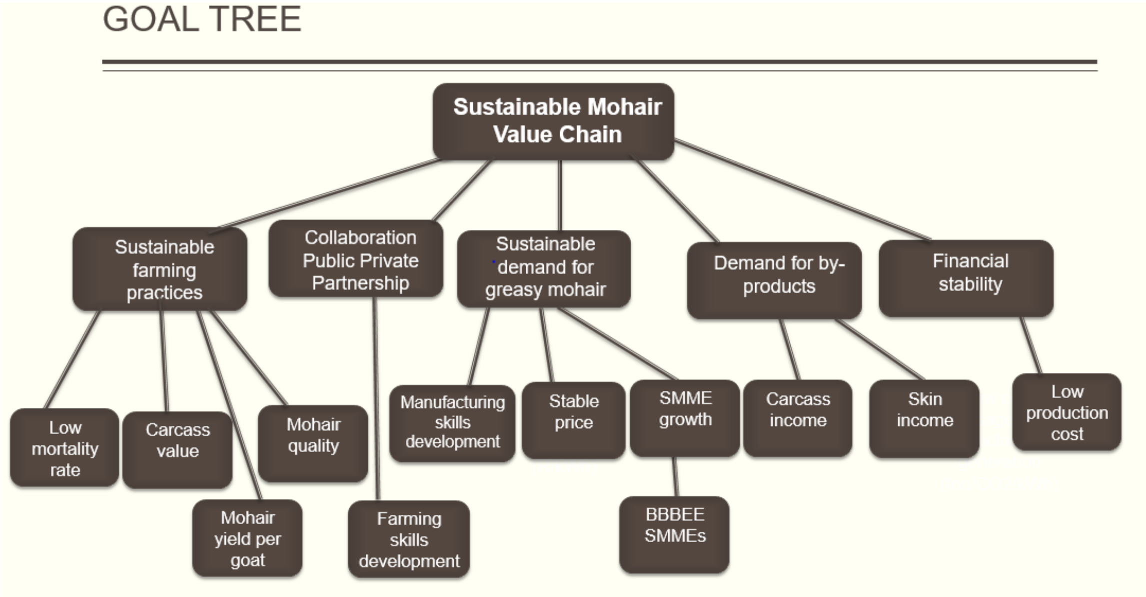

Figure 5: Sustainable mohair value chain goal tree
Source: Participants during capacity building workshop

1.3 **Mohair Value Chain Stakeholders**

The existing documents (e.g. Department of Agriculture Forestry and Fisheries, 2015) presents mohair value chain that consists of only stakeholders involved in the supply chain[8], as shown in Figure 6. Initiatives to enhance competitiveness and sustainability of local enterprises requires bringing different stakeholders- from private and public sectors - together. Actions and activities of each stakeholder should reinforce one another to ensure long-term sustainability.

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[7] Capacity Building in System Dynamics Workshop was held on 12-14 June 2017. See the acknowledgments for the list of participants.

[8] A note on the difference between value chain and supply chain: supply chain is the process showing all the stakeholders involved in providing a good / product, viewed from supply-led perspective. Value chain is a set of interrelated activities that a firm in an industry undertakes to create competitive advantage viewed from demand-led perspective.

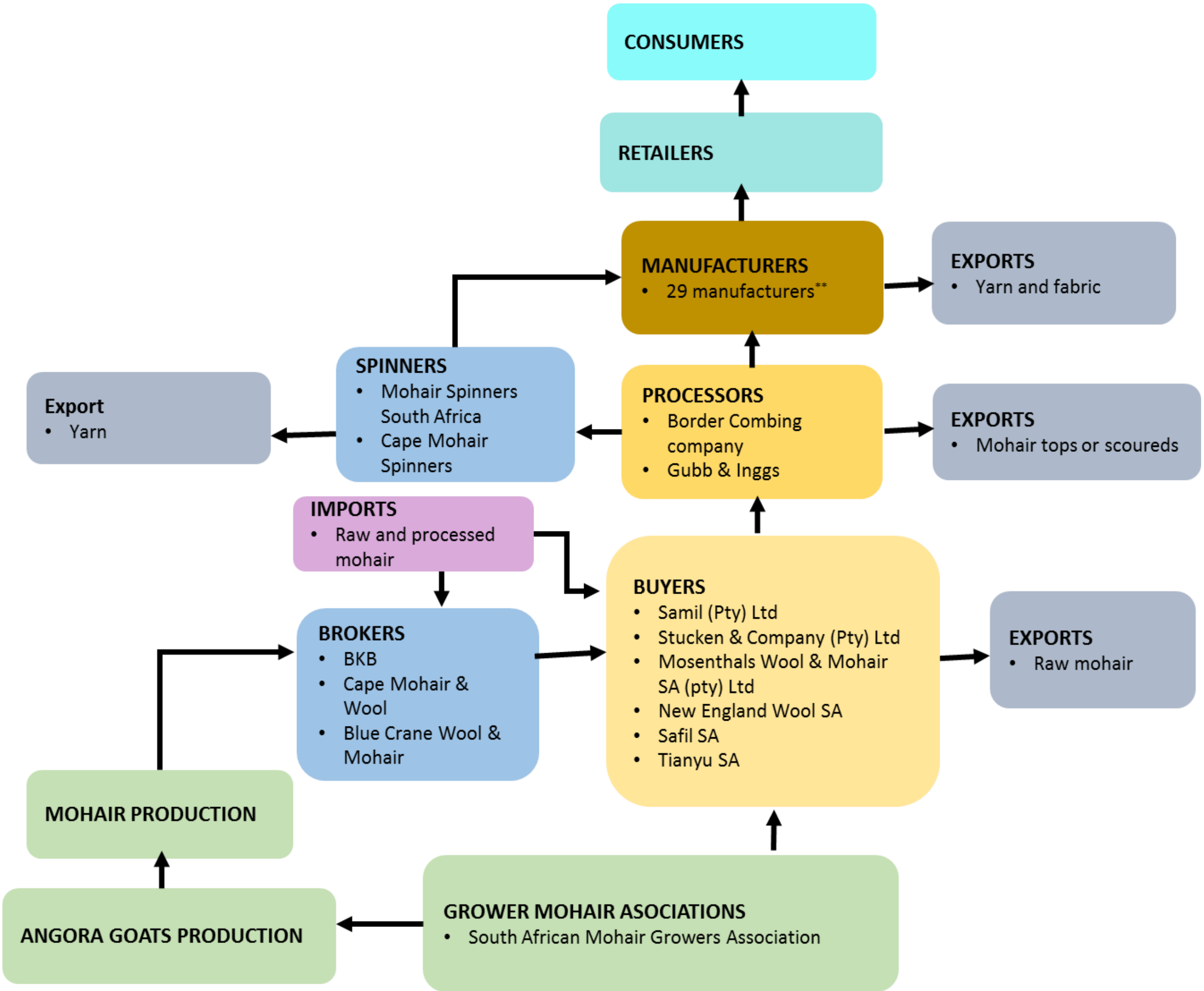

Figure 6: Structure of Mohair industry
Source: Adapted from Department of Agriculture Forestry and Fisheries (2015), with inputs from Mohair SA[9]
Notes: **Refer to Mohair SA[10] for the list of manufacturers

The mohair value chain stakeholders in South Africa are diverse and extends beyond those involved in the supply chain as illustrated in Figure 7. The list of stakeholders was consolidated during Capacity Building Workshop of this project.

[9] Inputs from Deon Saayman, Mohair SA, Personal Communication
[10] http://www.mohair.co.za/filter/buy_mohair/manufacturers and http://www.mohair.co.za/filter/buy_mohair/retailers

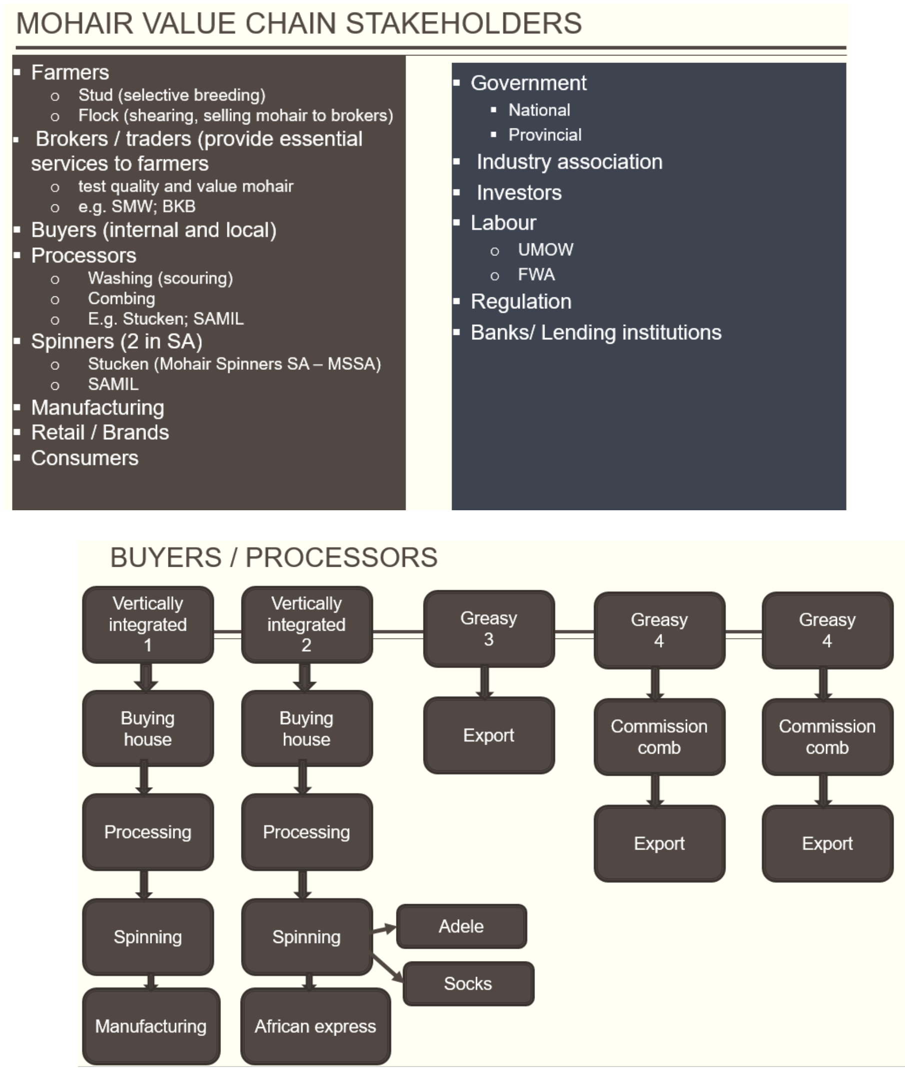

Figure 7: Mohair value chain stakeholders
Source: Participants during capacity building workshop

Based on Figure 6, Figure 7, and additional data gathered from various sources[11], a preliminary mohair market map was developed (see Figure 8) following Hellin and Meijer (2006) framework, which consists of:

- The mohair value chain stakeholders
- Enabling environment stakeholders in mohair value chain (institutions, policies and processes that shape the market environment)
- Service providers in mohair value chain (business or market expansion services that support the value chains)

[11] These include: desktop analysis on documents relating to mohair Industry and inputs from stakeholder report back on unrealized opportunities

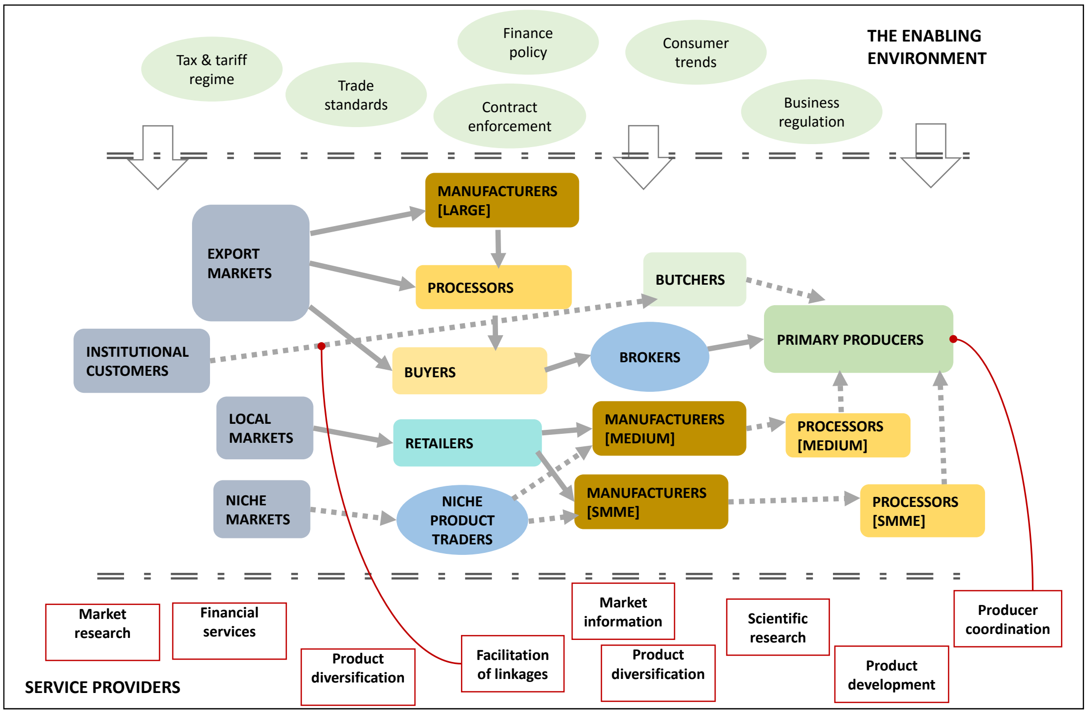

Figure 8: Preliminary mohair industry market map
Bold arrows represents existing links; dashed arrows represents potential links

Value chain stakeholders entails actors who actually transact the mohair and its related products as they move through the value chain. According to Bammann (2007), a value chain is defined as "a full range of activities which are required to bring a product or service from conception, through the different phases of production, transformation, delivery to final customers, and final disposal after use". This implies that both upstream and downstream activities need to be considered. Further, defying convention, the value chain stakeholders presented reverses the direction of the chain, showing the flow of *income* from the markets along the chain to the primary producers, rather than conventional flow of *goods* in the opposite direction (Hellin and Meijer, 2006). This counter-intuitivism emphasises a demand-led perspective and is often characterised by having a "pull supply chain".

Enabling environments entail critical factors that shape the mohair value chain environment and its operations, but is subject to change. Enabling environmental factors are created by government authorities at different levels and institutions (policies, regulations and practices) or civil society organisations, which are beyond the control of the value chain stakeholders. The purpose of the enabling environments is not to map the *status quo*, but also to understand trends that are affecting the entire value chain, examine powers and interests driving change and determining opportunities for practical implementation, lobbying and policy focus.

Service providers provide *business and market expansion* with support for product development, diversification and enhancing competitiveness.

Market growth, Product development and Diversification were recognised as the most important unrealised opportunities within the industry[12]. This includes the need to explore new product ranges related to skin and meat as well as blending of the fibre with other natural fibres such as cashmere and wild silk. Market growth is also closely tied with consumer awareness and greater market penetration

[12] Sourced from the outputs of stakeholder engagement workshop breakaway sessions

as well as increasing the number of farmers within the industry and assisting with business development.

As observed in Figure 8, there are many driving forces for coordination in the mohair value chain. The implication is that all the stakeholders should work together towards the objectives of enhancing the industry competitiveness and identifying opportunities for a sustainable mohair value chain. System Dynamics provides a tool that can facilitate such collaborative effort.

PART II: WHY SYSTEM DYNAMICS FOR MOHAIR INDUSTRY?

This section provides a brief discussion of System Dynamics and why it is an appropriate approach to examine the sustainability of mohair industry. The modelling process and primary production model are also outlined

2 SYSTEM DYNAMICS FOR MOHAIR INDUSTRY

2.1 What is System Dynamics?

System Dynamics is a field of study, founded in the mid-1950 by Jay Forrester at the Massachusetts Institute of Technology (MIT), based on feedback control theory (Forrester, 1961, Sterman, 2000). System Dynamics provides a well-established framework for “describing, modelling, simulating and analysing complex ‘real-world’ issues” (Pruyt, 2013). A non-technical definition of System Dynamics describes the method as “an **integrated approach** to understand **situations for complex real world** issues to **guide decision making over time** for achieving **sustainable long-term solutions**” (SD Class of 2012, Stellenbosch University)[13].

Effective decision-making and learning in a world of growing dynamic complexity requires new skills and tools to understand the structure of complex systems in which the problems faced are embedded. **System Dynamics** was developed to address this need, and provides a practical tool to facilitate decision-making in complex, multi-person problem settings. It disconnects the impulsive habit of immediately thinking about one (and only one) ‘solution’ when a problem is experienced and provides insights into the root causes of the problem (de Haan and de Heer, 2014).

Since its inception, System Dynamics has found a wide range of applications by large companies, consulting agencies, universities, business schools and government organisations. It has become an important part of public and private decision-making and policy design (Probst and Bassi, 2014).

Guidelines for the System Dynamics modelling process are well developed (e.g. Forrester and Senge, 1980, Roberts et al., 1983, Wolstenholme, 1990, Sterman, 2000, Moxnes, 2009) as shown in Table 1, and consists of iterative activities that involve qualitative and quantitative modelling (Musango et al., 2014). Qualitative modelling entails problem identification and conceptualisation, where the issue being investigated is mapped out using qualitative tools such as Causal Loop Diagrams (Sterman, 2000). Quantitative modelling entails model building in a System Dynamics software, model testing and, finally, policy testing and analysis (Sterman, 2000).

Table 1: System Dynamics modelling process across various literature

Randers (1980)	Richardson and Pugh (1981)	Roberts et al. (1983)	Wolstenholme (1990)	Sterman (2000)	Moxnes (2009)
Conceptualization	Problem definition	Problem definition	Diagram construction and analysis	Problem articulation	Problem
	System conceptualization	System conceptualization		Dynamic hypothesis	Hypothesis
Formulation	Model formulation	Model representation	Simulation phase (stage 1)	Formulation	Analysis
Testing	Analysis of model behaviour	Model behaviour		Testing	Policy
	Model evaluation	Model evaluation			
Implementation	Policy analysis	Policy analysis and model use	Simulation phase (stage 2)	Policy formulation and evaluation	Implementation
	Model use				

Source: Adapted from Luna-Reyes and Anderson (2003)

The mohair industry modelling process utilised Moxnes (2009) outline, Problem, Hypothesis, Analysis, Policy and Implementation, commonly referred as P’HAPI. This is further discussed in section 2.4.

[13] This non-technical definition of System Dynamics was formulated by System Dynamics Class of 2012 at Stellenbosch University.

2.2 Applications of System Dynamics in Value Chain

- Applied widely in **supply chain**[14] studies to examine issues such as: strategic partnering in supply networks (Khaji and Shafaei, 2011); Ashayeri and Lemmes (2006) utilised System Dynamics to examine the economic value added of supply chain demand planning.

- There is limited application in **value chain**; however, given the complexity in the value chain, this is gaining interest. Pagani and Fine (2008) examined value network dynamics using System Dynamics. Barbosa and Azevedo (2017) advocates the use of hybrid simulation (System Dynamics, discrete event, agent-based modelling) for complex value chain environments.

- This project is ground-breaking as it is the first study to examine the sustainability of mohair industry value chain using System Dynamics. The mohair industry is dynamic and exhibits commodity market cycles; its performance depends on uncertainties of customer demand, prices and unexplored local markets.

Application of System Dynamics modelling in mohair industry value chain is expected to be beneficial in the following ways:

- Improving understanding and insights of the mohair value chain, from upstream to downstream activities, on all the stakeholders involved.

- Providing a logical framework for considering and setting policy goals for sustainable mohair value chain.

- Explicit considerations of assumptions, uncertainties, costs, consequences and spill overs.

- Identifying interventions in the mohair value chain that are effective and efficient.

- Identifying new opportunities, goals and horizons that expand the stakeholders' perceptions of what the mohair industry might offer to enhance competitiveness and value creation in a sustainable way.

2.3 Phase I Project Positioning for Downstream Mohair Value Chain

Economic possibilities are compounded in the downstream value-adding activities of Angora goat production. Why then did Phase I of the project focus on the primary producers if most of the potential value is in downstream, value-adding activities?

Firstly, the System Dynamics discipline focusses on gaining a holistic overview of a systems' structure that ultimately drives behaviour endogenously. In the case of the mohair industry, the upstream production (Angora goat production) is an integral part of the system structure that affects the wellbeing of downstream mohair processing and production of mohair consumer goods.

Secondly, it is not possible to create an accurate and robust commodity cycle model for mohair industry without starting with the raw material upstream production. Phase I project scope is tailored to have the ability to be seamlessly integrated into mohair commodity cycle of South Africa.

The underlying incentive for many downstream stakeholders are for the primary producers to pay more attention to the South African value adding sector. How can the project Phase I add any value to downstream

[14] Refer to footnote 2 for the differences between value chain and supply chain:

stakeholders for example, mohair processors, designers and manufactures of mohair consumer products?

Apart from forming the structural basis for a potential commodity cycle model of mohair, this phase of the project already gives downstream stakeholders the opportunity to understand the underlying structure of their raw materials. Such insights could lead to the identification of new synergies between supply chain echelons as well as insight into which changes in behaviour could have positive effects on timelines, quality and quantity of product supplied by the raw material producers. In other words, the value-adding sector would gain insight into how to change their behaviour towards primary producers for producers to reciprocate in a favourable way.

2.4 System Dynamics Modelling Process for Mohair Value Chain Project

The P'HAPI standard methodological framework is iterative in nature as illustrated in Figure 1. The customisation of the framework for mohair industry and the processes involved in Phase I modelling is highlighted in Figure 9.

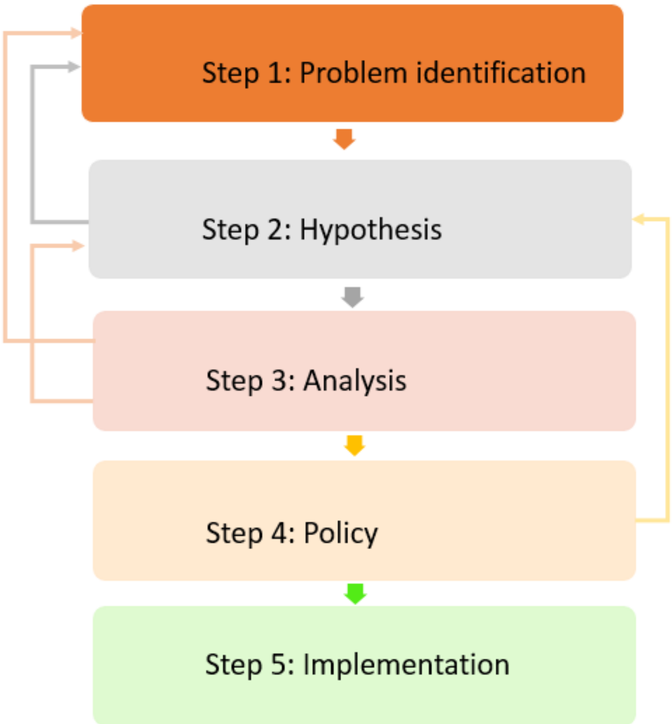

Figure 9: P'HAPI framework

Table 2: Phase I modelling process following P'HAPI framework

Modelling phase	Purpose	How it was achieved (Process)
Problem identification	• Define and confirm the scope of Phase I modelling of Mohair Value Chain project. • Identify the distinctive features of primary production activities • Identify the problem behaviour exhibited in the mohair primary production echelon. • Identify stakeholders influencing mohair primary production echelon. • Identify an appropriate historical reference mode and reliable historical data showing the development of the reference mode over time.	• Developing project scoping document with South Africa Mohair Cluster • Capacity Building Workshop • Fortnightly meetings between South Africa Mohair Cluster and modelling team
Hypothesis	• Formulate the hypothesis of the primary production echelon using causal loop diagram. • Develop the mohair primary production echelon system structure using stock and flow model. • Iteratively update and adapt the problem identification.	• Capacity Building Workshop • Angora primary producers interviews • Mohair SA interviews • Fortnightly meetings between South Africa Mohair Cluster and modelling team • Literature review
Analysis	• Undertake structural and behavioural tests. • Examine whether the results support or reject the hypothesis • Revise the hypothesis or analysis accordingly upon probing the results. • Identify key parameters that creates disturbances in the Mohair Primary production	• Modelling team translating hypothesis into the stock and flows • Internal review and validation • South Africa Mohair Cluster and Mohair SA review and of the project report • Stakeholder engagement workshop
Policy analysis	• Policy analysis regarding primary producer decision-making are discussed • Further analysis will be constituted upon linking the model with Phase II modelling	• Simulation of the model and analysis of results • Scenario analysis • Presenting policy questions to stakeholders in a neutral structure oriented manner
Implementation	• Facilitated discussions on unrealised opportunities to enhance competitiveness in the entire mohair value chain in a neutral manner • Further analysis of potential policies in the entire mohair value chain will be constituted as part of Phase II modelling • Implementation will be informed as part of Phase II modelling on aspects including costs, risks, mohair industry stakeholder perceptions and fairness	• Sensitivity analysis to identify important leverage intervention points • Externalisation and formalisation of producer mental models through the stakeholder engagement workshop

PART III: PHASE I MODEL DESCRIPTION

This section describes the Mohair Primary Production Echelon Model (MoPPEM) and highlights the model boundary, key assumptions made, model structure and scenarios identified.

3 MODEL DESCRIPTION

3.1 Mohair Primary Production Echelon Model (MoPPEM) Boundary

Selecting the model boundary and time horizon is an essential principle in System Dynamics (Sterman, 2000). A balance should be made between useful, operational representation of structures and leverage points available, while capturing the feedbacks unaccounted for, in day-to-day decision-making processes.

MoPPEM represents the first-echelon of the mohair industry value chain. While primary production practices such as breeders, commercial farmers, stud breeders are recognised in the mohair industry, the model scope is on general farming, which represent 80% of the total Angora primary production practices. In addition, MoPPEM represents the entire primary production in an aggregated manner and does not distinguish between farms or any specific producers (as individual agents).

The model captures the dynamics of Angora goat production up to the point of greasy mohair.

Different industry structures existed prior to 1994[15]. Hence, the timeframe 1994 -2050[16] was robust and relevant for the project. MoPPEM was calibrated using information from Capacity Building Training, Primary Producers interviews, Mohair SA, South Africa Mohair Cluster and modelling team and stakeholder engagement workshop.

The model was developed using Vensim® - a System Dynamics modelling software. Ventana the makers of Vensim®, established the variable naming convention (Lai and Wahba, 2001) that was followed in MoPPEM documentation as follows:

- Exogenous variables are in capital letters; converters (experiencing instantaneous causal effect) are in lower case; and stocks capitalised in the first letter of each word.
- If link forms part of a feedback loop, the causal connectors are curved.
- Model parameters are italicised as prescribed in Rahmandad and Sterman (2012).
- Policy variables are indicated in blue;
- Scenario variables are shown in red;
- Parameter estimations are shown in green; and
- Model switches are in purple.

3.2 Key Assumptions

Understanding the assumptions of the model is essential to ensure that the model is utilised appropriately (Sterman, 2000). Further, the assumptions are tested to whether they are reasonable for the model purpose. The key MoPPEM assumptions are discussed in this section.

3.2.1 Model perspective on Mohair Industry Value Chain

The Angora goat production process is modelled according to producers' decision-making regarding breeding, sheering and slaughtering. The primary producer receives income from mohair sales, and income is received approximately one week after auction. Other related value chain sectors, carcass and skin, are modelled explicitly to represent the potential supplementary income sources for primary producers. There are perceptions that the primary producers are currently not engaged in value addition activities. This however is a narrow understanding of value addition for the mohair industry. A broader understanding is to consider primary producer value addition as 'economically adding value to a product by changing its current place,

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[15] Refer: http://www.daff.gov.za/daffweb3/Portals/0/General%20Publications/Agricultural%20Marketing%20Extension%20Training%20Paper%20No.8%20Wool%20and%20Mohair.pdf

[16] This was identified and confirmed during the Capacity Building Workshop, 12-14 June 2017

time and from one set of characteristics preferred in the market place' (Boland, 2017). In the context of mohair primary producers, this implies that Total Value addition[17] for all products, which includes hair, carcass and skin, should be accounted for in value addition activities.

3.2.2 Aggregated MoPPEM Causal Model

The stocks within the aggregate causal model of MoPPEM are *Goats*, *Total Veld Size in Hectare*, *Veld Carrying Capacity in kg of Feed per Hectare*, *Perceived Capital Available for Feed per Year* as well as *Perceived Return on Investment* (Figure 10).

The primary premise of MoPPEM is that the change in the number of goats (i.e. the birth, death and slaughtering rates) depend on the "demand per supply fraction" as well as the economic incentive of farming. 'Demand' refers to the total resources required to sustain all goats currently in the system. 'Supply' entails providing feed and other resources from (1) the available veld or (2) feed that is bought. Note that this dual formulation of MoPPEM supply means that the validity of the model does not depend on the underlying assumption that farming is done using an extensive grazing farming system. Even with no natural carrying capacity goats can be healthily reared if it is cost effective to supplement the necessary amount of feed, i.e. intensive farming.

[17] This was pointed during the Fortnightly meetings, 4 October 2017

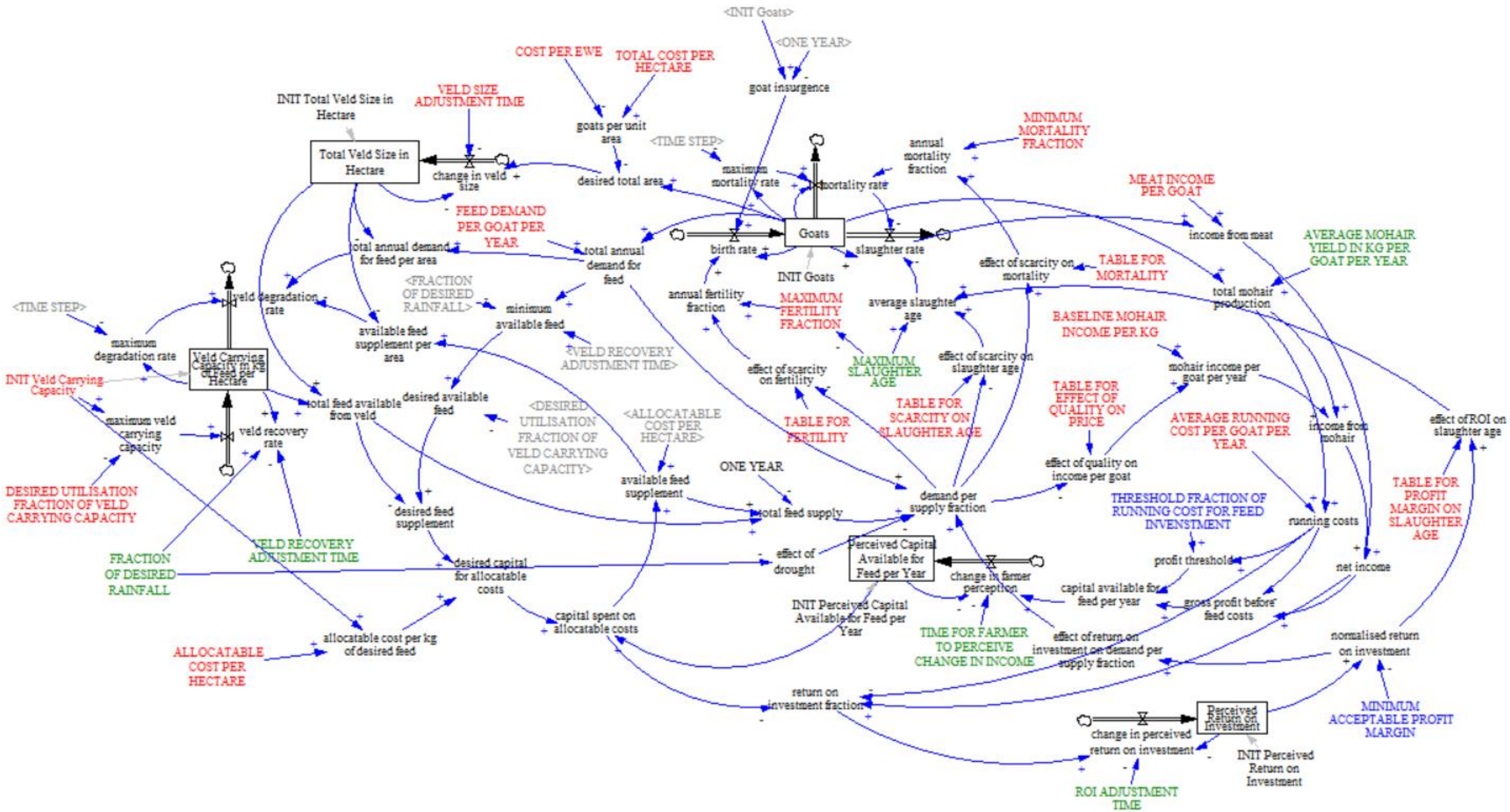

Figure 10: Aggregate MoPPEM structure showing causal relationships

Demand per supply fraction

Demand per supply fraction is the main driver of MoPPEM. It represents the resources that are available, relative to the resources required. This relationship is impacted by the following feedback loops: births, mortality, slaughter and mohair quality feedback loops, as shown in Figure 11. The smaller the demand per supply fraction, the more prosperous the situation. The demand per supply fraction influences the following aspects of primary production:

- Birth rate: resource scarcity results in a diminished birth rate
- Mortality rate: resource scarcity results in an accelerated mortality rate
- Slaughter rate: resource scarcity prompts farmers to slaughter goats at a younger age
- Income from mohair: resource scarcity negatively impacts mohair quality which negatively affects the income from mohair

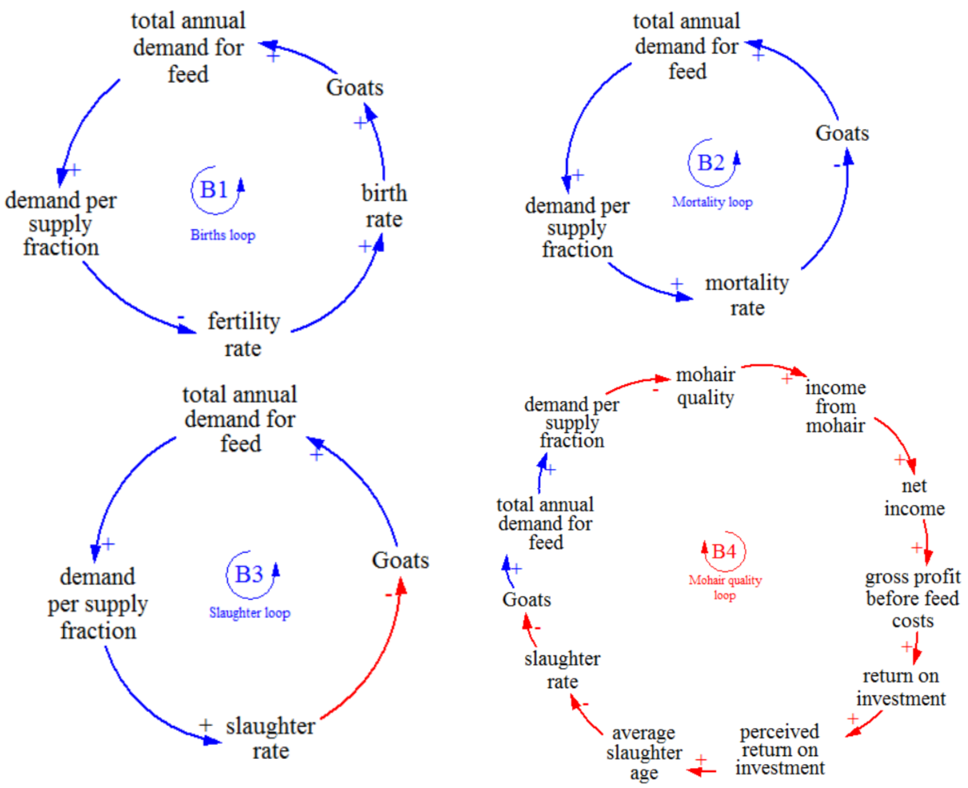

Figure 11: Demand per supply related feedback loops

Feed from the available veld

Unlike most System Dynamics carrying capacity models, MoPPEM is not constrained to a fixed surface area. The surface area can change as farmer needs change since space is abundant in South Africa. In practice, it depends on what farmers decide to utilize land for – if Angora goats are not farmed it is likely that something else will be farmed on a particular piece of land. The model assumes that the total surface area allocated to goats are dependent on the number of goats kept, with a certain perception delay. Additionally, the veld carrying capacity per unit of surface area fluctuates depending on the amount of grazing (veld degradation rate) as well as the recovery rate. The veld degradation rate is estimated as the difference between the “total annual demand for feed per area” and the “available feed supplement per area”. This means that whatever feed that is required (that is dependent on population size) is not provided supplementary, will be taken from the land through grazing. The recovery rate is positively related to the current carrying capacity per unit of surface area as well as the annual rainfall.

The main feedback loop relating to available feed is presented in Figure 12.

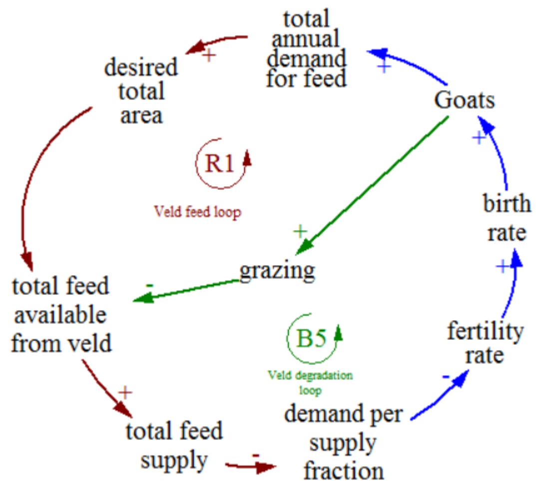

Figure 12: Feed from available veld related feedback loops

Feed that is bought

Feed is bought if: (a) the natural carrying capacity would be depleted without supplementing feed; and (b) there is enough capital left over after recouping all overhead costs to afford supplementary feed. The capital available refers to the farmers’ perception of his cash flow in the last couple of months. This formulation is preferred over the ongoing accumulation of all income and expenditures to determine viability of feed purchases because it better represents the farmers’ mental model and is more accurate since “mistakes” in estimation of these values are not accumulated throughout the entire simulation time.

The main feedback loop relating to feed that is bought is presented in Figure 13.

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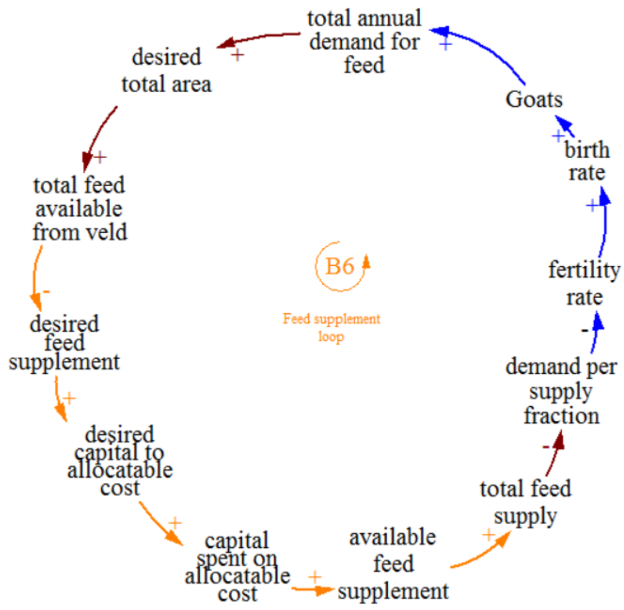


Figure 13: Feed supplement feedback loop

Net profit

An abundant demand per supply fraction results in net population growth in the case where the net profit is satisfactory. Apart from resource scarcity, financial incentive is the other driver of Angora goat farming. The Net profit from Angora goat farming is estimated as: "net income – overhead costs – capital spent on allocatable costs" where the majority of the allocatable cost is supplementary feed costs.

- Net income: potential income sources are mohair, meat and skin sales. Mohair income occurs gradually throughout the life of the Angora goats. A longer lifespan therefore implies a greater total income from mohair per goat. As mentioned earlier, mohair income can be negatively affected by resource scarcity. In contrast, income from meat and skin occurs once upon slaughter and is mostly independent from the age of slaughter.
- Overhead costs: this formulation of overhead costs explicitly excludes the supply of any supplementary feed. The primary sources of overhead costs are wages and rations, asset repairs as well as fuel and oil. Overhead costs occur gradually throughout any goat's lifespan similar to income from mohair.
- Allocatable costs: feed purchases represents the majority of total allocatable costs. Other allocatable costs are animal medical expenses, marketing and shearing costs. As mentioned earlier, feed is bought (a) if the natural carrying capacity would be depleted without supplementing feed AND (b) there is enough capital left over after recouping all running costs to afford supplementary feed.

Note that net income does not affect any naturally occurring production processes (fertility or mortality) but rather only the farmer's decision on size. This is manifested by perceived return on investment only affecting slaughter rate while demand per supply fraction affects birth rate, mortality rate and death rate.

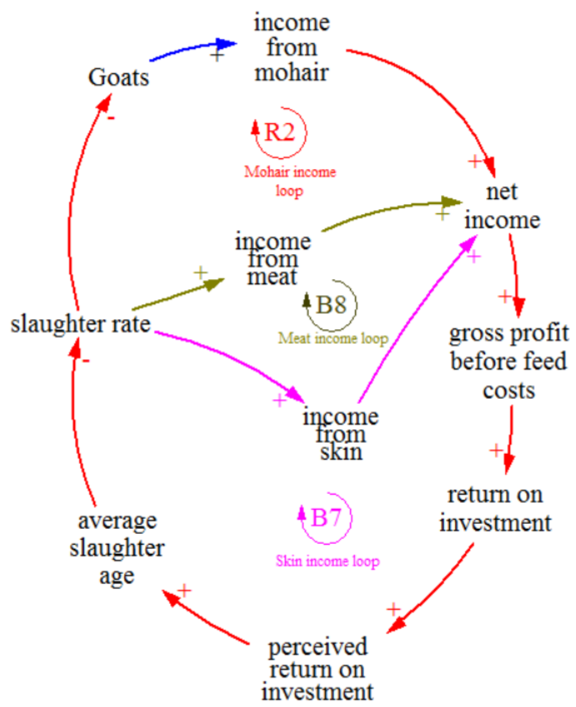


Figure 14: Primary producer income related feedback loops

Figure 15 shows the combined MoPPEM loops, which represent the dynamic hypothesis in the primary production echelon. It should be noted that other dynamics are also observed and captured in stock and flows structures, detailed in section 3.3.

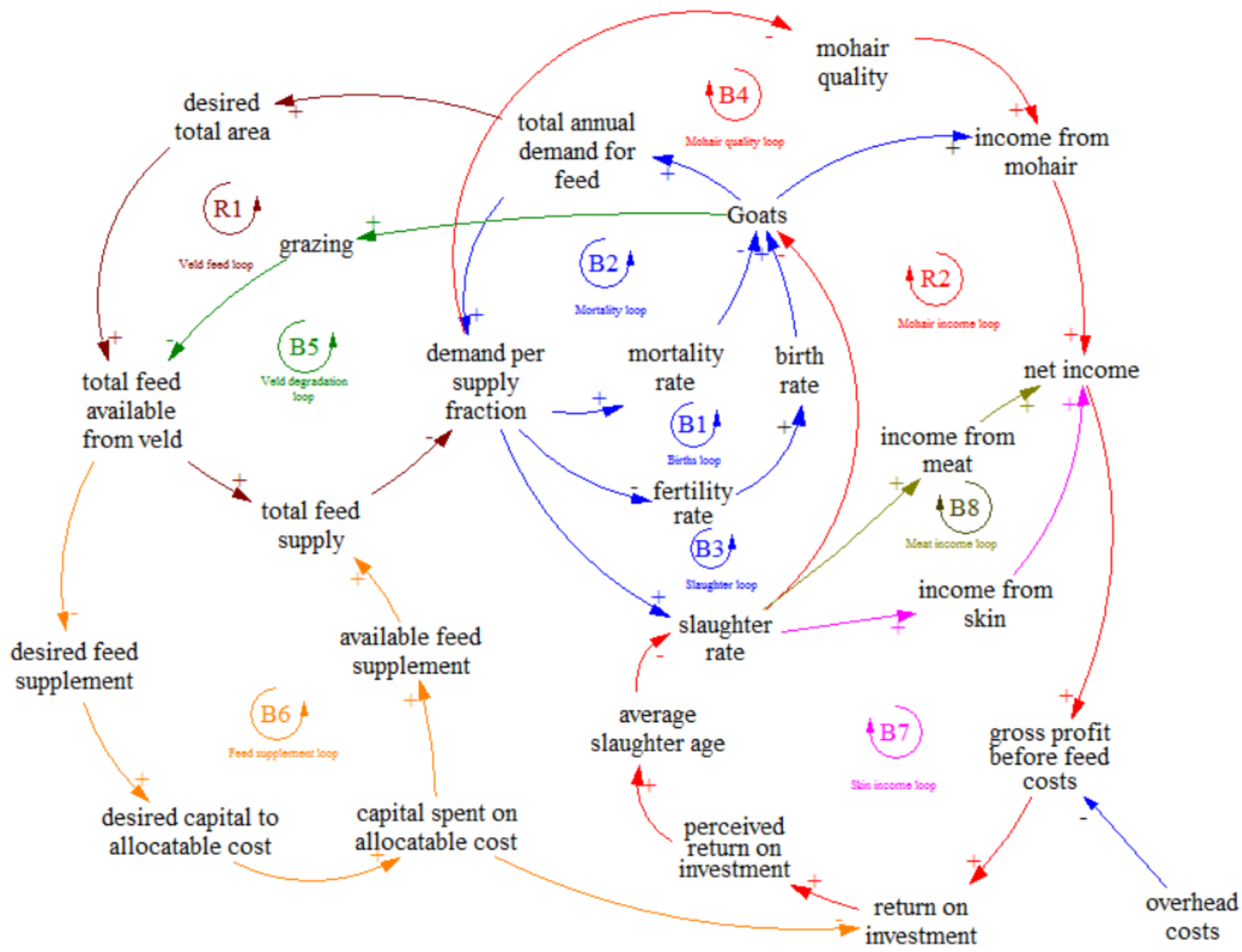


Figure 15: Aggregate MoPPEM causal loops

3.3 Detailed MoPPEM Structure

The structure of the detailed MoPPEM consists of 6 main sub-models (sectors): Angora goat production; mohair production; carcass production; skin production; resource scarcity; and producers' income. An aggregated MoPPEM stock and flow diagram is initially set in equilibrium to highlight the interconnectedness between the six sub-models, the main feedback loops and the disturbances that influence the outputs of mohair, carcass and skin.

3.3.1 Angora Goat Production Sector

- The Angora goat production sector represents the quantities of goats and their transition from one age group to the next, over time, broken into 7 categories as follows: Unborn Kids; Newborn Kid; Summer Kids; Winter Kids; Young Goats; Kapaters; and Breeding Goats.
- This classification was developed based on interviews with primary producers and their relevance in the Mohair Primary Production Echelon.
- It involves activities that relate to breeding Angora goats in order to shear based on age and or season (winter or summer), as well as managing the stock of mature goats through slaughtering.
- The dynamics involved in each goat group category, which essentially defines assumptions that were made, are as follows:
    - The stock of unborn kids is explicitly represented, which is usually unobserved stock

- Conception rate and Birth rate increase stocks of Unborn Kids and Newborn Kids respectively, while the movement to other stocks is due to aging.
- Mortality rate is the main determinant of the dynamics of all the stocks in the aging chain, which is higher for Newborn Kids
- There is one breeding season per annum. All ewes do not give birth every year. This is due to health, genetics and nutrition. Farmers always strive for the maximum birth rate possible. There is never a situation where farmers would intervene to stop potential conception.
- Ewes conceive once a year, and the gestation period is 148 days.
- Female young goats past a certain maturity level (2 years minus gestation period) can become pregnant along with the mature breeding stock.
- Most males are castrated as kids (Kapaters) in general farming and are kept along with ewes for their mohair.
- Slaughtering only occurs in Kapaters and Breeding stock.
- Scarcity of veld influences fertility rate, which in turn affects birth rate.

Table 3: Parameters in Angora goat production sector

Parameter	Description	Value	units	Source
MAXIMUM CONCEPTION FRACTION PER BREEDING SEASON	The number of kids produced per goat in the breeding stock per season assuming no resource scarcity.	0.7	Dimensionless (Dmnl)	Capacity Building Workshop, June 2017
MINIMUM MISCARRIAGE FRACTION	The fraction of the total pregnancies that end in miscarriage assuming no resource scarcity. This fraction includes stillborn goats.	0.2	Dmnl	Capacity Building Workshop, June 2017
MINIMUM NEWBORN KID MORTALITY FRACTION	The fraction of newborn kids that die before becoming summer kids assuming no resource scarcity.	0.1	Dmnl	Capacity Building Workshop, June 2017
MINIMUM SUMMER KIDS MORTALITY FRACTION	The fraction of summer kids that die before becoming winter kids assuming no resource scarcity.	0.05	Dmnl	Capacity Building Workshop, June 2017
MINIMUM WINTER KIDS MORTALITY FRACTION	The fraction of winter kids that die before becoming young goats assuming no resource scarcity.	0.05	Dmnl	Capacity Building Workshop, June 2017
MINIMUM YOUNG GOAT MORTALITY FRACTION	The fraction of young goats that die before becoming either mature breeding stock or kapaters assuming no resource scarcity.	0.05	Dmnl	Capacity Building Workshop, June 2017
MINIMUM BREEDING GOATS MORTALITY FRACTION PER YEAR	The fraction of breeding goats lost to predators, theft or any other vulnerability assuming no resource scarcity.	0.05	Dmnl	Capacity Building Workshop, June 2017
MINIMUM KAPATERS MORTALITY FRACTION PER YEAR	The fraction of kapaters lost to predators, theft or any other vulnerability assuming no resource scarcity.	0.05	Dmnl	Capacity Building Workshop, June 2017
FRACTION OF FEMALE POPULATION	The fraction of the total young goats that are female.	0.5	Dmnl	Modeler hypothesis, based on assumption that there is 50 chance of male or female goats
GESTATION PERIOD	The average duration of Angora goat pregnancy	148	Days	http://www.angoragoat.com/kidding.html
TABLE FOR SCARCITY ON FERTILITY	Shows the relationship between demand per supply fraction (scarcity) and its effect on the on the ability of goats to reproduce. Reproductive abilities decrease during periods of shortage.			Modeler hypothesis, based on qualitative primary producer interviews
TABLE FOR SCARCITY ON MORTALITY	Shows the relationship between demand per supply fraction (scarcity) and its effect on the on the mortality. Mortality rate increases during periods of shortage.			Modeler hypothesis, based on qualitative primary producer interviews
TABLE FOR SCARCITY ON SLAUGHTER AGE OF KAPATERS	Shows the relationship between demand per supply fraction (scarcity) and its effect on the Kapaters slaughtering age. Slaughtering rate is higher at younger age during periods of shortage.			Modeler hypothesis, based on qualitative primary producer interviews
TABLE FOR SCARCITY	Shows the relationship between demand per			Modeler hypothesis, based on

ON SLAUGHTER AGE OF BREEDING GOATS	supply fraction (scarcity) and its effect on the breeding goats slaughtering age. Slaughtering rate is higher at younger age during periods of shortage.			qualitative primary producer interviews
ELASTICITY OF MISCARRIAGE ON MORTALITY	The responsiveness of the miscarriage rate to resource scarcity.	2	Dmnl	Modeler hypothesis, based on qualitative primary producer interviews
ELASTICITY OF NEWBORN KID MORTALITY	The responsiveness of the newborn kid mortality rate to resource scarcity.	1.8	Dmnl	Modeler hypothesis, based on qualitative primary producer interviews
ELASTICITY OF SUMMER KID MORTALITY	The responsiveness of the summer kid mortality rate to resource scarcity.	1.6	Dmnl	Modeler hypothesis, based on qualitative primary producer interviews
ELASTICITY OF WINTER KID MORTALITY	The responsiveness of the winter kid mortality rate to resource scarcity.	1.3	Dmnl	Modeler hypothesis, based on qualitative primary producer interviews
ELASTICITY OF YOUNG GOAT MORTALITY	The responsiveness of the young goat mortality rate to resource scarcity.	1.1	Dmnl	Modeler hypothesis, based on qualitative primary producer interviews
ELASTICITY OF KAPATER MORTALITY	The responsiveness of the Kapater mortality rate to resource scarcity.	1	Dmnl	Modeler hypothesis, based on qualitative primary producer interviews
ELASTICITY OF BREEDING GOAT MORTALITY	The responsiveness of the breeding goat mortality rate to resource scarcity.	1.1	Dmnl	Modeler hypothesis, based on qualitative primary producer interviews

Note: Policy variables = Blue; Scenario Variables = Red; Parameter assumptions = Green; Model switches = Purple

3.3.2 Mohair Production Sector

- This is directly linked with the Angora goat production and involves shearing the goats for mohair
- Goats spend half a year (6 months) in each juvenile stock (from Newborn Kids to Young Goats). Hence, to accurately capture the mohair production and income from juvenile goats, the flow of the aging juveniles was utilised and not the total homogenous stock quantities. Using total homogenous stock quantities would undervalue the actual income per goat from a technical perspective. According to the primary producers' interviews, each type of goat gets sheared once before "moving on to the next stock".
- Shearing begins 6 months after birth. Summer kids and winter kids sheared once as they move along the aging chain. Hence, the first shear occurs at six months age.
- Shearing for Young Goats, Kapaters and Breeding goats occurs twice a year (in Summer and Winter)
- Mohair is always sold upon shearing
- Mohair quality is affected by resource scarcity and age
- As demand per supply increases, the quality of mohair decreases implying price received from mohair decreases.

Table 4: Parameters in mohair production sector

Parameter	Description	Value	Units	Source
MOHAIR YIELD FOR SUMMER KIDS	The amount of mohair produced when shearing one goat.	0.4	kg/goat/shearing	Capacity Building workshop, June 2017
MOHAIR YIELD FOR WINTER KIDS	The amount of mohair produced when shearing one goat.	0.65	kg/goat/shearing	Capacity Building workshop, June 2017
MOHAIR YIELD FOR YOUNG GOATS	The amount of mohair produced when shearing one goat.	1	kg/goat/shearing	Capacity Building workshop, June 2017
MOHAIR YIELD FOR KAPATERS	The amount of mohair produced when shearing one goat.	1.7	kg/goat/shearing	Capacity Building workshop, June 2017
MOHAIR YIELD FOR BREEDING GOATS	The amount of mohair produced when shearing one goat.	1.7	kg/goat/shearing	Capacity Building workshop, June 2017
TABLE FOR EFFECT OF QUALITY ON PRICE	Shows the relationship between demand per supply fraction (scarcity) and its effect on the mohair price. Mohair produced during periods of resource abundance is worth more than		Dmnl	Modeler hypothesis, based on qualitative primary producer interviews

	mohair produced during times of scarcity.			
ELASTICITY OF SCARCITY ON SUMMER KID MOHAIR QUALITY	The responsiveness of the summer kid mohair price to a quality discrepancy due to resource scarcity.	1.5	Dmnl	Modeler hypothesis, based on qualitative primary producer interviews
ELASTICITY OF SCARCITY ON WINTER KID MOHAIR QUALITY	The responsiveness of the winter kid mohair price to a quality discrepancy due to resource scarcity.	1.2	Dmnl	Modeler hypothesis, based on qualitative primary producer interviews
ELASTICITY OF SCARCITY ON YOUNG GOAT MOHAIR QUALITY	The responsiveness of the young goat mohair price to a quality discrepancy due to resource scarcity.	1.4	Dmnl	Modeler hypothesis, based on qualitative primary producer interviews
ELASTICITY OF SCARCITY ON KAPATER MOHAIR QUALITY	The responsiveness of the kapater mohair price to a quality discrepancy due to resource scarcity.	1	Dmnl	Modeler hypothesis, based on qualitative primary producer interviews
ELASTICITY OF SCARCITY ON BREEDING GOAT MOHAIR QUALITY	The responsiveness of the breeding goat mohair price to a quality discrepancy due to resource scarcity.	1.2	Dmnl	Modeler hypothesis, based on qualitative primary producer interviews

Note: Policy variables = Blue; Scenario Variables = Red; Parameter assumptions = Green; Model switches = Purple

3.3.3 *Carcass Production Sector*

- This is directly linked with the Angora goat production and involves disposal of mature goats, Breeding Goats and Kapaters, through slaughtering.
- The decision to slaughter Breeding Goats and Kapaters depends on the maturity and physical aging of each animal only as well as the perceived return on investment.

Table 5: Parameters in carcass production sector

Parameter	Description	Value	Units	Source
MAXIMUM SLAUGHTER AGE OF KAPATERS	The maximum age at which farmers slaughter Kapaters. This value represents the reference mode that reflects reality.	8	years	Capacity Building workshop, June 2017
MAXIMUM SLAUGHTER AGE OF BREEDING GOATS	The maximum age at which farmers slaughter breeding goats. This value represents the reference mode that reflects reality.	8	years	Capacity Building workshop, June 2017
MEAT YIELD PER GOAT	The average amount of meat produced per goat slaughtered.	35	Kg/Goat	Stakeholder workshop, November 2017
MEAT PRICE PER KG	The income received by the producer per kg of angora goat meat.	11	R/kg	Stakeholder workshop, November 2017

Note: Policy variables = Blue; Scenario Variables = Red; Parameter assumptions = Green; Model switches = Purple

3.3.4 *Skin Production Sector*

- This is directly linked with the Angora goat production during the disposal of the mature goats – slaughtering
- For every goat slaughtered, there is goat skin that can become a potential source of income.

Table 6: Parameters in skin production sector

Parameter	Description	Value	Units	Source
MAXIMUM SLAUGHTER AGE OF KAPATERS	The maximum age at which farmers slaughter Kapaters. This value represents the reference mode that reflects reality.	8	years	Capacity Building workshop, June 2017
MAXIMUM SLAUGHTER AGE OF BREEDING GOATS	The maximum age at which farmers slaughter breeding goats.	8	years	Capacity Building workshop, June 2017

	This value represents the reference mode that reflects reality.			
SKIN YIELD PER GOAT	The number of skins produced per goat upon slaughter.	1	Skin/Goat	Modeler hypothesis, based on qualitative primary producer interviews
SKIN PRICE PER PIECE	The potential income generated per skin with additional market development.	50	Rand/Skin	Modeler hypothesis, based on qualitative primary producer interviews

Note: Policy variables = Blue; Scenario Variables = Red; Parameter assumptions = Green; Model switches = Purple

3.3.5 *Resource scarcity sub-model*

- An implicit underlying structural assumption is that the industry is striving to increase the Angora goat population under all environmental and economic circumstances: the only things preventing the industry from rapid expansion of Angora goat farming is resource scarcity, theft, illness etc.
- Resource scarce environment (veld capacity) has a significant impact on the conception rate, birth rate as well as kid mortality rate.
- This sub-model represents the availability of veld, which has a major influence on the fertility and hence, birth rate
- It consists of two stocks: *Total Veld Size in Hectare*, *Veld Carrying Capacity in kg of Feed per Hectare*
- Veld is degraded when goats consume veld faster than the veld can replenish itself; veld replenishment is assumed to be affected by drought
- Resource scarcity influences the need to provide food supplement

Table 7: Parameters in Resource scarcity production sector

Parameter	Description	Value	Units	Source
DESIRED UTILISATION FRACTION OF VELD CARRYING CAPACITY	The desired fraction of the maximum carrying capacity that farmers aim to maintain their veld at.	0.8	Dmnl	Modeler hypothesis, , based on qualitative primary producer interviews
RAINFALL	The annual rainfall in South Africa nano meter per year.		Nm/Year	Quantec EasyData
EXPECTED RAINFALL	The expected amount of rainfall expected in South Africa. The average rainfall in South Africa from 1994 to 2015 in nano meters per year.	4.68834e+008	Nm/Year	Quantec EasyData
VELD RECOVERY ADJUSTMENT TIME	The veld recovery adjustment time. The time it takes to replenish carrying capacity.	1	Year	Modeler hypothesis, based on qualitative primary producer interviews
VELD RECOVERY ELASTICITY	The responsiveness of the veld recovery rate to rainfall.	1	Dmnl	Modeler hypothesis, based on qualitative primary producer interviews
CARRYING CAPACITY ELASTICITY	The responsiveness of amount of grazing to the current state of the carrying capacity.	2	Dmnl	Modeler hypothesis, based on qualitative primary producer interviews
VELD SIZE ADJUSTMENT TIME	The average amount of time it takes a producer to change the veld size whenever a change in goat population size occurs.	5	Year	Modeler hypothesis, based on qualitative primary producer interviews
FEED DEMAND FOR NEWBORN KID PER YEAR	The extra feed a nursing mother requires when raising a newborn.	40	Kg/year/goat	McGregor (2005)
FEED DEMAND FOR SUMMER KID PER YEAR	The annual feed requirements per goat per year.	182.5	Kg/year/goat	McGregor (2005)
FEED DEMAND FOR WINTER KID PER YEAR	The annual feed requirements per goat per year.	182.5	Kg/year/goat	McGregor (2005)
FEED DEMAND FOR YOUNG GOAT	The annual feed requirements per	228.5	Kg/year/goat	McGregor (2005)

PER YEAR	goat per year.			
FEED DEMAND FOR KAPATER PER YEAR	The annual feed requirements per goat per year.	310	Kg/year/goat	McGregor (2005)
FEED DEMAND FOR BREEDING GOAT PER YEAR	The annual feed requirements per goat per year.	310	Kg/year/goat	McGregor (2005)

Note: Policy variables = Blue; Scenario Variables = Red; Parameter assumptions = Green; Model switches = Purple

3.3.6 Producers’ income sub-model

- This sub-model represents the primary producers income and the decision making process relating to breeding, slaughtering and feed provision. The producers’ income is mainly from mohair, skin and carcass.
- There are two stocks in this sub-model: *Perceived Capital Available for Feed per Year* as well as *Perceived Return on Investment*
- Running expenses influences the return on investment, which in turn affects the producers’ perceived return on investment and perceived available capital for feed.
- Mohair price is exogenously determined and received in local currency
- Kapaters and breeding goat are assumed to have same weight and price of live goat

Table 8: Parameters in producers’ income sector

Parameter	Description	Value	Units	Source
BASELINE MOHAIR INCOME FOR SUMMER KIDS	The amount of income received per kg of mohair.	341.91	Rand/kg	See note below the table
BASELINE MOHAIR INCOME FOR WINTER KIDS	The amount of income received per kg of mohair.	285.29	Rand/kg	See note below the table
BASELINE MOHAIR INCOME PER YOUNG GOAT SHEAR	The amount of income received per kg of mohair.	260.67	Rand/kg	See note below the table
BASELINE MOHAIR INCOME PER KAPATER SHEAR	The amount of income received per kg of mohair.	187.865	Rand/kg	See note below the table
BASELINE MOHAIR INCOME PER BREEDING GOAT SHEAR	The amount of income received per kg of mohair.	187.865	Rand/kg	
TABLE FOR RETURN ON INVESTMENT ON SLAUGHTER AGE OF KAPATERS	Represents the relationship between return on investment and the decision of the primary producer to slaughter Kapaters. Higher return on investment results in slaughtering at later age		Dmnl	Modeler hypothesis ,based on qualitative primary producer interviews
TABLE FOR RETURN ON INVESTMENT ON SLAUGHTER AGE OF BREEDING GOATS	Represents the relationship between return on investment and the decision of the primary producer to slaughter breeding goats at younger age. Higher return on investment results in slaughtering at later age		Dmnl	Modeler hypothesis, based on qualitative primary producer interviews
EFFECT OF RETURN ON INVESTMENT ON DEMAND PER SUPPLY FRACTION ELASTICITY	The responsiveness of amount of the return on investment on the demand per supply fraction.	0.5	Dmnl	Modeler hypothesis, based on qualitative primary producer interviews
TIME FOR FARMER TO PERCEIVE CHANGE IN INCOME	The average time it takes a farmer to perceive a change in the amount of capital available to spend on feed.	1	Year	Modeler hypothesis, based on qualitative primary producer interviews
COST PER EWE	The production cost per ewe.	243.72	Rand/Goat	Deon Saayman reporting on August 2017
TOTAL COST PER HECTARE	The estimated total cost per hectare.	459.87	Rand/HA	Deon Saayman reporting on August 2017
BASELINE OVERHEAD COST PER KG OF MOHAIR PRODUCED	The estimated overhead cost per kg of mohair. Produced roughage and pastures (R 11/kg mohair) as well as overhead costs (R 69/kg mohair).	80	Rand/kg	Deon Saayman reporting on August 2017
BASELINE ALLOCATABLE COST PER HECTARE	The total allocatable cost per hectare. Includes feed, Vet etc.	127	Rand/HA	Deon Saayman reporting on August 2017
MINIMUM ACCEPTABLE RETURN ON INVESTMENT	The minimum acceptable return on investment for the farmer to consider Angora goat farming to be a feasible	1.9	Dmnl	Modeler hypothesis

	business.			
THRESHOLD FRACTION OF RUNNING COST FOR FEED INVESTMENT	The fraction of the running costs reserved for expenditure other than feed expenditure. This is the minimum dividend the farmer needs to sustain himself/herself.	0.3	Dmnl	Modeler hypothesis

Note: Policy variables = Blue; Scenario Variables = Red; Parameter assumptions = Green; Model switches = Purple

Note: http://www.mohair.co.za/uploads/auction/results/201715MarketReport.pdf and http://www.mohair.co.za/uploads/auction/results/201706MarketReport.pdf

3.4 MoPPEM Scenario Definition

MoPPEM was utilized to examine primary producer decision points and their respective impacts on key mohair Industry indicators. The outcomes of the Capacity Building Workshop held on 12-14 June 2017 guided the development of these scenarios, which were: (a) Baseline Scenario; (b) Elke jaar is 'n maer jaar' scenario; (c) Genetic oriented Scenario, (d) Total value addition scenario and (e) Population vulnerability Scenario (Table 9). The technical description of disturbances that relates to each of the scenarios is detailed in Table 10.

Table 9: Description of MoPPEM scenarios

Scenario	Description
Baseline scenario	General continuation of the current primary production activities. Income source is only from mohair production. Meat and skin is not contributing to the primary producers' income.
'Elke jaar is 'n maer jaar' scenario	Continuous non-conducive weather patterns and how the primary producers respond to the hostile environment. Income source from mohair production
Genetic oriented scenario	No irregular disturbances relating to weather patterns. Income source only from mohair production. Consideration of genetic oriented mohair hair production. Kidding on average is around 70-80% but with genetics programme, this could be close to 100%
Total value addition scenario	Consideration of mohair value adding related activities, meat and skin, as part of income generation.
Population vulnerability scenario	Consideration to reduce Angora goat stock from predators, fires and theft. Income is only from mohair production.

Table 10: Technical description of MoPPEM disturbances

Scenario	Activation parameter	Technical description of disturbance	Parameter values
Baseline scenario	None; All variables starting with the word "TEST" equal to 0		
'Elke jaar is 'n maer jaar' scenario	TEST MAER JAAR = 1	Environmental hardship is depicted by a continuous drought spanning multiple years. A 40% step decrease in rainfall, followed by a return to the average rainfall after five years.	DROUGHT START TIME = 2020; DROUGHT DURATION = 5 years; FRACTION OF AVERAGE RAINFALL = 0.4
Genetic oriented scenario	TEST GENETICS = 1	The kidding rate is increased through genetic management. This entails a ramp increase of 20% for the conception rate as well as a ramp decrease of 50% for the miscarriage rate. These rates are ramped over a 10 year period since genetic management implementation cannot happen suddenly and takes a while to implement.	GENETIC START TIME = 2020; GENETICS DURATION = 10 years; FRACTIONAL DECREASE IN MISCARRIAGE = 0.1; FRACTIONAL INCREASE IN CONCEPTION = 0.1
Total value addition scenario	TEST VALUE ADDITION = 1	An increase in value of other Angora goat products result in an overall increase in profitability of farming. A step increase of current meat selling price is simulated through for example, strengthening networks with South Africa retailers and promoting Angora goat meat as nutritious and delicious alternative to South Africa middle-class.	VALUE ADDITION DISTURBANCE DURATION = 2020; VALUE ADDITION DISTURBANCE DURATION = 10; FRACTIONAL PRICE DISTURBANCE = 15;
Population vulnerability scenario	TEST POPULATION VULNERABILITY = 1	Predators, fires and theft drastically wipe out the Angora goat population of South Africa in a very short amount of time (in this case three months). The disturbance is depicted using a PULSE function where the goat natural mortality rate is increased by a factor of 50 for a duration of three months.	POPULATION VULNERABILITY START TIME = 2020; POPULATION VULNERABILITY DURATION = 3/12 year; FRACTIONAL CHANGE IN MORTALITY RATE = 50

3.5 MoPPEM Model Validation

System Dynamics entails a suite of tests to validate models to improve the confidence in their use for the purpose for which they were developed (see Barlas, 1996). The validation tests applied to MoPPEM include:

- *Structural validation*: This involved comparing the model system with what is practically known in the mohair primary production, as well as what is expected in reality. It involved checking the parameters consistency with the available empirical knowledge. As an illustration, it is not possible to have negative goat production. Further, SDM-Doc, which is a tool developed for model validation and verification (see Martinez-Moyano, 2012), was also utilised to provide a full documentation of model parameters.

- *Behavioural validation*: involving the comparison of model results with historical data. This was done for the variables in which historical data was available for the periods 1994 – 2016. Model variables were not necessarily meant to reproduce all the historical data but to at least provide similar behaviour pattern.

- *Sensitivity analysis*: this was undertaken for the parameters with high uncertainty. It was assumed that the changes in the uncertain parameters would take place from 2017.

- *Expert opinion*: this was based on the capacity building workshop, interviews with the primary producers, review by the South Africa Mohair Cluster and inputs from stakeholder workshop

- In addition, literature sources were utilised for some unknown variables within South African context. E.g. extra feed requirements when breeding goat is pregnant and nursing was obtained from Australian Cashmere Growers Association[18]. In other cases, where historical data was available, calibration was done to provide optimal estimates of parameters.

[18] www.acga.org.au

PART IV: PHASE I MODELLING RESULTS

This section highlights key MoPPEM results. The purpose is to utilise the results as discussion points to identify and highlight the future of mohair production.

4 MoPPEM SIMULATION RESULTS

4.1 Baseline scenario

MoPPEM baseline scenario presents the key mohair industry indicators. The available data trend for some variables for the period 1994-2016 was compared against the model output. The purpose was not to replicate point on point historical behaviour, but to improve the confidence in the model usability based on the match of baseline projections with historical behaviour.

Figure 16 presents total goat production and shows the capability of MoPPEM in replicating historical trends. The match is generally good, with the exception of the period 1999 to 2001. This could be due to either the absence of an important factor influencing production that is not captured in the model or severe data inaccuracies. It was thus assumed that an event happened, exogenous from the system depicted, that influenced the average running cost per kg of mohair produced. Even though the specific event is not modelled, the effects of said event were taken into account.

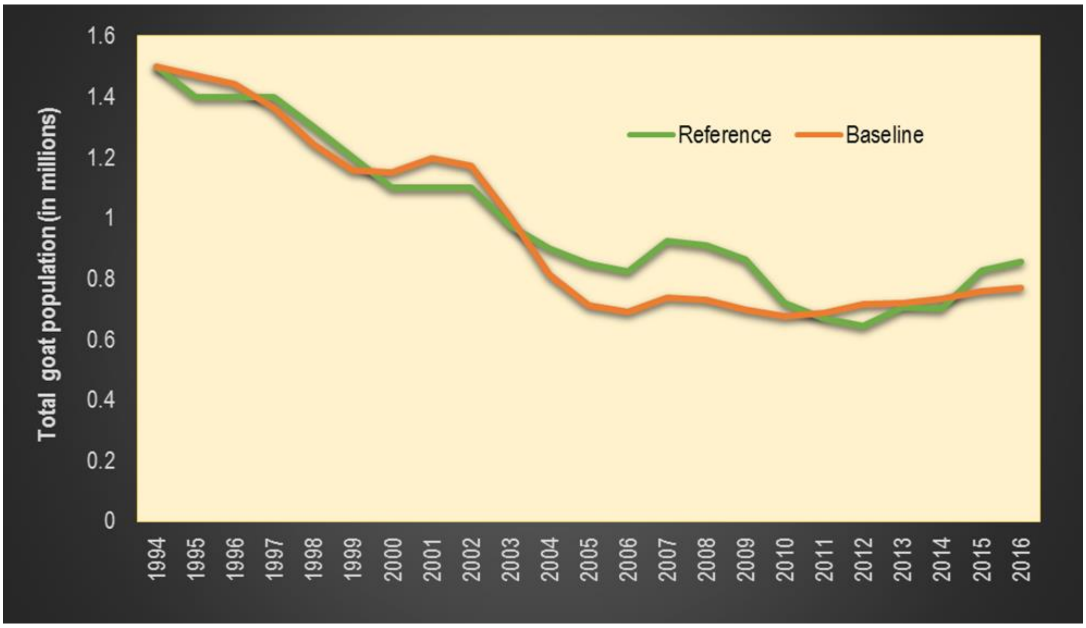
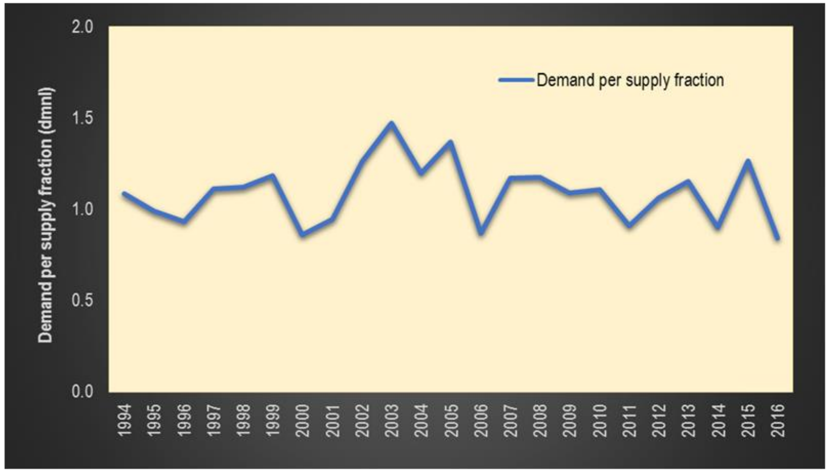


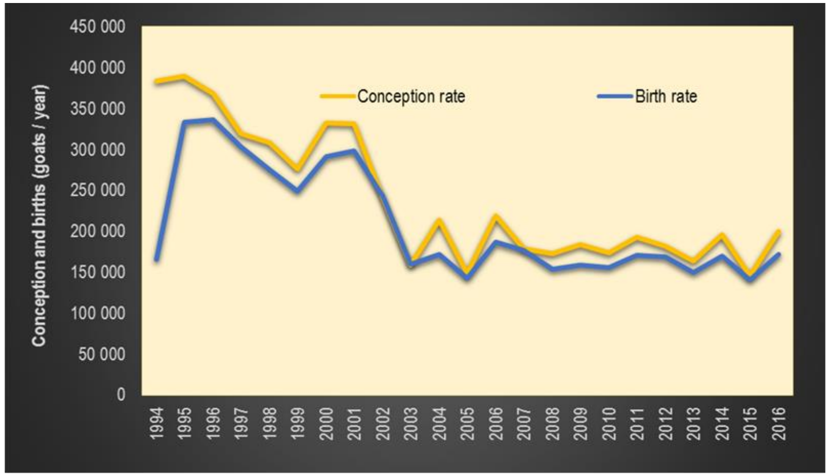
Figure 16: Comparison of total goat population in baseline with data

The evidence of this possibility is observed in other key baseline results indicators presented in Figure 17, namely: demand per supply fraction, fertility rates, kidding fraction, slaughtering rates, goats categorised by age and gender, mortality rates, perceived return on investment and effect on quality on income per goat.

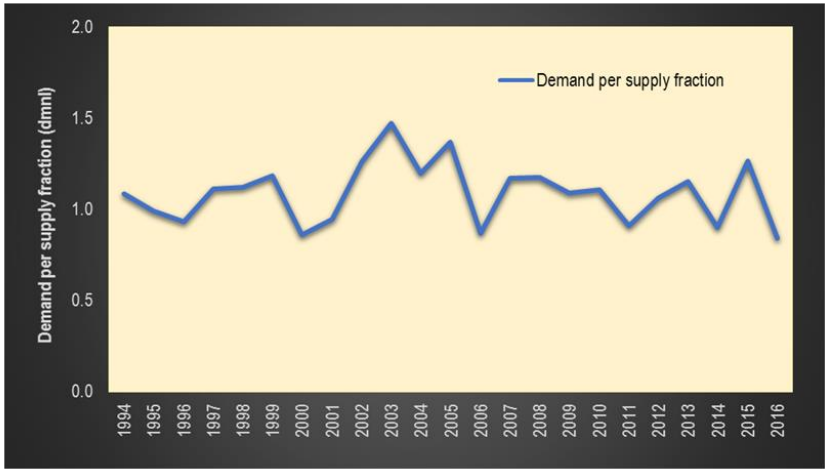
- The lower the demand per supply fraction the better; this implies feed availability which in turn results in increased fertility and mohair quality, and decreased mortality and slaughtering age.
- Farmers' decision on slaughtering rates is that they are quick to slaughter Kapaters; breeding stock is slaughtered last.
- Mortality rates of breeding stocks and Kapaters is high due to their large numbers.



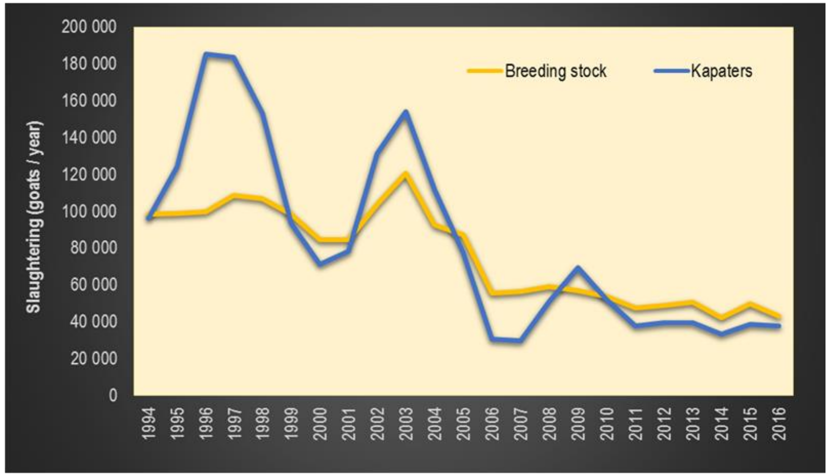
a) Demand per supply fraction, baseline



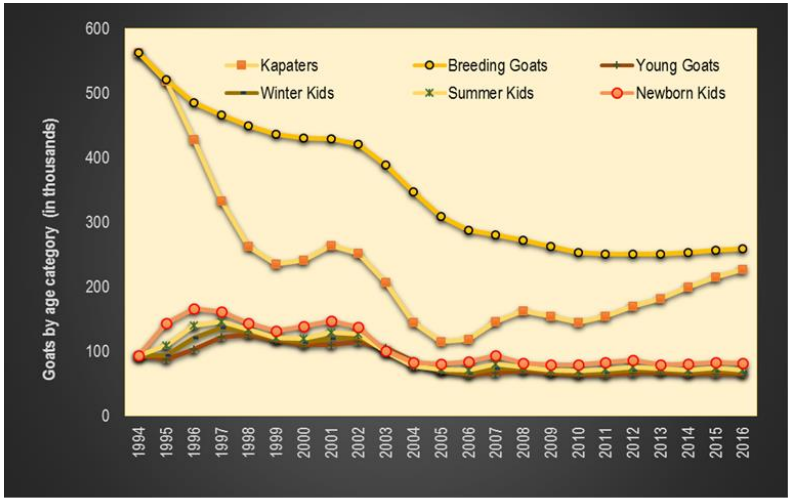
b) Birth rate and conception rate, baseline



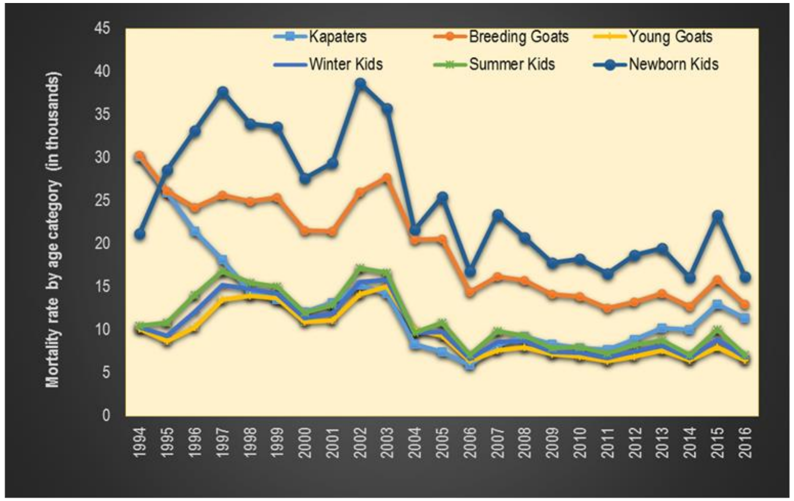
c) Kidding fraction, baseline



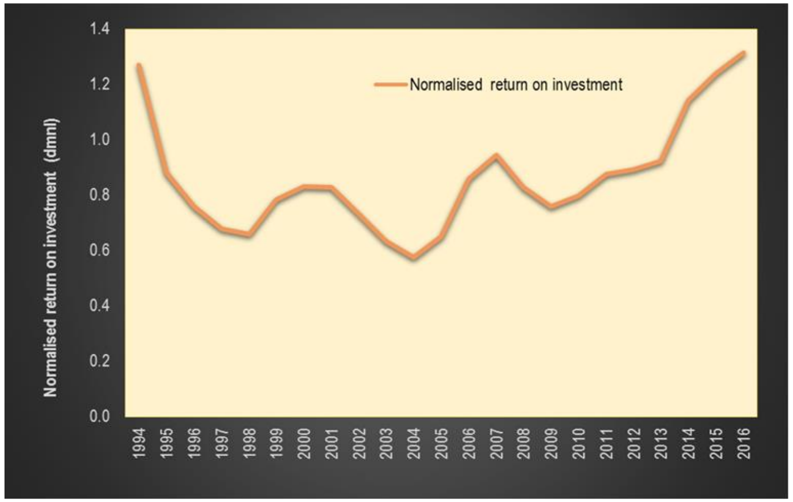
d) Slaughtering rates, baseline



e) Goats categorised by age and gender, baseline



f) Mortality rates, baseline



g) Normalised return on investment, baseline

h) Reference effect of quality on income per goat, baseline

Figure 17: Other relevant indicators, baseline

When goat production data was replicated as shown in Figure 16, then the mohair production simulation results is lower than the historical data and vice versa (see Figure 18). Some possibilities for this discrepancy could be that: (i) the total goat production data does not fully capture the goat population; or (ii) the average shearing per goat has been changing over time or the mohair production. However, despite the discrepancies, MoPPEM accurately represents the structure of the primary production as mohair production baseline result similarly follows behavior pattern observed in the historical data.

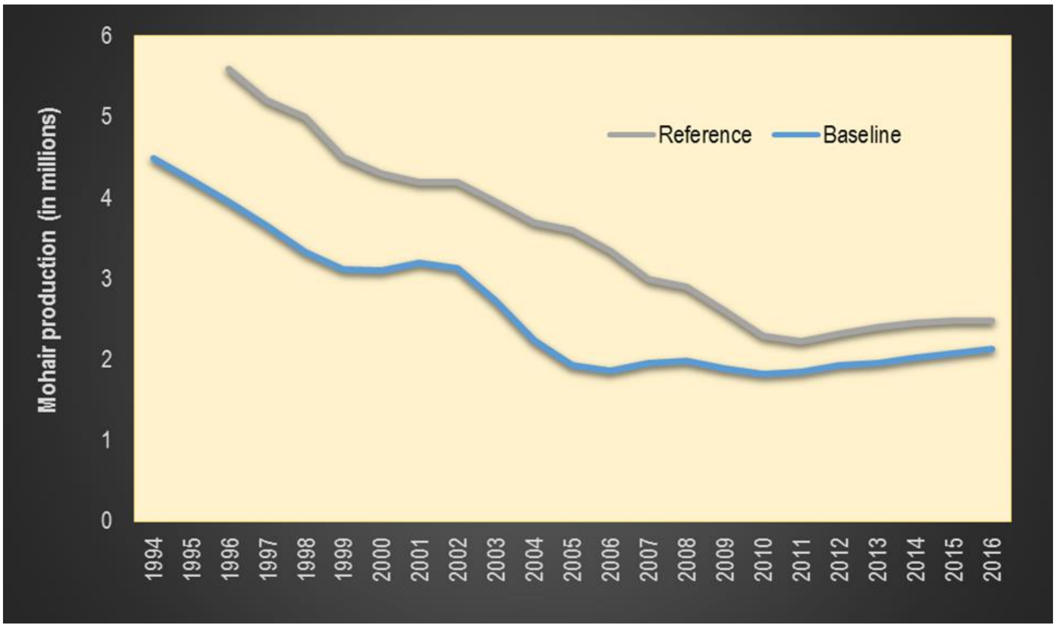


Figure 18: Comparison of total mohair production in baseline with data

Based on the expert opinion validation[19], Angora goat production data is estimated from mohair production data; hence, accurate Angora goat production data is unavailable. Thus, assuming that Angora goat production data is inaccurate, mohair production data was replicated (Figure 19), and the total Angora goat production baseline results adjusted to approximate the reference mohair production, as shown in Figure 20. The scenario analysis parameters were also examined using the mohair production initialisation baseline results (Figure 19 and Figure 20).

[19] Deon Saayman, Personal Communication, 4 December 2017

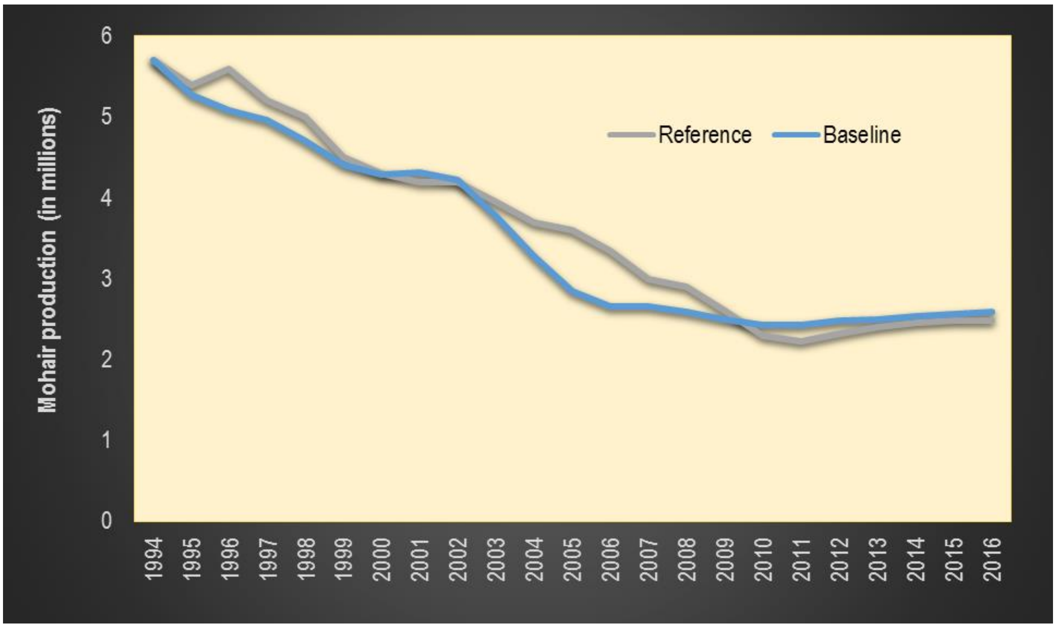


Figure 19: Validation using mohair production data as reference and comparison with baseline results

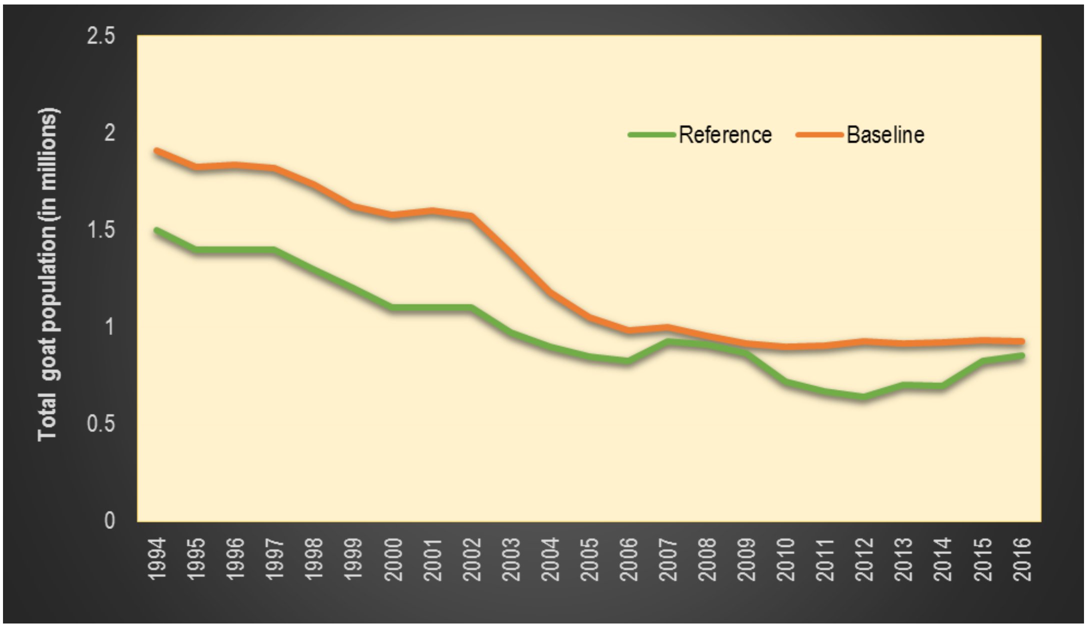


Figure 20: Adjusted goat production baseline results to approximate reference mohair production

4.2 **Scenario analysis**

This section provides an analysis and comparison of the key indicators from the four scenarios relative to the baseline.

4.2.1 Total goat production

Increasing the total goat production is of particular interest in reviving and enhancing the mohair industry sustainability. Examining the contribution of the scenarios to goat production, Elke jaar is 'n maer jaar' scenario results in the lowest number of Angora goat production (Figure 21). This scenario was formulated to depict the effect of unpredictable non-conducive weather conditions on the primary production. It is observed that continuous extended drought would drive the Angora primary producers out of business, which can also potentially result in the extinction of the industry. Similarly, population vulnerability scenario results in huge reduction of total goats within a short span (Figure 21). The scenario was formulated as pulse, and happens within half a year. This scenario indicates that short-term vulnerabilities in the mohair industry such as predators, fires and theft, can have lasting effects on the production sustainability. It is therefore crucial for the industry as a whole to manage the risks appropriately.

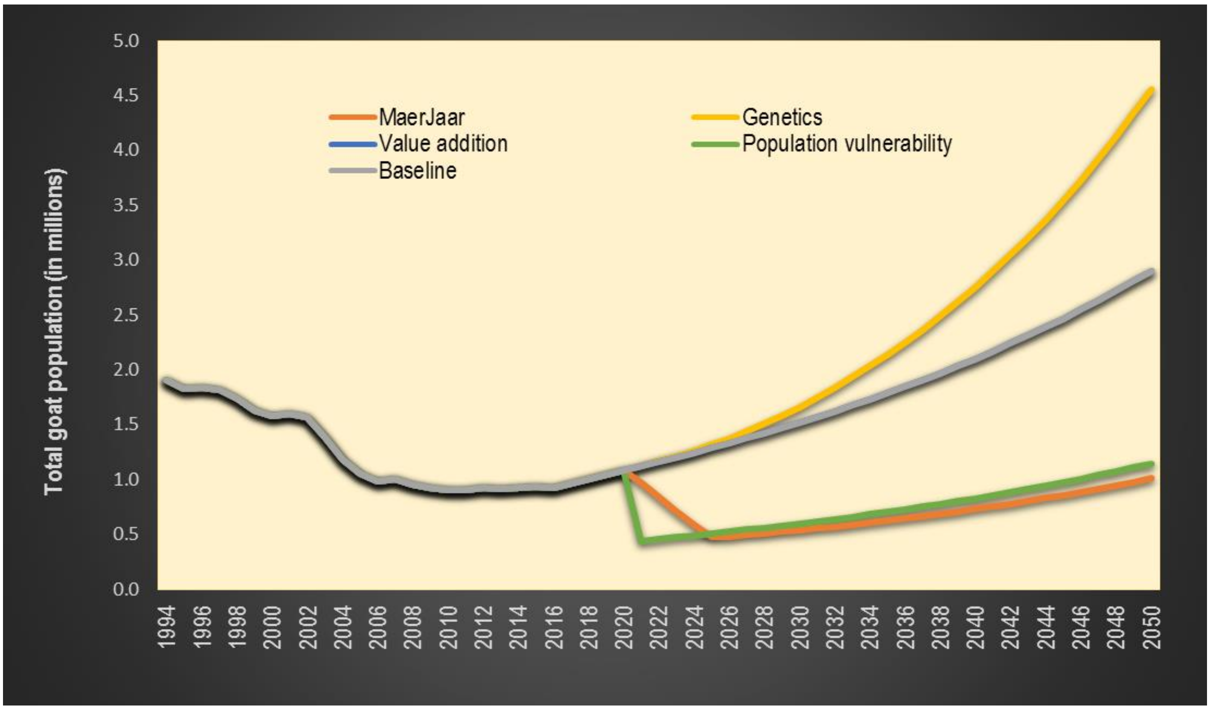


Figure 21: Total goat population scenarios comparison

On the contrary, the genetic programme has the greatest influence on Angora goat production relative to other scenarios and any other model parameter examined. With this scenario, the projected total goat production is about 57.2% more relative to the baseline scenario in 2040 (Table 11). Genetic oriented scenario is therefore a high leverage point for Angora goat production. This scenario depicts the potential for genetic programme in contributing to the industry growth and sustainability.

Table 11: Percentage change in total goat production relative to baseline

Scenario	2016	2030	2040	2050
Elke jaar is 'n maer jaar'	0%	-64.67%	-65.17%	-65.22%
Total value addition	0%	0%	0%	0%
Genetic oriented	0%	9.32%	31.11%	57.24%
Population vulnerability	0%	-60.56%	-60.55%	-60.55%

The total goat production in total value addition scenario is similar to baseline because the scenario only explores the contribution of utilising skin and carcass as potential income generating activities.

4.2.2 *Primary producer income and production costs*

Primary producer income influences the farmer's decision regarding the ability to supply additional feed, which results in additional production costs. In Elke jaar is 'n maer jaar' scenario, the primary producers who continue with the production during the drought season manage through providing feed supplement, but experience a lower return on investment relative to the baseline, as observed in Figure 22. The lifespan for the goats is shorter because slaughtering occurs at younger age; hence, less income is received from shearing. It is thus critical to identify measures to make intensive farming profitable.

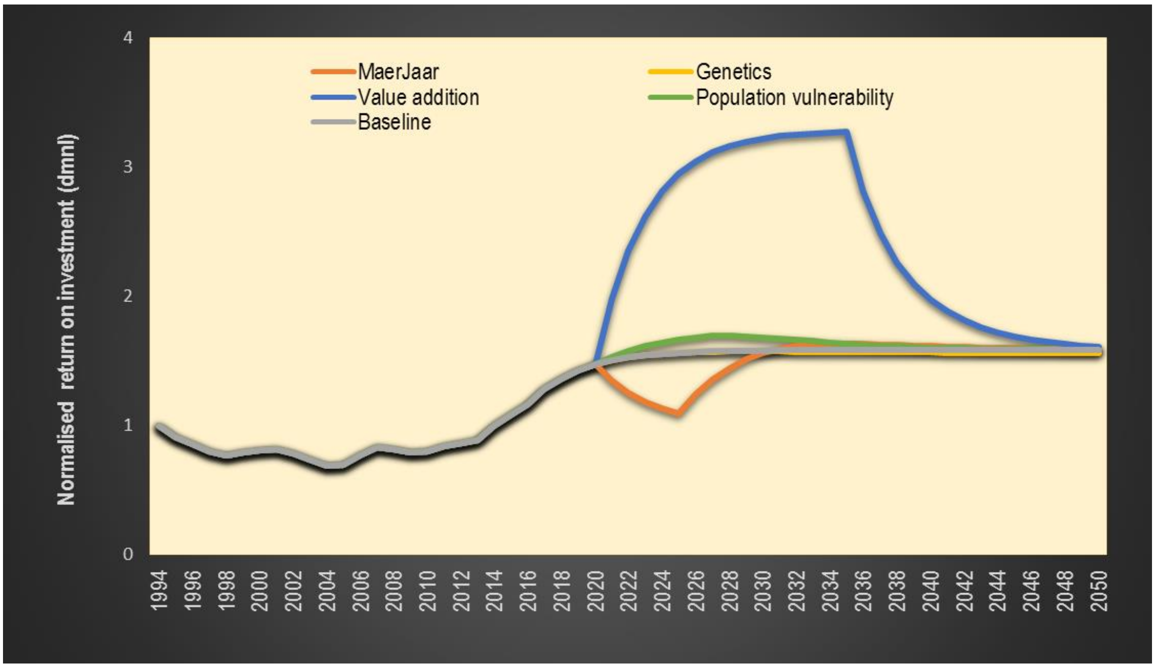


Figure 22: Normalised return on the investment scenarios comparison

While genetic oriented scenario improves goat production, the implication is that it results in increased feed requirements, implying that more capital is required for additional feed (Figure 23). Further, even though the genetics scenario is an important leverage point for increasing goat production, there is no significant impact on the return on investment per goat (see Figure 22) due to the assumption that the quality of mohair is not manipulated or if the quality increases, it has no real effect on the price since it is an industry-wide increase in quality.

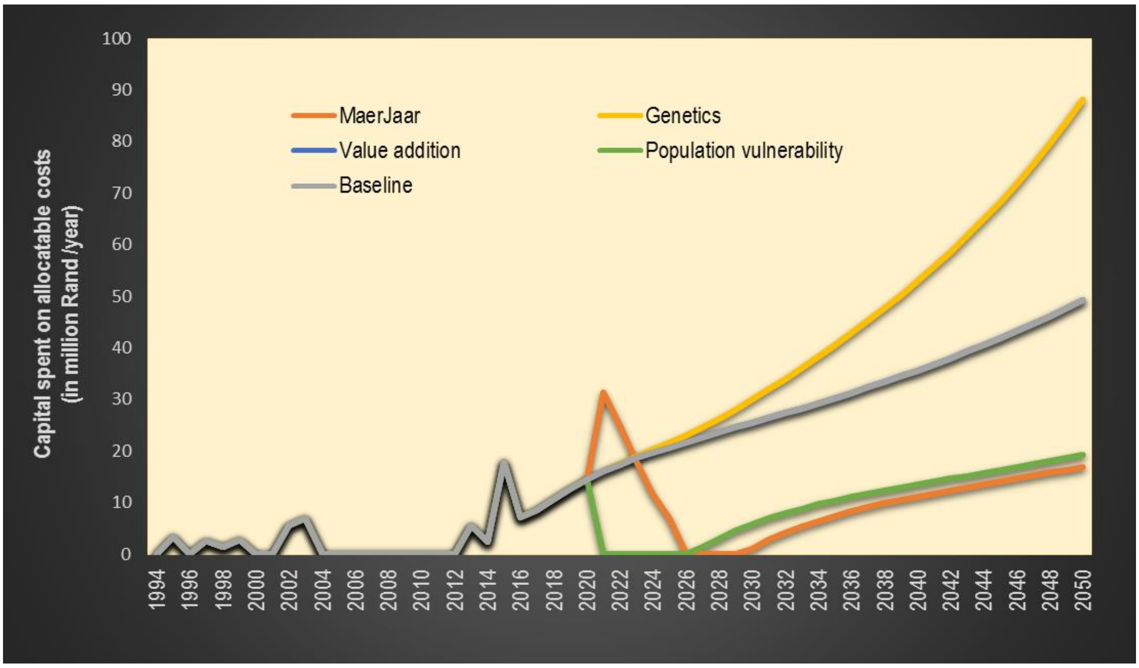


Figure 23: Capital spent on allocatable costs scenarios comparison

Total value addition scenario was formulated as temporary value addition in order to provide insights when: (i) there are gains in income and (ii) there are income losses. Income losses can occur from mohair price and not necessarily skin and meat income. Return on investment is also mainly improved by the additional income received from skin and meat income (see Figure 24). Extra income from other related activities can therefore contribute to improving mohair quality without necessarily relying on mohair price, hence, increasing the industry desirability for total value addition.

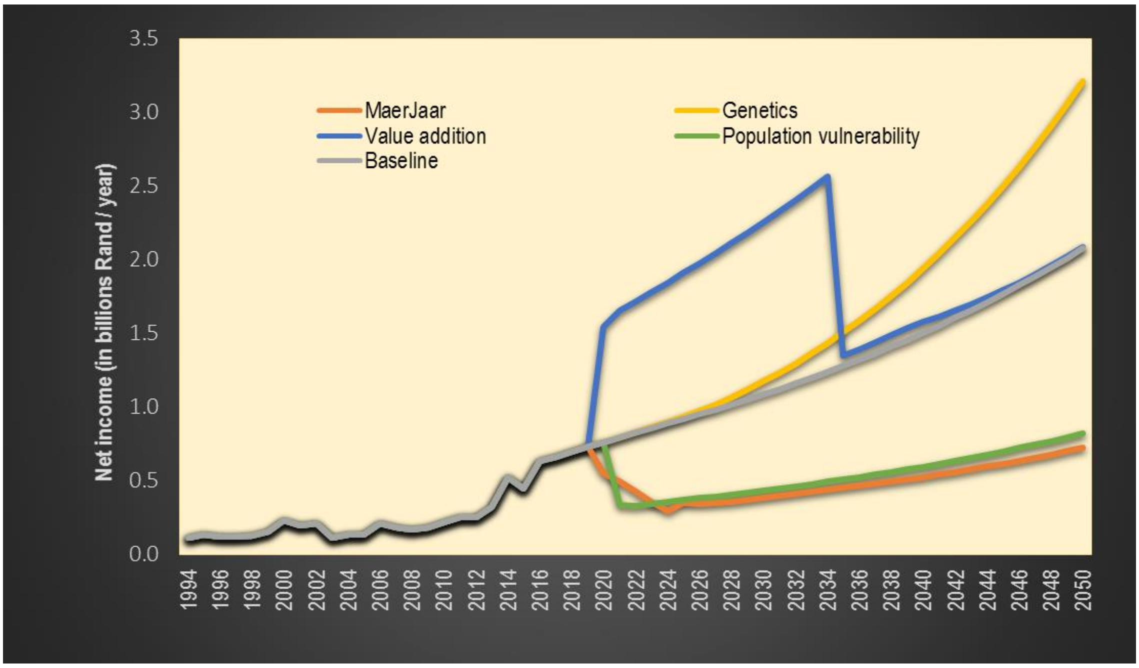


Figure 24: Net income scenarios comparison

4.2.3 *Mohair quality*

Improving mohair quality is a key aspect to enhance the industry competitiveness. Comparing the four scenarios, the total value addition scenario has the largest effect in improving the mohair quality (Figure 25) which in turn improves return on investment observed in Figure 22. Mohair quality increases due to increase in demand per supply fraction brought on by income from value adding related activities - meat and skin (Figure 26). The Elke jaar is 'n maer jaar' scenario has the least effect on the mohair quality which ultimately results in decrease in net income and total goat production.

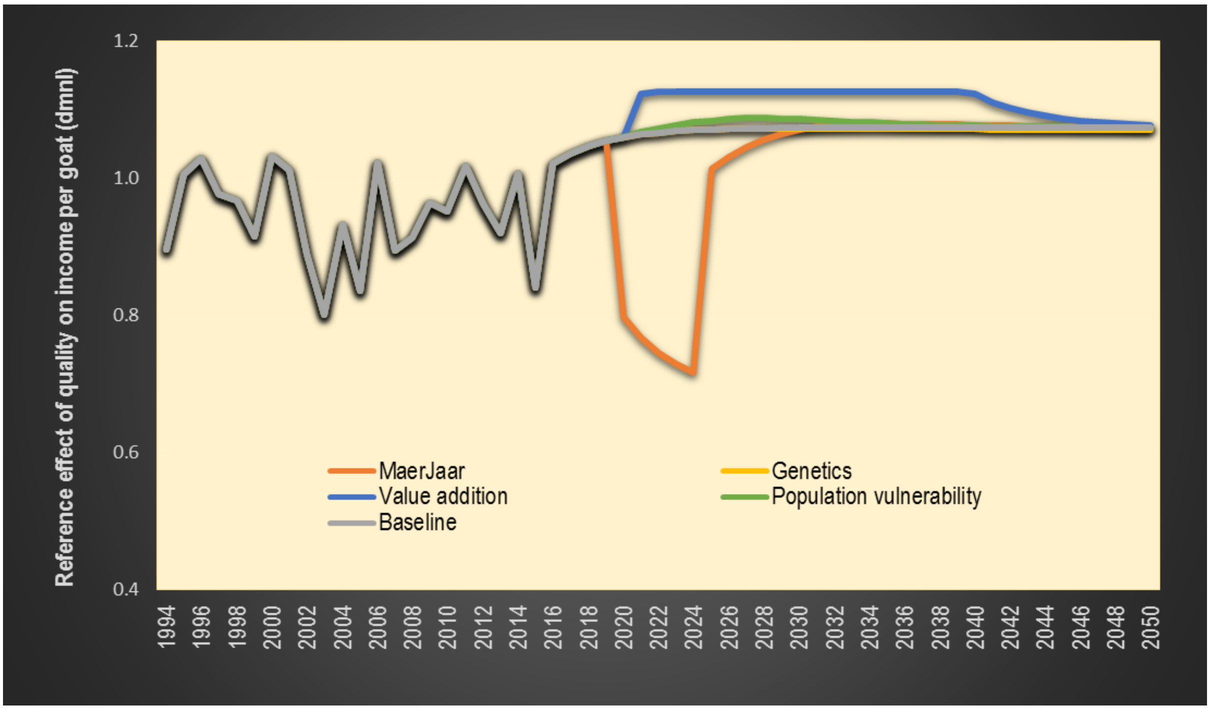


Figure 25: Effect of quality on income per goat scenarios comparison

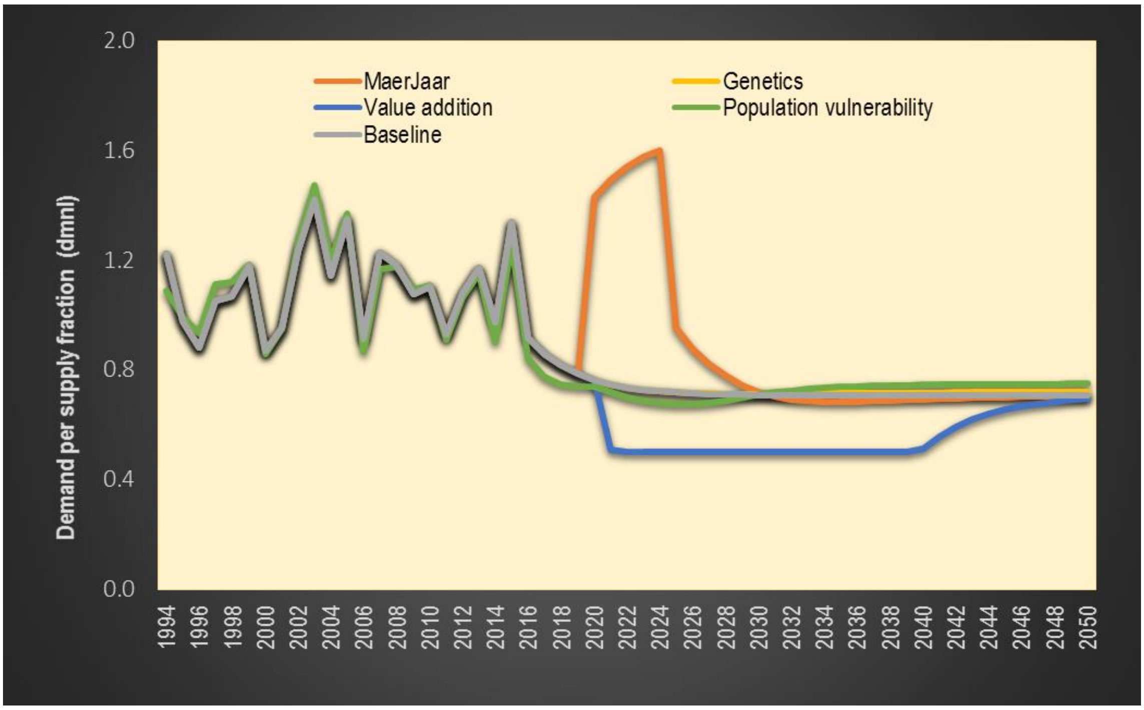


Figure 26: Demand per supply fraction scenarios comparison

4.3 Sensitivity analysis

Sensitivity analysis was undertaken to explore the impact of key primary producer indicators due to changes in fertility and minimum acceptable profitability (see Table 12). These sensitivities are relevant in the South Mohair Industry due to the present approach to improve Angora goat production and quality, as well sustainability in primary production.

Table 12: Sensitivity analysis parameters

Parameter	Unit	Value	Range
FRACTIONAL INCREASE IN CONCEPTION	Dmnl	0.1	[-0.1, 0.2]
FRACTIONAL DECREASE IN MISCARRIAGE	Dmnl	0.1	[-0.7, 2]
MINIMUM ACCEPTABLE RETURN ON INVESTMENT	Dmnl	1.85	[1.7, 2]

The confidence bounds in Figure 27 shows that goat production and net income are very sensitive to changes in fertility fractions – conception rate and miscarriage rate. On the contrary, the demand supply fraction and perceived net income are less sensitive to the fertility fractions.

Minimum acceptable return on investments seems to be the main driver of most of the key primary production indicators as observed in Figure 28.

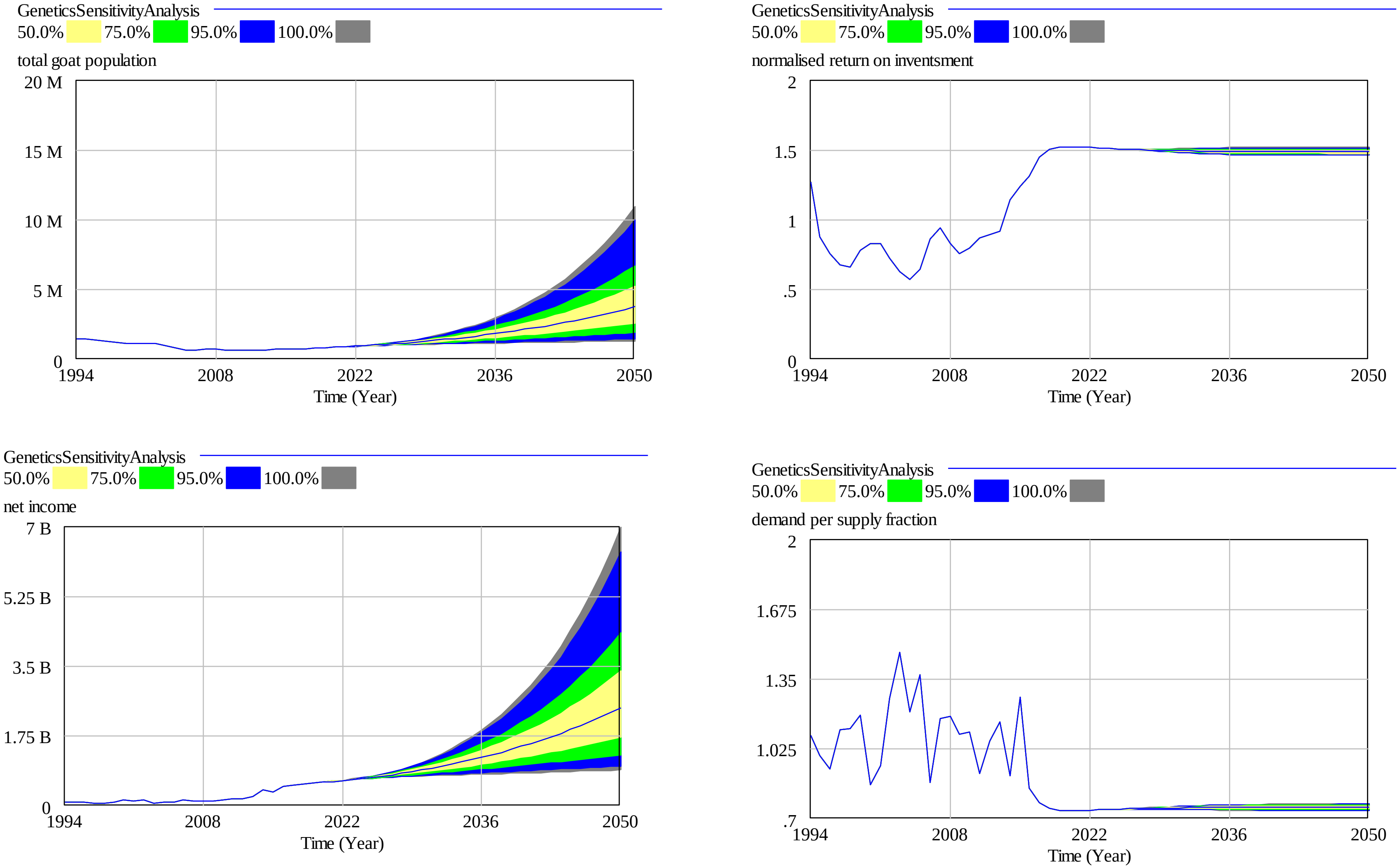


Figure 27: Sensitivity of fertility rates parameters on key primary producer indicators

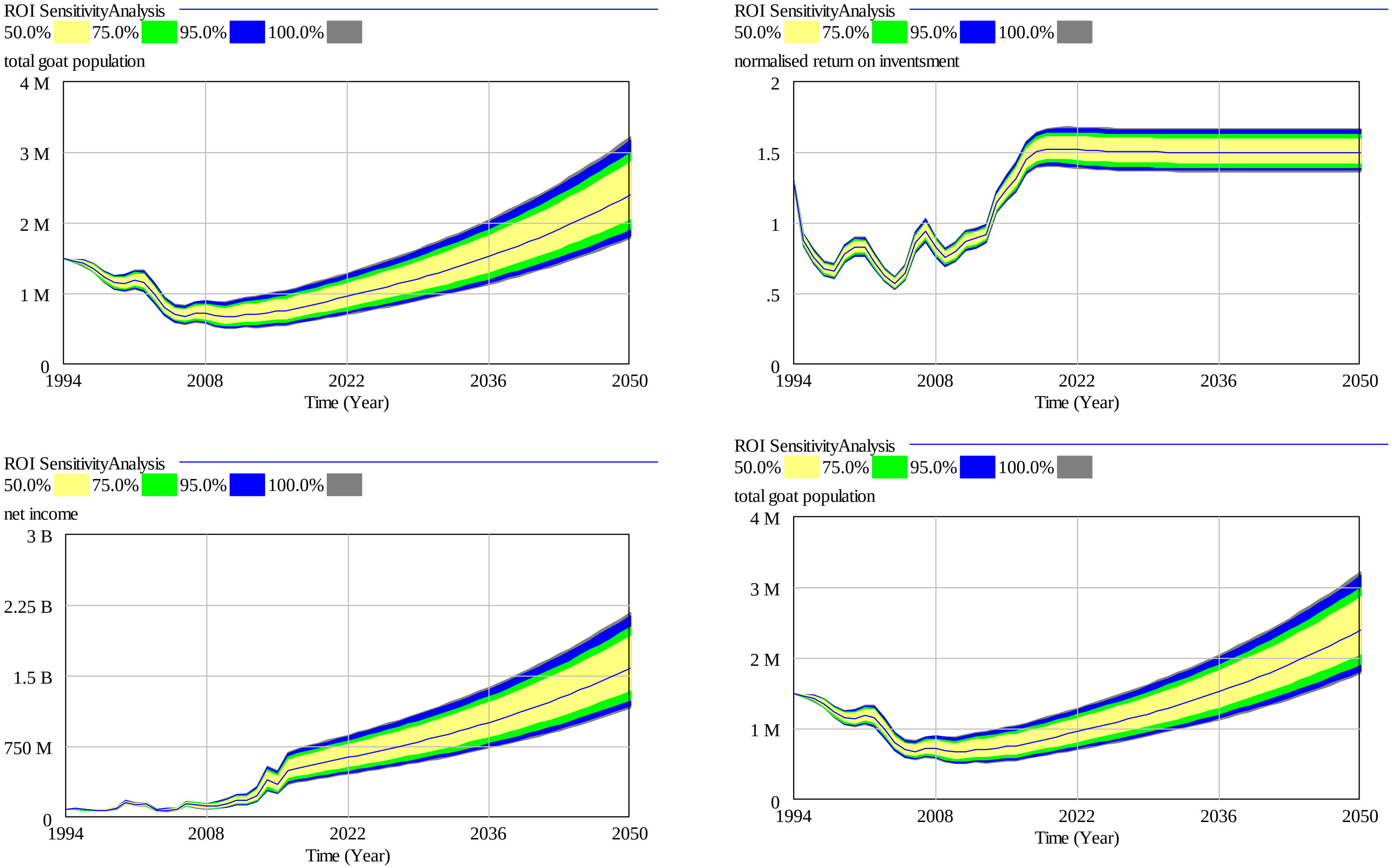


Figure 28: Sensitivity of minimum acceptable profitability on key primary producer indicators

4.4 Model application, limitations and way forward

- The model only focused on the primary production echelon of the mohair value chain. The remaining echelons of the mohair industry will be integrated in the Phase II of the project.

- The model results point to some potential data inaccuracies or feedback loop not captured. This can be refined in phase II of the project with inputs from the industry stakeholders.

- The model is specific to South Africa Mohair primary production and is not directly replicable to other countries without customising the specific primary production practices.

PART V: PHASE II MODELLING PROPOSAL

This section provides a proposal for modelling phase II, which will focus on providing insights into designing implementation projects for enhancing competitiveness and sustainability in the mohair industry.

5 PHASE II MODELLING PROPOSAL

5.1 Sub-sectors for Phase II Modelling

The following Echelons are proposed for the Phase II modelling:

- *Processing echelon*: where the greasy mohair is prepared for spinning, and includes activities such as sorting, grading, scouring (washing, rinsing and drying), carding and combing, picking and carding. While this is the general processing process, processing of skin into leather will be considered.

- *Spinning echelon*: where the tops is prepared into yarn.

- *Manufacturing echelon*: Which entails weaving yarn into finished products as well as Angora goat leather products. This echelon will explore some of the unrealised industry opportunities relating to Market growth, Product development and Diversification, which were highlighted during the stakeholder engagement workshop, to provide insights into designing implementation projects.

5.2 Group Model Building

Given the importance of designing implementation projects, Group Model Building is proposed at the beginning of the Phase II, with the key stakeholders in the various value chain echelons (primary production, processing, spinning and manufacturing).

Group model building is a methodology that draws upon System Dynamics to elicit a shared model from a group of participants rather than from one modelling expert. This technique could contribute to the understanding of the modelling process, facilitate communication among modellers and clients, and set up a methodological framework to promote constructive discussion around the merits of qualitative versus quantitative modelling. This method is very useful for coming to consensus on the exact nature of the problem, identifying causes and effects, creating buy-in and communicating openly without politics (or biased views) coming into play. The method is especially effective if participants have the ability or authority to exact change within their organisation.

This method entails the development of a qualitative System Dynamics model (or system map) in a group of various stakeholders. Practically, this means that representative stakeholders within the Angora goat value-chain would be invited to create a structural model of the mohair industry together as a group. The stakeholders would therefore get the opportunity to understand the inner-working (i.e. drivers of change and expected impacts) behind the actions and behaviour of other stakeholders in the value-chain. This not only gives the advantage of catharsis and formalising and consolidating mental models, but also of having a facilitated discussion that is content-driven instead of politically- or socially-driven.

The criteria for using the methods are that there must be a problem happening over time (or an opportunity, currently missed, to realize), with dynamic feedback within the system, and multiple stakeholders or participants playing a role in determining the performance of the system. Since the extension to phase II of mohair value contains all three elements, group model building becomes an appropriate approach in Project Phase II.

5.3 Data Requirements

Processing echelon

- Stakeholders involved in processing mohair, skin and carcass in South Africa
- Key activities in the processing of greasy mohair
- Value addition data in the processing echelon
- Costs and resource utilisation in the processing

Spinning echelon

- Stakeholders involved in spinning mohair, tanning leather, butchers in South Africa
- Key activities in the spinning yarn
- Value addition data in the spinning
- Costs and resource utilisation in the processing

Manufacturing echelon

- Stakeholders involved in manufacturing mohair related products in South Africa
- Key products manufacturing
- Value addition in the manufacturing
- Exploring unrealised product and market development activities
- Costs and resource utilisation in the manufacturing

5.4 Timeframe and Activities

The proposed timeframe for Phase II is **April – 30 October 2018** and will include the following tasks:

Activity	Jan-March	April	May	June	July	Aug	Sept	Oct
MoPPEM wider dissemination								
Developing scope of work document								
Project management								
Preparation and signing of Phase II contractual agreement								
Group model building								
Data collection								
Model extension to other echelons								
Report writing								
Draft report writing								
Report review								
Final report delivery								

The modelling team will comprise of the following with the highlighted main responsibilities:

- Josephine Musango – Project management; model building; report writing
- Lize Duminy – Group model building facilitator
- Benjamin Batinge – Model building; data collection
- Suzanne Smit – Facilitation assistance in Group Model Building
- Andrea M. Bassi – Final report reviewer
- Blake Robinson – Coordinate Phase II contractual agreement signing between South Africa Mohair Cluster and Sustainability Institute (SI) Projects

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APPENDIX A: FACTORS IDENTIFIED AT CAPACITY BUILDING WORKSHOP

Table A1: Angora Primary Producers

Concerns	Why is it a concern?	Desired outcomes
Predators (Jackal / Lynx / Caracal)	• Changed legislation / green • Poor land management • Increased mortality rate	• Recognition by government • Controlled numbers
Labour	• Inflexible labour laws • Land tenure (rural to urban) • Aging labour force	
Unstable prices	• Fashion dependent • Currency volatility • Buyer dynamics	• Integrated supply chain • Non-fashion markets (carpets) • Consistent marketing and product development • Stronger competition
Access to land (emerging primary producers)	• Poor policy	• Better policy
Lack of finance (emerging primary producers)	• Poor execution	• Better execution
Lack of skills (emerging primary producers)	• Poor and inadequate education	• Better education
Offtake animal	• No meat market • Skin market limited	• Consistent offtake (agreement) • Product development • Investment • Regulation on Angora goat meat
Farming knowledge loss	• Lack of support from SETA	• Skills development
Drought	• Decreases veld availability	
Mohair hair income	• Time delay before farmer is paid	
Water availability	• Water availability is a problem for farmers in Greyton using irrigation	
Theft	• Reduces the stock of goat	

Table A2: Buyers / Processors

Concerns	Why is it a concern?	Desired outcomes
Finance	• SARS VAT payment	• Bridging finance
Currency volatility	• Time delays	• Longer payment terms
Lack of traceability	• Brand requirements: Social; Environmental	• Traceability
Flow of market	• Cashflow	
Pesticides / APEO's	• Oekotex	• Pesticide / APEO free mohair
Auction dynamics	• Non-market related price fluctuations	• Market forces
Under capacity processing	• Finance insufficient supply	• Running at full capacity

Table A3: Spinners; Manufacturers

Concerns	Why is it a concern?	Desired outcomes
Lack of technical abilities	• Scarce skills • Lack of investment in training	• Skilled technical ability
Aged equipment	• Unable to utilize equipment efficiently	• Modern relevant equipment • Relevant to market needs
Dyeing capabilities (small lot)	• Market requirements	• Meet market needs
Access to small yarn quantities	• Not commercially viable for small orders	• Increased manufactured product sales
Lack of innovative product development	• Inability for increased market demand	• Internal product development and innovation
Limited market access	• Cannot meet market potential	•

Table A4: Retailer / Brand

Concerns	Why is it a concern?	Desired outcomes
Lack of awareness	• Inhibiting sales	• Recognise brand
Supply chain		• Increased demand
Traceability		
Price		

Table A5: Consumer

Concerns	Why is it a concern?	Desired outcomes
Lack of awareness	• Little desire to buy mohair products	• Educate consumers • Preferential consumer
Supply chain		
Traceability		
Price		

APPENDIX B: PROJECT STAKEHOLDER ENGAGEMENT PROCESS

Table B1: Phase I project stakeholder engagement process

Date	Activity	Participants
29 Jan 2017 – 10 March 2017	Starts conversations with the client on the potential to use SD for the project; forming project modelling team	Members of client team; funding team; modelling team; stakeholders in mohair industry value chain
10 March 2017	First scoping meeting	3 members of client team; 1 modelling team
9 May 2017	Second scoping meeting	3 members of client team; 2 modelling team
27 April – 9 June 2017	Development of Project Phase I scope of work document	2 modelling team in collaboration with 3 client team
6 June 2017	Project initiation and capacity building preparation meeting	3 members of client team; 1 modelling team
12-14 June 2017	Capacity building in System Dynamics	See the list of participants in acknowledgements
19 June 2017	Fortnightly project meeting	3 Modellers
19 July 2017	Fortnightly project meeting	1 member from client team; 3 modellers
2 August 2017	Fortnightly project meeting	
24 August 2017	Fortnightly project meeting	2 members from client team; 2 modellers
7 September 2017	Fortnightly project meeting	2 members from client team; 2 modellers
20 Sept 2017	Workshop planning meeting	2 members from client team; 1 modeller
5 October 2017	Fortnightly project meeting	4 members from client team; 3 modellers
23 October 2017	Fortnightly project meeting	3 members from client team; 2 modellers
3 November 2017	Stakeholder Engagement Workshop preparation meeting	3 modelling team
8 November 2017	Stakeholder Engagement Workshop preparation meeting	1 member from client team; 3 modelling team
14 -15 November 2017	Stakeholder Engagement Workshop	

APPENDIX C: STAKEHOLDER ENGAGEMENT WORKSHOP PARTICIPANTS

NAME	INSTITUTION / AFFILIATION
MANUFACTURERS	
Mike Brosnahan	SAMIL Natural Fibres
Denys Hobson	Cape Mohair
Adele Cutten	Southseas Mohair
Nico Stucken	Stucken Group
Anthony Kirsten	Stucken Group
Sophia Booley	Karoo Looms
Frances Bekker	Nomvula Knitters
Larissa Primmer	LA Mohair
MOHAIR SA	
Deon Saayman	Mohair SA
Rothner Bekker	Mohair SA
Lindsay Humpreys	Mohair SA
Anle Marais	Mohair SA
Riaan Marais	Mohair SA
ANGORA FARMERS	
Jordi van Hasselt	Angora Farming
Ben van der Westhuizen	Angora Farming
GENETICS & SUSTAINABILITY	
Karen Quayle	QUALITY SUSTAINABILITY PROJECT
BROKERS	
Isak Staats	BKB
Pierre van der Vyver	CMW
THE DTI	
Elaine Smith	The dti
Abisha Tembo	The dti
Dimikatso Moji	The dti
CTCP DESK	
Gavin Smith	The IDC
THE IDC SBU TEXTILES & CLOTHING	
Dineo Swambane	The IDC
Potsi Mochebelele	THE IDC
David van Wyk	The IDC
DEPARTMENT OF ENVIRONMENTAL AFFAIRS	
Zamaswazi Nkuna	Department of Environmental Affairs
AGRI-PROCESSING SCHEME	
Cebisa Nyadeni	Agri Processing Scheme Incentive Development and Administration Division (IDAD)

Shareen Osman	Agri Processing Scheme Product Development
SAMC CLUSTER NPC	
Camila Gillman	South Africa Mohair Cluster
Ian Taverner	South Africa Mohair Cluster
Martin Viljoen	South Africa Mohair Cluster
Mia Smuts	South Africa Mohair Cluster
Kylie Salmon	Beetle Inc
MEAT INITIATIVE	
Elna van der Bergh	Angora Farming
Gerhard dos Santos	Noorsveld Hoenders
SYSTEM DYNAMICS FACILATATION TEAM	
Josephine Musango	Stellenbosch University
Benjamin Batinge	Stellenbosch University
Suzanne Smit	Stellenbosch University
PREDATOR MANAGEMENT	
H.O. de Waal	University of the Free State
CSIR	
Dr Sunshine Blouw	CSIR
DEPARTMENT OF ECONOMIC DEVELOPMENT, ENVIRONMENTAL AFFAIRS AND TOURISM	
Akho Skejana	Eastern Cape Dev. Council

This document is the product of phase I of Mohair Value Chain Project and only focused on primary production aspects of the project. Phase II of the project will complete the analysis of the industry value chain