Evaluating traceability systems within the South African sheep meat supply chain

by

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DECLARATION

I, Melissa van der Merwe, declare that the dissertation, which I hereby submit for the degree MSc(Agric) Agricultural Economics at the University of Pretoria, is my own work and has not been submitted for a degree at any other tertiary institution.

SIGNATURE: …… DATE: December 2012

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"I can do all things through Him who strengthens me." – Philippians 4:13

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ABSTRACT

One of the latest trends in the market for food products is the desire amongst consumers to know the origin of the products they purchase and to feel physically or emotionally connected to the farm and the producer. However, given the many efforts by producers and retailers to mislead consumers about the origin of products, for consumers to have faith in the origin of food products, they need to have some guarantee about the true origin of products. Thus, to be able to successfully guarantee the origin of food products, traceability systems need to be in place and they need to comply with the necessary legislation.

This consumer need for origin-based food is now playing out in a variety of ways as food processors and retailers are labelling their products according to the origin of the product. Quite often, regional names are used for that identification. One iconic South African example of a product with regional identity is Karoo Lamb. In July this year producers from the Karoo region launched Karoo Lamb, a certification scheme, with

[1] Where sheep meat refers to both mutton and lamb

a chain-wide traceability system in place to guarantee the Karoo origin of sheep meat in South African retail stores.

The question, though, is whether all abattoirs and meat processors in South Africa are able to deliver origin-guaranteed products. The key factor here is the traceability system they have in place. The general objective of this study is therefore to assess current traceability systems in the sheep meat industry and to establish their ability to guarantee the origin of a carcass. This traceability system should be able to protect, manage and govern the food of origin attributes of a product in the sheep meat industry.

The specific objectives of the study are: i) to create a high level process map to indicate the flow of Karoo Lamb products; ii) to share information by developing a detailed description of current and potential traceability systems in the Karoo Lamb supply chain; iii) to identify critical control points for maintaining product information and to test if these systems are in line with best practices; iv) to investigate the decision-making factors impacting on the implementation of a traceability system; and v) to develop recommendations for effectively implementing a traceability system that protects, manages and governs food of origin attributes. In response to these objectives, five hypotheses were developed and tested. The five hypotheses basically aimed to identify the tipping factor in the traceability implementation decision-making process.

The population of South African sheep slaughtering abattoirs was used to draw a random sample of 55 abattoirs selected to participate in the research survey by means of interview administrated, structured questionnaires. The data was then processed and analysed to include a combination of quantitative and qualitative analysis.

The results obtained by the research indicate that 92 % of the abattoirs in South Africa have proper traceability systems in place that enable them to market and deliver origin-guaranteed products. The 3 (8 %) abattoirs that do not have traceability systems are in the Northern Cape and Eastern Cape. This might become problematic, since sheep from these regions are often marketed as Karoo lamb. Without proper traceability systems, this credence attribute cannot be guaranteed.

According to the hypothesis test, the fact that an abattoir delivers to a retailer is the single most significant factor, compared to the other factors tested, for abattoirs to implement a traceability system. Research showed that 95 % of retail delivering abattoirs have traceability systems in place, and the other 5 % of abattoirs are those situated in remote rural areas and their retail customers have little other choice than to buy from these abattoirs. However, the study identified poor knowledge on the costs and benefits of a traceability system as a potential drawback in doing a proper cost benefit analysis and therefore proper research on the economics of traceability systems was almost impossible.

At the abattoir level, traceability systems are quite easily implemented because it is much easier to trace a single carcass in an abattoir than to trace different pieces of one carcass in the processing plant. Since this study did not include detail pertaining to the downstream tiers; meat processors, packers, wholesalers and retailers, it is not possible to conclude that the entire sheep supply chain can guarantee a product's origin in the case of Karoo Lamb. The integrity of these role players will play a vital role in their ability to guarantee the origin of a sheep meat product especially when sheep carcasses are moved outside the Karoo boundaries for processing and packaging.

It is therefore clear that the downstream tiers play a vital part in the South African sheep meat industry in terms of chain-wide traceability and transparency in order to guarantee the origin of a sheep meat product such as Karoo Lamb. Further research is therefore required to evaluate the other role players in the sheep meat industry for chain-wide traceabiltiy systems, in order to test the readiness of this chain and industry to guarantee the origin of a product like Karoo Lamb.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

CHAPTER 1

INTRODUCTION

1.1 BACKGROUND

Consumers throughout the world are becoming more aware of the importance of traceability (ability to track products back to their source) within meat supply chains (Gellynck & Verbeke, 2001:368; Hobbs, 2004:397). In order to provide safe and high quality food products to the consumer with respect to origin and processing, it is critical to implement traceability systems along the entire supply chain. This summarises the importance of traceability within meat industries worldwide. One of the key questions, raised in this study, is if this is also the case in the South African sheep meat industry. Bulut and Lawrence (2007:13) elaborated further on this dilemma by identifying abattoirs and meat processing plants as the weakest links in terms of traceability within meat supply chains. Therefore, the ultimate goal for all members of the meat supply chain must be to create supply chains that are traceable from farm to fork.

Traceability within supply chains has been a hot topic in the meat industries across the world in recent years. The recent development and implementation of traceability systems in meat chains can be due to several reasons:

- Increasing consumer consciousness in terms of the safety of meat products
- Rising consumer demand for high quality meat products, where quality can be divided into objective and perceived quality perspectives and where perceived quality includes intrinsic and extrinsic attributes
- Rising consumer demand for locally produced food products or the demand for food products of which the origin is known and clearly indicated.

Firstly, increasing consumer consciousness in terms of the health and safety of meat products (Meuwissen, Velthuis, Hogeveen & Huirne, 2003:167; Souza-Monteiro & Caswell, 2004:2-3) caused a tremendous increase in interest regarding traceability

systems. Livestock-related diseases such as bovine spongiform encephalopathy (BSE) and foot and mouth disease (FMD), bioterrorism threats and high profile food scares as well as recalls of meat products due to *Salmonella* and *Escherichia coli* 0157 (*E. coli*), raised awareness for the much needed implementation of proper traceability systems within beef supply chains but also in other meat supply chains (Bulut & Lawrence, 2007:1). Reliable systems to trace individual meat products back to the animal and farm of origin are of the utmost importance. This will re-establish consumers' trust in the safety of meat and meat products after confidence was lost through outbreaks of the above-mentioned livestock-related diseases and the possibility that these diseases might be transferred to humans (Mousavi, Sarhadi, Lenk & Fawcett, 2002:17).

Secondly, in a globalised food market where consumers are becoming more educated in terms of product attributes, the demand for meat of exceptional quality is increasing. The term quality is however a multifaceted concept. Quality can be divided into the objective quality perspective and the perceived (or search) quality perspective, where the perceived quality perspective includes both intrinsic and extrinsic quality attributes (Espejel, Fandos & Flavian, 2007:683). Intrinsic quality attributes are characteristics that are part of the physical product for example taste, colour and tenderness, which can be measured on the product. Extrinsic quality attributes also called credence attributes cannot be measured on the product and include, amongst others, measures like organic, free range, fair trade production and food of origin (Trienekens & Beulens, 2011:5).

Olsen and Jacoby, in Oude Ophuis and Van Trijp (1995:179-180), identified numerous quality attributes for fresh meat products, summarised in Table 1.1. However, according to Prof H. Schönfeldt (2012) from the University of Pretoria, tenderness and species are nowadays regarded as more important when it comes to the buying decision.

Table 1.1: Quality attributes for fresh meat products

Intrinsic quality attributes	Extrinsic quality attributes
Appearance	Price
Size	Brand name
Marbling	Place of purchase
Cut	Nutritional information
Juiciness	Product information
Colour	Country of origin

Source: Oude Ophuis & Van Trijp (1995:179-180)

Synonyms for the extrinsic quality attribute, country of origin can also be region of origin or food of origin. This particular attribute is classified as extrinsic to the product because the verification of the origin of the product will be indicated externally to the product, for example on the product label. This quality attribute will not be uncovered before, during or after consumption, it will only be visible through a product label or mark (Van Zyl, 2011:5). A meat supply chain therefore requires the implementation of an efficient traceability system to be able to trace a product from the region of production to the consumer, before the origin of a food product can be conveyed honestly to consumers. These traceability systems will not only enable producers to tell a story in terms of the farm and vegetation the animal was reared on but also give more information on the animal breed and the intrinsic quality attributes such as tenderness, marbling and juiciness pertaining to the specific breed.

Thirdly, globalisation of the food market in the past decade has meant that consumers have developed a certain need to acquire the regional identity of a specific food product. Naturally, food products are land based and have a regional or geographical origin, but this association between food and region has disappeared over time (Van Rijswijk, Frewer, Menozzi & Failoli, 2008:453) and consumers are feeling more disconnected from the rural landscape. This disconnect can be re-established by means of products that are linked to their region of origin, thereby offering a mythical connection to the specific values associated with the region in terms of environmental, cultural and social characteristics. The ability to link products to specific regions can also be a valuable tool for producers. This link offers a valuable differentiation strategy when marketing commodity products and opens up the possibility of entering into a niche market (Kirsten, 2011:40). However, to be able to determine and guarantee the region of origin of a product consumed, a traceability

system is needed to track the product back to the country or region where the animal was reared in order to honestly and correctly label the meat product to convey a specific message to consumers. Traceability can therefore be an important tool to help to establish the authenticity of food in order to re-establish consumer trust, to check that claims made by producers are true but also to provide producers with additional marketing options to possibly create added value (Van Rijswijk, Frewer, Menozzi & Failoli, 2008:453).

In addition to the main reasons mentioned in previous studies for the implementation of traceability systems, Coff, Barling, Korthals and Nielsen (2008:5) presented a description of the key objectives of traceability in the food sector with a particular focus on risk management and food safety, control and verification, supply chain management efficiency, provenance and quality assurance of products, and information and communication to the consumer (refer to Table 1.2 for details).

Table 1.2: Key functions of traceability in the food sector

Objectives of traceability in food
1. Risk management and food safety
• Risk assessment: mapping of foods and feed, food ingredients and processing technologies that have food safety implications (e.g. hygiene) • Food residue surveillance: food sampling at appropriate points testing for residues (e.g. pesticides) • Public health recall systems: identification of breakdowns in food safety along the food supply chain, allowing recall of contaminated products for the purpose of protecting public health
2. Control and verification
• Surveillance and auditing of producer and retailer activities • Avoidance of fraud and theft: control of products by chemical and molecular approaches (biological 'food-prints') • Identification of responsible actors but also claims of innocence • Ingredients definition • Avoidance of negative claims (e.g. 'may contain genetically modified organism (GMO) traces')
3. Supply chain management efficiency
• Cost effective management of the supply chain • Computerised stock inventory and ordering systems linked to point of sale • Just in time delivery systems • Efficient use of resources (cost minimisation)
4. Provenance and quality assurance of products
• Marketing of health, ethical and other claims • Authenticity: identity of the product (food authentication) and the producer • Typicality: as with European schemes for Protected Destination of Origin (PDO) and Protected Geographical Indication (PGI) • Quality assurance of standards at different stages of production and/or processing (e.g. environmental protocols for production) • Final product quality assurance

Objectives of traceability in food
5. Information and communication to the consumer
• Transparency of the production history • Facilitation of informed food choice, through transparency and the ability to compare different products • Recognition of specific consumers' concerns and information demands – where such concerns and demands are not static but may evolve • Public participation: consumer services, companies' 'care lines' and consultation to obtain consumer feedback

Source: Coff *et al.* (2008:5)

From the functions listed in Table 1.2, it is clear that there are numerous advantages to the implementation of proper traceability systems in food and meat supply chains. An analysis in terms of the costs of the implementation of proper traceability systems should however be considered to develop a balanced evaluation of the feasibility of such traceability systems.

Traceability systems were furthermore defined by Coff *et al.* (2008:6) as being a tool for management, government and communication. Firstly, as a tool for management, traceability systems can be used for supply chain management and internal management of resources. Secondly, as a government tool, it can be used for political and administrative governance of food chains, for verification of product attributes, for liability claims and for anti-fraud measures. Thirdly, as a communication tool, traceability systems can be used to capture the value of food qualities and inform consumers about these qualities.

A study was done by Du Plessis and Du Rand (2011:1) to determine the significance of traceability in consumer decision making towards buying Karoo Lamb. During this study the following conclusions were made in terms of the relative importance of each product attribute as viewed by South African consumers (Table 1.2 and Figure 1.1).

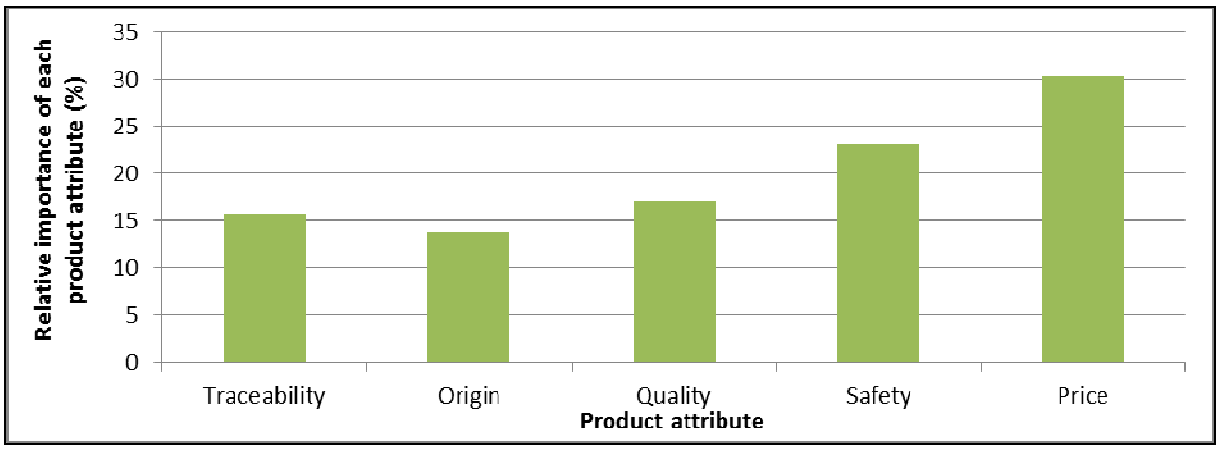


Figure 1.1: Relative importance of each product attribute
Source: Du Plessis and Du Rand (2011:5)

Figure 1.1 clearly indicates that consumers regard the price of a product by far the most important attribute to consider in the decision-making process, followed by safety and quality attributes. Consumers feel that traceability and the origin of a meat product is of lesser importance when making buying decisions. These conclusions were made, however, by using a completely random sample of 1011 South African lamb meat consumers that varied according to age, gender, wealth, social status and nationality (Du Plessis & Du Rand, 2011:3). Lamb meat is currently the most expensive meat product in South African and is mostly purchased by the higher Living Standard Measurement (LSM) group of South African consumers. Sheep meat is furthermore the least consumed meat product in South Africa (BFAP, 2011:31-33). One is to wonder if the results in Figure 1.1 would have been different, maybe leaning less towards price and more towards the other attributes, if only higher LSM South African lamb meat consumers were surveyed.

Another conclusion made by Du Plessis and Du Rand (2011:4-6) in terms of the relative importance of attribute levels, within an attribute, based on the attribute level utility value, where one attribute's utility level cannot be compared to the utility level of another attribute, is shown in Table 1.3.

Table 1.3: Attribute relative importance

Attribute	Attribute levels	Attribute relative importance (%)	Attribute level utility value
1. Traceability	Trace to animal	15.7 %	–0.001
	Trace to birth farm		*0.075*
	Trace to abattoir		0.031
	Trace to processing plant		0.001
	No trace		–0.106
2. Origin	Origin: Local region	13.8 %	0.003
	Origin: National (SA) region		–0.052
	Origin: No region		–0.070
	Origin: Specific (Karoo) region		*0.118*
3. Quality	***Quality through certification***	17 %	0.089
	Quality through labelling/branding		0.049
	Quality through origin		0.054
	Quality not assured		–0.193
4. Safety	***Safety through certification***	23.1 %	0.162
	Safety through labelling/branding		0.063
	Safety through place of purchase		0.144
	Safety not guaranteed		–0.181
	No safety knowledge		–0.188
5. Price	10 % more	30.4 %	–0.118
	7.5 % more		–0.103
	5 % more		–0.084
	2.5 % more		–0.036
	Same price		–0.033
	2.5 % less		0.040
	5 % less		0.135
	7.5 % less		***0.138***
	10 % less		0.061

Source: Du Plessis and Du Rand (2011:6)

The results from Table 1.3 shows that consumers have the greatest preference for the following attribute levels of the different attributes based on the attribute level utility value:

- Traceability levels that are able to trace lamb meat back to the birth farm
- Lamb meat products originating from the specific Karoo region
- Quality and safety claims that are guaranteed by means of certification
- Price of lamb meat that are 7.5 % less than the normal price of lamb meat.

This growing awareness for food safety, food quality and the need to know the origin of food products among consumers, together with the opportunistic behaviour of supply chain members exploiting certain concepts, like the Karoo region of origin concept to gain market access in high value markets, highlights the need for

traceability systems to verify these claims and protect the Karoo region of origin from exploitation.

1.2 THE KAROO

According to Le Roux, Kotzè, Nel and Glen (in Kirsten, Troskie, Vermeulen, Schönfeldt & Bramley, 2008:1), the great semi-arid area stretching north-eastwards from the Cape is called the Karoo. The Karoo region covers almost 50 % of the total area of South Africa and is typically flat, dry shrubland with grass growth restricted by the rainfall in the region. The Karoo is far from major urban areas and distribution centres and is home to flocks of sheep, grazing freely amongst the scattered shrubs.

Sheep produced in this region graze on the Karoo shrubs year round, as these shrubs are palatable and meet the nutritional needs of the animals. The Karoo shrubs furthermore provide a distinct taste to the sheep meat. Karoo sheep meat is described as “mouth-wateringly succulent, imbued with the subtle, fragrant flavours of the Karoo bush” (Kirsten *et al.*, 2008:1). This is not surprising since sheep reared in the Karoo region feed on different species of wild herbs, whereas sheep reared in other regions normally feed on limited grass types. The diet of the Karoo reared sheep, in combination with the image and reputation of the Karoo, is what makes the concept of Karoo Lamb most sought after (Kirsten *et al.*, 2008:1).

The Karoo region, as defined by a study conducted by Kirsten *et al.* (2008:11), is shown in Figure 1.2. From this study it was clear that defining the Karoo region was a tricky situation. A first draft of the map of the Karoo was prepared by the Geographical Information System (GIS) Team of the Western Cape Department of Agriculture and the boundaries of the Karoo in this particular map were defined as follows (Kirsten *et al.,* 2008:11):

- The western and southern border of the Karoo was defined by the boundary between the winter and summer rainfall areas of South Africa
- The northern border was defined by the Gariep river
- The eastern border was defined by the Winterberg mountain ranges.

This was still not sufficient since the unique characteristics of the Karoo sheep meat are mainly due to the specific diet of the sheep, consisting mostly of specific Karoo plant species and not necessarily based on the region or location of origin in which the sheep are reared, even though the region does give some indication regarding the vegetation in the area. These Karoo plant species included: (i) *Plnthus karrooicus* ("Silverkaroo"), (ii) *Penzia spincescens* ("Skaapbossie"), (iii) *Eriocephalus ericoides* ("Kapokbossie"), (iv) *Salsola glabrescens* ("Rivierganna"), (v) *Pentzia incana* ("Ankerkaroo") and (vi) *Pieronia glauca/rosenia humilis* ("Perdebos") (Vermeulen, Schönfeldt & Kirsten, 2008:9).

However, most of the six typical Karoo shrubs are not limited to the Karoo but are found in other parts of South Africa including the Free State as well as in Namibia. Nevertheless, the map of the Karoo (where the Karoo is indicated in the light brown colour) as presented in Figure 1.2 was accepted as sound in principle (Kirsten *et al.*, 2008:11).

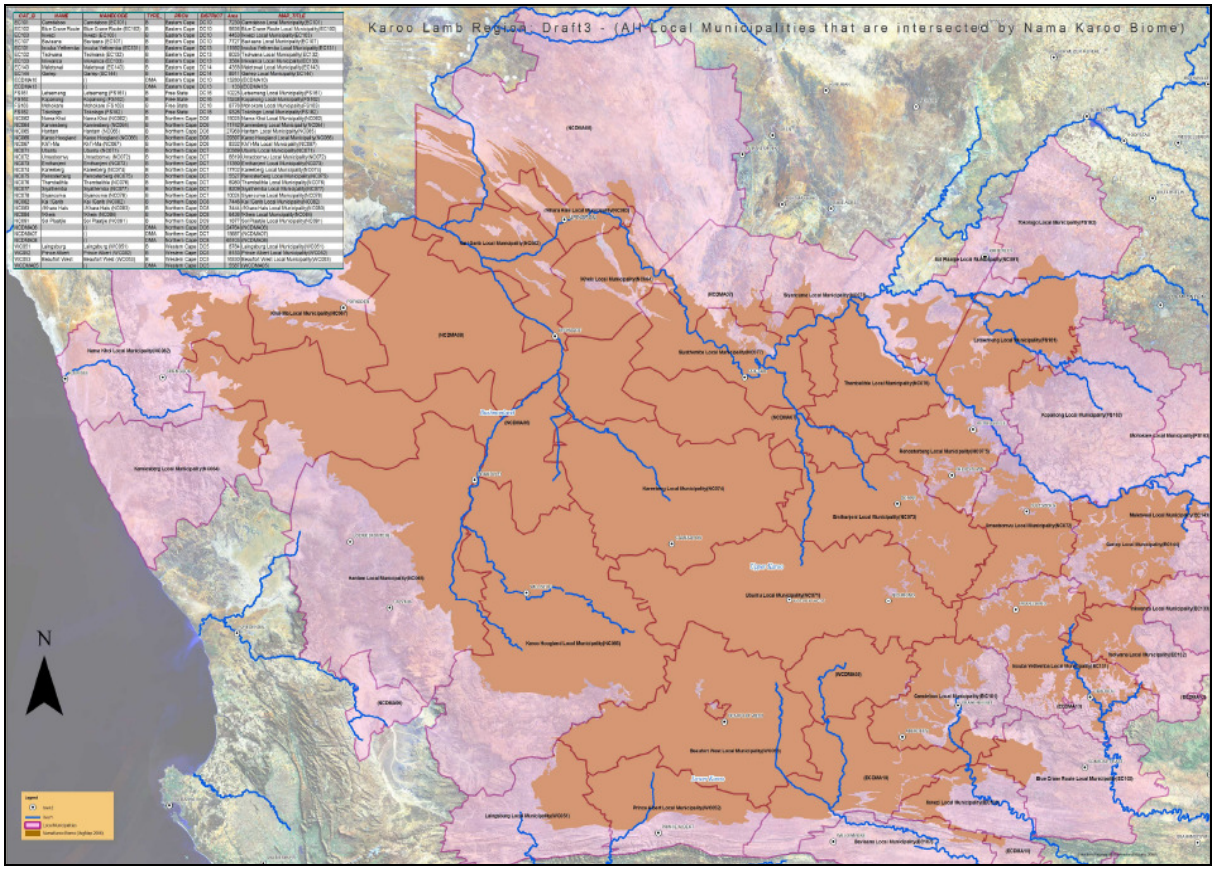


Figure 1.2: The Karoo region in South Africa
Source: Kirsten *et al.* (2008:11)

The Karoo region can be divided into the Central Karoo region (13 971 600 ha) and the region around the central Karoo (32 410 300 ha). Farms in the Central Karoo region are without a doubt Karoo farms and have a high probability of having all six of the Karoo plant species on the farm. The areas surrounding the Central Karoo have a lower probability of having all six of the Karoo plant species on the farm and some of these farms can even be excluded from the Karoo region based on this.

The municipalities, provinces, districts as well as the area in km^2, included in the central and surrounding Karoo regions, are tabulated in the two tables below (Table 1.4 and Table 1.5).

Table 1.4: Central Karoo municipality, province and size

CENTRAL KAROO		
Municipality	**PROVINCE**	**Area (km^2)**
Camdeboo	Eastern Cape	7 230
Inxuba Yethemba	Eastern Cape	11 592
ECDMA10	Eastern Cape	13 280
Karoo Hoogland	Northern Cape	29 397
Ubuntu	Northern Cape	20 389
Umsobomvu	Northern Cape	6 819
Emthanjeni	Northern Cape	11 390
Kareeberg	Northern Cape	17 702
Beaufort West	Western Cape	16 330
WCDMA05	Western Cape	5 587
TOTAL KM^2		**139 716**

Source: Karoo Meat of Origin (2012e)

Table 1.5: Surrounding Karoo municipality, province and size

SURROUNDING KAROO		
Municipality	**PROVINCE**	**Area (km^2)**
Letsemeng	Free State	10225
Kopanong	Free State	15248
Mohokare	Free State	8776
Tokologo	Free State	9326
NCDMA06	Northern Cape	24764

SURROUNDING KAROO		
Municipality	**PROVINCE**	**Area (km^2)**
NCDMA08	Northern Cape	65103
Hantam	Northern Cape	27 968
Kai !Garib	Northern Cape	7 446
//Khara Hais	Northern Cape	3 444
!Kheis	Northern Cape	6 436
KhГi-Ma	Northern Cape	8 332
Nama Khoi	Northern Cape	15 025
Kamiesberg	Northern Cape	11 742
Siyathemba	Northern Cape	8 209
Siyancuma	Northern Cape	10 024
Renosterberg	Northern Cape	5 527
Thembelihle	Northern Cape	6 980
Sol Plaatjie	Northern Cape	1 877
NCDMA07	Northern Cape	15 687
Laingsburg	Western Cape	8 784
Prince Albert	Western Cape	8 153
Blue Crane	Eastern Cape	9 836
Ikwezi	Eastern Cape	4 453
Baviaans	Eastern Cape	7 727
Tsolwana	Eastern Cape	6 025
Inkwanca	Eastern Cape	3 584
ECDMA13	Eastern Cape	133
Maletswai	Eastern Cape	4 358
Gariep	Eastern Cape	8 911
TOTAL KM^2		**324 103**

Source: Karoo Meat of Origin (2012e)

1.3 PROBLEM STATEMENT

When thinking about the Karoo, what comes to mind is sunsets, windmills, hospitality, free roaming sheep, the smell of earth, freshly brewed coffee and the taste of genuine, fresh from the farm, barbequed under the stars Karoo lamb chops.

According to Kirsten *et al.* (2008:1), these images, and the tranquillity and honesty of the Karoo way of life are the reasons why the Karoo concept became synonymous with quality, tradition and wholesomeness. The reputation for quality which is embedded in words such as Karoo has significant marketing potential and is as such already sought after by members of the sheep supply chain often with little or no link to the region (Kirsten *et al.,* 2008:1).

Karoo products are products with specific regional qualities that are based on the natural environment present in the Karoo. The combination of the natural environment, the product specific qualities and the regional image creates a unique identity for a product, in this case, sheep meat produced in the Karoo region (Du Plessis & Du Rand, 2011:1).

Karoo sheep meat is therefore defined as: “Sheep meat [mutton or lamb] that carries the Karoo certification mark. Sheep meat, regardless of breed, produced and slaughtered in the Karoo region. Only sheep originating from (that is, born in) the Karoo, or, alternatively, that are born outside the Karoo but remained in the area of the Karoo for a continuous period of at least six months immediately before slaughter, and which are free of diseases. Karoo sheep derive from free-range grazing or production on indigenous veld vegetation with access to clean water.” (Karoo Meat of Origin, 2012a).

Because products from the Karoo have unique characteristics in terms of quality and reputation which gives them an edge in terms of marketing potential, the concept “Karoo” is attached to products with little or no link to the region to exploit the marketing potential and gains related to the concept. Sheep that are reared and slaughtered outside the Karoo region are often wrongly marketed under the Karoo brand thereby exploiting the Karoo concept and robbing the Karoo community of the competitive edge related to actual Karoo Lamb.

Labelling and protection through a geographical indication (GI) could potentially apply to Karoo sheep meat to curb the exploitation if the quality, reputation or other characteristics are essentially attributable to the geographical origin of the meat. According to Article 22 of Trade Related Aspects of Intellectual Property Rights

(TRIPS) (WTO, 2012:1), GIs are “indications which identify a good as originating in the territory of a member, or a region or locality in that territory, where a given quality, reputation or other characteristic of the good is essentially attributable to its geographical origin”. However, unlike the European Union (EU), the concept of GIs does not exist in the South African law framework. This means that even though the Karoo is a GI according to TRIPS it cannot be protected as such (Bramley, 2012).

The labelling of products may be an alternative way to try and protect the Karoo Lamb concept but as stated by Du Plessis and Du Rand (2011:2), consumers are easily fooled when it comes to labelled products. In the case of Karoo sheep meat, consumers can be and have been misled as to the true origin of the meat being sold and the reputation and image of the product. Karoo sheep meat therefore stands in danger of being usurped. Even though South African law does not protect GIs, products such as Karoo sheep meat can be protected in the South African law framework by means of the trademark law and by registering the concept of Karoo sheep meat as a certification mark. The establishment of a certification mark and the correct labelling of the products could potentially curb the opportunistic behaviour of free riding sheep meat supply chain members (Bramley, 2012).

To try and prevent the exploitation of the Karoo concept and to be able to guarantee the credence attributes, such as origin of a product, proper traceability and certification systems need to be in place. These traceability systems should at least be able to capture information regarding the origin, the producer, the sheep rearing process, the slaughtering process in the abattoir, the procedures and processes during cutting and deboning at the processing plants and the packaging and labelling of sheep meat cuts as well as information regarding the movement of the product along the supply chain, to guarantee a traceable, high quality product and ensure consumer confidence in the product. Traceability is therefore basically a proactive approach of origin guarantees, food safety and quality management as it requires pre-incident investment in the form of auditing.

The perception is that traceability is often lacking in sheep meat supply chains in South Africa, which hampers the quality guarantee and maintenance of traceability systems from the sheep production farm to the sheep meat consumer. The weak

links (supposedly abattoirs and meat processing plants) in terms of traceability in the sheep meat supply chain are mainly due to the role players' strategies to minimise costs and to maximise profits. In doing this, important measures to ensure the basic value, quality of sheep meat products and credence attributes are generally bypassed to cut seemingly unnecessary costs.

1.4 RESEARCH OBJECTIVES

The study has the following overall objectives:

- To assess current traceability systems in the red meat industry and to establish their ability to guarantee the origin of the carcass;
- To develop a model and subsequent recommendations towards establishing an effective traceability system within the Karoo sheep meat supply chains in South Africa, that protects, manages and governs the food of origin attributes of Karoo sheep meat

This study aims to achieve the following specific research objectives:

- To create a high-level process map with information flows of the current South African sheep meat supply chain, specifically the Karoo sheep meat supply chain
- To identify within this high-level process map, the flow and destination of Karoo sheep meat products
- To determine the flow of information within the Karoo sheep meat supply chain, using the high-level process map
- To develop a detailed description of current and potential traceability systems applied to Karoo sheep meat supply chains, with specific reference to the level, breadth and depth of these traceability systems
- To establish if the Karoo sheep meat supply chain's traceability systems are in line with the best practices
- To identify critical control points within existing and potential Karoo sheep meat supply chains to maintain the integrity of the product

- To investigate factors that might influence the decisions and ability of Karoo sheep abattoirs and processing plants to implement improved traceability systems
- To develop recommendations towards establishing an effective traceability system in the Karoo sheep meat supply chains in South Africa that protects, manages and governs the 'food of origin' attributes of Karoo sheep meat
- To test the opinions and/or perceptions of role-players within the Karoo sheep meat supply chain towards these recommendations to establish an effective traceability system.

In response to these research objectives, five hypotheses were identified and tested.

1.5 IDENTIFYING THE HYPOTHESES

The hypothesised independent variables that could possibly impact the implementation decision of traceability systems at the abattoir level as well as the direction of their influences are summarised in Table 1.6.

Table 1.6: Variables expected to influence the traceability implementation decision

Variable	Definition	Expected sign
Dependent variable		
Traceability	Dummy variable scoring 1, if the abattoir has a traceability system in place and 0 if the abattoir does not have a traceability system in place.	
Independent variables		
Size	Number of sheep slaughtered per day. Dummy variable scoring 1, if the abattoir has a capacity of 120 sheep or more and 0, if the abattoir has a capacity of less than 120 sheep.	+
Capital level	Capital amount that is required to rebuild and re-equip an abattoir with the exact operations and specifications of the specific participant abattoir. Dummy variable scoring 1, if the abattoir has a capital level of R20million or more and 0, if the abattoir has a capacity of less than R20million.	+
Market outlets	Proportion (%) of carcasses slaughtered destined for retailers. Dummy variable scoring 1, if the abattoir slaughters to deliver carcasses to retailers and 0 if the abattoir slaughters carcasses not destined for retailers.	+
HAS	Dummy variable scoring 1, if the abattoir has a Hygiene Assurance System (HAS) in place and 0 if the abattoir does not have HAS in place.	+
Vertical integration	Dummy variable scoring 1, if the abattoir has vertical integration up and or down in the supply chain and 0 if the abattoir does not have vertical integration in the supply chain.	+

The following hypotheses, summarised in Table 1.7, are tested in Chapter 4 by means of Fisher's exact test.

Table 1.7: Independent variables, expectations and hypotheses

Nr	Independent Variable	H_0: $\theta = 1$ (Independence)	Expectation	H_a: $\theta > 1$ (Positive Association)
1	Size	The presence of a traceability system is independent of the size of the abattoir.	Larger abattoirs are more likely to have traceability systems in place.	The proportion of abattoirs with traceability systems is higher among large abattoirs.
2	Capital level	The presence of a traceability system is independent of the capital of the abattoir.	More capital intensive abattoirs are more likely to have traceability systems in place.	The proportion of abattoirs with traceability systems is higher among capital intensive abattoirs.
3	Market outlets	The presence of a traceability system is independent of the market outlet of the abattoir.	Abattoirs that deliver their product to retailers are more likely to have traceability systems in place.	The proportion of abattoirs with traceability systems is higher among abattoirs delivering to retailers.
4	Presence of HAS	The presence of a traceability system is independent of the presence of a HACCP system at the abattoir.	Abattoirs that have HACCP systems in place are more likely to have a traceability system in place.	The proportion of abattoirs with traceability systems is higher among abattoirs that have HACCP in place.
5	Vertical integration	The presence of a traceability system is independent of vertical integration up and down from the abattoir.	Abattoirs that are vertically integrated up or down in the supply chain are more likely to have traceability systems in place.	The proportion of abattoirs with traceability systems is higher among abattoirs that are vertically integrated.

Hypothesis 1: the larger the abattoir and the higher the slaughtering capacity of the abattoir, the higher the probability for the abattoir to have a proper traceability system in place. This is due to the fact that the total variable cost of traceability increases with the size of the abattoir. In contrast, the average fixed cost for the implementation of traceability systems decreases with an increase in animals slaughtered. However, the batch traceability system ensures that groups of animals can be collected from the same origin and slaughtered at the same time. This gives small and medium sized abattoirs an advantage over large abattoirs because large abattoirs cannot fill their big-scale operations from the groups of animals supplied by one or a few individual farms and feedlots. This results in higher traceability costs for larger abattoirs since they need animal or product specific traceability systems to enable them to mix animals from different origins without mixing batches and still keep track of the origin of the animals.

Hypothesis 2: abattoirs that are more capital intensive tend to have more stringent traceability systems in place. It is easier for a very small abattoir, with a capacity of 1 to 2 animals per day, to have a traceability system in place without increasing cost. This can be done by means of a paper trail for record keeping where information about the animals entering the abattoir and the information about the carcasses exiting the abattoir are recorded by hand. However, where large abattoirs deal with around 3 000 animals per day, this is not efficient enough. Here a costlier, more stringent traceability system is needed to ensure proper traceability.

Hypothesis 3: abattoirs that slaughter carcasses for retail chains have more stringent traceability systems in place than abattoirs slaughtering for the wholesale market or local butcheries. This is because retailers require traceability systems to be in place at the abattoir level to guarantee product quality and safety. This contributes to the competitiveness in the industry.

Hypothesis 4: abattoirs that have HAS in place are assumed to have a higher probability of having a traceability system in place. Therefore HAS requires a traceability system in place.

Hypothesis 5: abattoirs that are vertically integrated, either upstream or downstream, in the form of a production unit (farm or feedlot) or a market outlet (butchery, wholesaler or retailer), tend to have a more stringent traceability system in place due to the fact that it is easier to maintain an information trail needed for the successful implementation of a traceability system if the abattoir owns other parts of the supply chain as well.

1.6 RESEARCH DESIGN

1.6.1 Sampling

The study focuses in detail on abattoirs in the sheep meat supply chain in South Africa. To some extent, however, the study also evaluates the processing plants responsible for the cutting and deboning of carcasses received from the abattoirs as well as the wholesalers, retailers and butcheries buying these carcasses or meat

cuts. This is to get a better understanding of the complete supply chain and also to determine if chain-wide traceability systems are in place. This helps the study in identifying factors that influence decision making in terms of traceability systems at the abattoir level.

An understanding of all the role players within the meat supply chain, upstream and downstream (first, second and third tiers) is required for an effective study. The first upstream tier in this study's supply chain is the sheep farmer, but this tier does not form a great part of the participants in the study since the farmer is the starting point of the sheep meat supply chain and has little or no bargaining power and control in terms of the traceability systems in place downstream in the supply chain. The focal firm, first, second and third downstream tiers (abattoirs, processing plants, wholesalers and retailers or butcheries) are discussed in some detail, since these supply chain members have more control over the traceability systems in the sheep meat supply chain. Their participation aids in understanding the overall sheep meat supply chain. The main focus of this study is however the South African sheep abattoirs.

Figure 1.3 illustrates the location of the first, second and third tiers both upstream and downstream within the South African sheep meat supply chain as well as the focal firm which, in this case, is the sheep abattoirs.

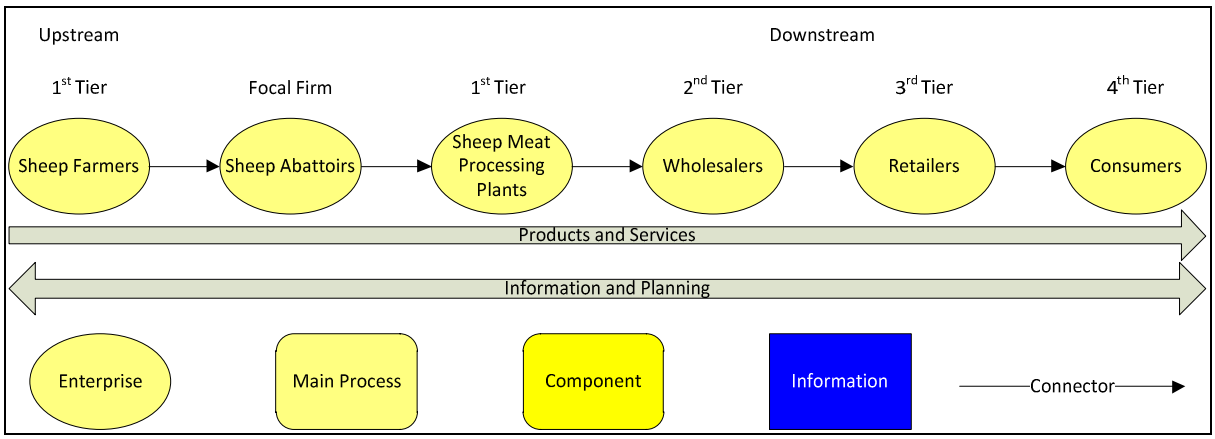


Figure 1.3: Representation of the focal firm, upstream and downstream firms (with legend)

Source: Fawcett, Ellram and Ogden (2007:7)

Note: The same legend applies for all other supply chains and flow charts to follow in this study.

The population of abattoirs in the study was limited to abattoirs slaughtering sheep in South Africa. The abattoirs were not restricted to being purely sheep slaughtering abattoirs. Many of these abattoirs also slaughtered cattle, goats, ostriches and pigs. In order to complete the study, a random sample of 55 abattoirs was drawn from the total population of 284 sheep slaughtering abattoirs, listed at the Red Meat Abattoir Association. The sample size was determined with a 95 % confidence level and 10 % confidence interval.

1.6.2 Data collection

The study applied a combination of qualitative and quantitative data analysis, and data collection was mainly done by means of interviewer-administered interviews: contacting and visiting the 55 randomly selected participant abattoirs and conducting surveys based on structured questionnaires (see Appendix A, p. 183, for the questionnaire used in the study). The structured questionnaire includes closed questions, where the participant is asked to choose from alternative options as well as open-ended questions, where the participant can answer the question in any way they like. Additionally, direct observations of the activities within the abattoirs and unstructured interviews, where the participants are allowed to speak freely on the topic being explored, are also used in an attempt to enrich the primary data collected. With every questionnaire an interview is scheduled with the particular participant abattoir. In this way the participant abattoir can ask if a question is unclear. The interviewer can also use the opportunity to clear up any uncertainties regarding the industry in the case where an industry specialist is interviewed.

Some of the questions that the study attempts to answer include questions relating to the level of traceability within the abattoirs, the type of traceability systems that are in place in the abattoirs, possible reasons why traceability systems are or are not in place, costs for implementing proper traceability systems, benefits gained from implementing traceability systems and identifying the parties within the supply chain that benefit from the implementation of traceability systems. The questionnaire further explores the opinions of abattoirs and processing plants in terms of the future of traceability systems in the sheep meat industry as well as the different traceability systems available.

1.6.3 Strategy of inquiry

The strategy of inquiry used in the study was a combination of qualitative and quantitative survey research. A similar study conducted by Donnelly, Karlsen and Olsen (2009) also used survey research in their evaluation of the importance of transformation for traceability on lamb and lamb products. Bulut and Lawrence (2007) also used this strategy of inquiry when they evaluated the levels of traceability in the meat slaughtering and processing plants in Iowa. They also used a qualitative response regression model, specifically the logit model, to identify the significant factors that influence the traceability implementation decision.

After the data collection process, Microsoft Excel was used to code the questionnaires for data analysis. The statistical package STATA was used for hypothesis testing by means of the Fisher's exact test and to calculate descriptive statistics to contribute to the comprehensiveness of the analysis.

1.6.4 Fisher's Exact Test

Bulut and Lawrence (2007) used a qualitative response regression model, specifically the logit model in addition to descriptive statistics to identify the significant factors that influence the traceability implementation decisions. This method could not be used in this particular study. In order to use the logit model, a relatively large sample and variation within the data is needed. Both of these factors were lacking in this specific study. For survey research the usual approach to follow for contingency tables is the Chi-square (χ^2) statistic, where the Chi-square test is applied to each cell of the contingency table. However, when the sample size is small, the results produced by the Chi-square test statistic may be misleading. An alternative test was therefore needed in order to test the mentioned hypotheses (Bower, 2012:1-3).

In the case of a small, unenlargeable sample, Fisher's exact test is the more accurate test to use as it is specifically developed for exact inference on small samples. This test looks at a contingency table that displays how different factors produced different outcomes.

The Fisher's exact test is based on the following assumptions (Lani, 2009:2):

- It is assumed that the sample was drawn from the population by means of random sampling
- Directional hypothesis is assumed, meaning that either a positive association or a negative association is predicted but not both
- The binary data are independent and the proportions are therefore not correlated
- It is assumed that the observations are mutually exclusive
- The measurement level of the variables is assumed to be dichotomous.

The null hypothesis of this test is one based on independence: the relative proportions of one variable are independent of the second variable. The result of the Fisher's exact test is an exact p-value that can be compared to a specific level of significance, usually at 5 % to determine the independence of the two variables compared in each hypothesis. This test is exact because it uses the exact hyper-geometric distribution rather than the approximate Chi-square distribution to compute the p-value (McDonald, 2009:1-2).

The hypotheses, hypotheses description, the Fisher's exact test results as well as the concluding statement and remarks regarding the hypotheses are discussed in detail in Chapter 4.

1.7 ACADEMIC VALUE AND INTENDED CONTRIBUTION OF THE STUDY

The main purpose of this study is to assess current traceability systems in the sheep meat industry and to establish their ability to guarantee the origin of the carcass. The study attempts to develop a model and subsequent recommendations towards establishing an effective traceability system within the Karoo sheep meat supply chains in South Africa that protects, manages and governs the food of origin attributes of Karoo sheep meat. The study furthermore includes a high level process map with information flows of the current South African Karoo sheep meat supply

chain. This is used to determine and evaluate whether traceability systems are in place and in the Karoo sheep meat supply chain and to what extent.

More intensive research on the topic of chain-wide traceability systems regarding meat products is long overdue. Recent food scares and consumer preferences regarding information about food of origin, as well as the recent enforcement of the Consumer Protection Act have brought about changes in regulations in supply chains, and there are increasing concerns across the world regarding the health and safety of meat products. Furthermore, demands placed upon meat supply chains by consumers in terms of the implementation of traceability systems may include intrinsic and extrinsic characteristics. It is therefore important for meat supply chain members to consider factors such as animal feeding, disease control, production systems, age and breed, all of which affect a product's intrinsic quality and can be observed by the consumer. On the other hand, extrinsic characteristics relating to animal production such as region of origin of the product are not directly observable by the consumer and can only be conveyed by means of labelling of the meat product, post slaughter (Sepúlveda, Maza & Pardos, 2010:366).

The level of traceability within the South African sheep meat supply chain, specifically in terms of food of origin, the weak links in the sheep meat supply chain with regard to traceability systems, possible reasons for the lack of traceability systems and recommendations for the implementation of traceability systems are some information that may come to light from the research. This ultimately aims to satisfy the specific objective: to develop a model and subsequent recommendations towards establishing an effective traceability system within the Karoo sheep meat supply chains in South Africa, which protects, manages and governs the food of origin attributes of Karoo sheep meat.

The aforementioned therefore proves the tremendous value that a study in chain-wide traceability systems, especially within the South African Karoo sheep meat supply chain, contributes to the existing knowledge and research base.

1.8 OUTLINE

Chapter 2 is dedicated towards explaining the concept of traceability and traceability systems in detail. Chapter 3 involves a brief overview of the South African sheep meat industry followed by the unpacking of most of the possible supply chain formations in the South African sheep meat industry. Chapter 4 focuses on the analysis of the data collected by means of a discussion of the descriptive statistics, followed by Fisher's exact test for hypothesis testing to try and understand the traceability decision making process at the abattoir level and the economics of implementing a traceability system. Chapter 5 looks at some of the international chain-wide traceability systems in place to guarantee the origin of a specific food product. Chapter 6 is dedicated to explaining the Karoo Meat of Origin supply chain and contrasting this supply chain with leading international supply chains. This dissertation concludes with concluding remarks and recommendations in Chapter 7.

CHAPTER 2

TRANSPARENCY AND TRACEABILITY IN RED MEAT SUPPLY CHAINS

2.1 INTRODUCTION

In this chapter transparency is discussed in terms of the various definitions, factors and barriers that complicate the implementation of transparency as well as the use of branding and labelling to enhance transparency. In terms of traceability systems, the various definitions and the challenges and barriers to the implementation of traceability systems are also covered. Furthermore, issues such as the function and purpose of traceability systems, the requirements and strategies, the systems, techniques and technology for the implementation of traceability systems as well as the potential costs and benefits related to the implementation are dealt with. Lastly, bottlenecks and success factors and the impact of integration and coordination on traceability systems are discussed.

2.2 TRANSPARENCY

2.2.1 Defining transparency

Transparency provides a method for the origin and history of a food product in a supply chain to be made evident and clear (Trienekens & Beulens, 2011:2). Bulut and Lawrence (2007:1-2) define transparency as production information being made publically available at each stage of the production process. Hofstede, Schepers, Spaans-Dijkstra, Trienekens and Beulens (2004:239) provide the following definition for transparency: “Transparency of a [meat] chain is the extent to which all [meat supply chain] stakeholders have a shared understanding of, and access to, the product-related information that they request, without loss, noise, delay and distortion.” Transparency can furthermore be divided into vertical and horizontal dimensions. The horizontal dimension is about the legislation and requirements that are relevant to the companies within the different stages of a supply chain and the

company strategies and operational processes. This dimension also involves the supply of information regarding policy and measures of each company to the key stakeholders and consumers. The vertical dimension, also called chain transparency, encompasses legislation and requirements that relate to all companies in a particular supply chain, and mainly focuses on the input and output flows of supply chain companies (Wognum, Bremmers, Trienekens, Van der Vorst & Bloemhof, 2011:66).

For purposes of this study the definition of transparency by Bulut and Lawrence (2007:1-2) is used. This definition states that transparency is the production of information that is publically available at each stage of the production process. Within this definition information regarding the origin of the product (the farm on which the product is produced) is also captured. This adds to the relevance of the definition to this particular study.

2.2.2 Factors complicating transparency

Trienekens and Beulens (2011:3-4) as well as Wognum *et al.* (2011:72) presented the following summary of the factors that complicate transparency of processes in food production. These factors complicate systems in terms of information flows which are difficult to manage and in which the achievement of transparency of products, processes and resources are more difficult to achieve. They are as follow:

- Diverging and converging streams of products increase the level of difficulty in the attempt to trace various raw material inputs going into the production process and the output of products coming out of a production process
- Due to weather conditions and seasonality or biological variation, raw materials and intermediate products may not be homogenous, which may further lead to variations in production (especially concerning the nature of both intensive and extensive meat production)
- The use of the same resources for the production of various products as well as the mixing of batches of raw materials from different suppliers can result in cross contamination

- Information during batch production can be kept per batch while information during continuous production can only be kept through production time or locations of storage facilities
- The internationalisation of food supply chains resulted in many off-shore suppliers being part of local supply chains; this increased the batch sources of raw materials, which made the achievement of traceability and transparency even more complex
- Similar or the same products are made with different raw materials and different resources
- The identification and registration of total product quantity and the active material of a product
- The perishable nature of raw materials complicates traceability and in turn reduces transparency even more – using raw materials on a first in first out (FIFO) basis is not always possible
- Batches of similar products but of different ages complicates traceability
- Arm's-length relationships in food supply chains are common and proper administration is often lacking
- A wide range of labels and a large assortment of products in food chains is a result of consumer demands for information regarding the origin of the food product, composition of food products and specific processes.

Transparency is costly in the short run and benefits only transpire in the long run (Wognum *et al.,* 2011:67). Four other barriers can be identified that hinder the establishment of transparency in terms of environmental effects in food supply chains. First of all, a measurement problem exists. It is unclear what the financial gains for pro-active companies are and if consumers are prepared to pay relatively more for sustainable and/or traceable food chains than for traditional food chains. Secondly, costs and/or benefits from environmental pro-active businesses caused along the supply chain and measures taken to enhance traceability and transparency in one stage can fail in an earlier or later stage. To rectify this, horizontal and vertical relocation of costs and benefits is essential to connect supply chain members. Thirdly, social and technical rigidity has a negative influence on innovativeness. Companies focus more on gathering data and less on sharing data with members along the supply chain to try and increase supply chain traceability while

simultaneously reducing transparency. Increasing the need for compliance with public environmental policy pressures by demanding certified environmental management systems can act as a fourth barrier (Wognum *et al.*, 2011:67-68).

There are many factors and barriers that complicate and affect transparency within supply chains. However, the transparency of documentation and information at each stage of production, but also between stakeholders in a supply chain, remains extremely important, not only to protect or inform the consumers of food products but also to protect and inform producers and processors within the supply chain.

2.2.3 Branding and labelling

By branding or labelling a product, the message of a transparent, traceable supply chain or production process is conveyed to the consumer. Other messages such as free range, organic, fat free, low fat, sugar free and GMO free can also be conveyed by means of labelling, all of which needs a proper traceability system in order for a transparent supply chain and a trustworthy brand and label.

2.2.3.1 Information Asymmetry

Information asymmetry between buyers and sellers is often a major problem in food supply chains. Attributes such as organic, group housed, free range and the origin of a food product are unobservable to the consumer and can be viewed with cynicism. By creating brands and labelling products, information asymmetry between buyers and sellers can be overcome. This argument, however, only holds true if the final handler has total control over attributes and claims made during the production process. Within supply chains this is, however, mostly not the case and branding and labelling proves to not be sufficient to overcome information asymmetry (Buhr, 2003:16).

A label is defined as a symbolic representation of large quantities of information, which are rarely communicated to consumers and which are not accessible to ordinary consumers. This can, at times, create more confusion than enlightenment. Proper traceability systems, where documentation regarding a certain product, in this

case a meat product, need to be in place to gather and share information from the farm of production through to the abattoir, processing plant, wholesaler, retailer, right up to the point of consumption. The implementation of such systems might offer solutions superior to only branding and labelling to try and overcome the information asymmetry issue (Buhr, 2003:16, 18; Coff *et al.*, 2008:5).

2.2.3.2 Origin-Based Labels

Origin-based labels mainly inform customers about products, specifically the products' key predictable quality characteristics. These products, unlike products carrying global labels, can only be produced within a given geographical area, where that particular area contributes something that makes the product unique and distinctively different (De Kop, Sautier & Gerz, 2006:9). The French concept of *terroir* best describes the conceptual meaning of area. According to De Kop *et al.* (2006:10), "a *terroir* is a historically developed interaction between (i) the product's biophysical properties that result from a specific geographical entity, and (ii) the local community's practices and culture". Origin-based labelling recognises that the products of a *terroir* possess additional value as opposed to global brands. This value however, belongs to the community and these products are supposedly sustainable and beneficial to the community if these products are not imitated by global brands. It is these replications that origin-based products as well as the local communities should be protected against (De Kop *et al.*, 2006:10).

2.2.3.3 Certification Marks

A certification mark is any word, name, symbol, or device used by a party or parties other than the owner of the mark to certify some aspect of the third parties' goods or services. Certification marks are used to identify the source such as the nature and quality of goods and guarantee that these goods have specific defined standards (USPTO, 2010; UNIDO, 2010:12-13).

This means that any entity (with the exception of the owner of the mark) that complies with the certification mark's standards and that has permission from the owner is entitled to use the mark. The owner of the certification mark controls the use

of the mark by ensuring that the mark is only attached to goods or services that display or contain the specified requirements or requisite characteristics that the owner of the mark has established or adopted for the certification. This mark inform buyers of the goods and services that the goods and services of the authorised user possess certain characteristics or meet certain qualification standards and that the presence of these characteristics or qualifications has been controlled and can be guaranteed (USPTO, 2010; UNIDO, 2010:12-13).

A certification mark is therefore a type of trademark that can certify (USPTO, 2010):

- Geographic origin
- Materials used, quality, method of manufacture, and accuracy
- Products made under the support of, or by members of a specific trade union or organisation.

For consumers to benefit optimally from the labelling of products, it is essential to ensure that complete and accurate information is provided and that product specifications are met. In the case of local markets, consumer confidence in products can be higher due to the shorter supply chains. But as the supply chains lengthen and consumer confidence decreases, proper certification and monitoring systems have to be implemented to ensure consumer confidence (FAO, 2007).

However, for a supply chain or production process to become transparent, a traceability system is needed.

2.3 TRACEABILITY

2.3.1 Defining traceability

There are ample definitions for traceability. Fundamentally traceability is a proactive approach to create and maintain a trail of information that follows the path of a product throughout the whole production process. In the case of food safety failures, traceability systems provide for the quick identification, measurement and containment of a hazard, which can reduce the negative effects for consumers

brought upon by such a health hazard (Bulut & Lawrence, 2007:1-2). The official traceability definition according to the EU as stated in Bulut and Lawrence (2007:1-2) is, “the ability to trace and follow a food, feed, food-producing animal or substance intended to be or expected to be incorporated into a food or feed, through all stages of production, processing and distribution”. For the purposes of the United States (USA) the EU definition was too detailed and Bailey, Robb and Checketts (2005:1) proposed the following definition: “the efficient and rapid tracking of a physical product and traits from and to critical points of origin or destination in the food chain necessary to achieve specific food safety and/or quality assurance goals”.

For the purposes of this study, the official definition for traceability as stated by the EU in Bulut and Lawrence (2007:1-2) is used. This definition is most complete as it also mentions the product being traceable throughout all the stages of the supply chain back to the production stage (be it Karoo sheep producing farms or sheep producing farms outside the Karoo region). This definition was furthermore used by Bulut and Lawrence (2007:1-2) to compile a study similar to this study. Here traceability was defined as: “the ability to trace and follow a food, feed, food-producing animal or substance intended to be or expected to be incorporated into a food or feed, through all stages of production, processing and distribution,” where, in this case, Karoo sheep and Karoo sheep meat are the mentioned “food, feed, food-producing animal or substance”.

Traceability can be divided into three particulars, namely, the level of the traceability system, the breadth of the traceability system and the depth of the traceability system. In order to understand the comprehensiveness of the word traceability, the definitions of level, breadth and depth will be discussed. Firstly, the level of a traceability system refers to the way in which a product can be traced back or tracked forward within a supply chain. Three levels exist: genetic, farm to retail and batch traceability. Genetic traceability refers to taking deoxyribonucleic acid (DNA) samples from carcasses to locate all the relevant records of the specific animal. Farm to retail traceability refers to the ability of the system to track the identity of all animals from a farm through the processing and distribution channels to a meat cut. Batch traceability is the ability to trace live animals from the farm up to carcasses at the abattoir level without further tracking on the cutting floor – the identities of the source

are maintained at the batch level. Secondly, the breadth of a traceability system refers to the amount of information that the traceability system records for each product, for example, the attributes – contact or production information such as free range, organic, Karoo certified and grain fed, to name a few. And thirdly, the depth of traceability refers to how far back or forward the traceability system is able to trace or track an item, for example, from the abattoir to the auction, feedlot or sheep farm or from the abattoir to the wholesaler, retailer or butchery (Bulut & Lawrence, 2007:3).

2.3.2 Functions and purpose of traceability systems

The main functions and purposes for the implementation of a traceability system, according to Hobbs (2003:37) and Meuwissen *et al.* (2003:169), are:

- Facilitating the trace back of products increases transparency and reduces the costs associated with or minimises the risks of a food safety problem
- Strengthening liability incentives and reducing the risk of liability claims
- Allowing ex ante verification of credence quality attributes
- Improving recall efficiency by improving the quality of the recall, thereby reducing costs and enhancing the image of the supply chain
- Improving the control of livestock epidemics, since movements between farms are tracked and epidemics such as foot and mouth disease can be caught in time.

Traceability systems, whether on meat supply chains or supply chains in general, bring various benefits to all members of a supply chain. The benefits apparent from traceability systems are amongst others: (i) assuring consumers of the safety and origin of food products, (ii) aiding with identifying infected or substandard products in a timely manner (Wilson & Clarke, 1998:127-129), (iii) allowing for the control of livestock related or other diseases and the monitoring of residues on food products, (iv) validating support measures, and (v) with regard to potential brand development, meeting regulation requirements (Simpson, Muggoch & Leat, 1998:121-122). Economic benefits of having traceability systems in place include: (i) increased efficiencies and savings within several areas in the supply chain, (ii) reduced disease levels, (iii) reduced payments for compensation, and (iv) allocating testing resources

more efficiently. It should be acknowledged, however, that the above-mentioned benefits for traceability systems come at the cost of implementing these systems (Hobbs, 2003:37-38).

From the functions and benefits listed above, it is clear that there are supposedly more advantages to the implementation of proper traceability systems in food and meat supply chains than possible disadvantages. However, to determine the full cost implication, an investigation in terms of the costs of the implementation of proper traceability systems should be done. Following this, the cost should be weighed against the benefits to determine the real benefits from the implementation of a traceability system.

2.3.3 Information arising from a traceable supply chain

Traceability systems are built into and developed for supply chains for various reasons. One of these reasons is to enhance transparency within a supply chain. As soon as a supply chain becomes transparent, information within the supply chain is of a higher quality, and information flows are faster.

Beulens, Coppens and Trienekens (in Trienekens & Van der Vorst 2006:451-452) identified the following information arising from a supply chain where a proper traceability system is in place:

- The inherent properties of a product such as size
- The process properties which constitute the history of what has happened to the product during production or processing
- Properties or means of production used on the product such as labour and machinery used in producing the product
- Origin or provenance data of a product deals with information related to the processes, resources, raw materials and intermediate products used to produce the product
- Actors involved during the lifecycle of the product
- Relationships between the different stakeholders of a supply chain.

This study focuses mainly on evaluating the sheep meat supply chain and traceability systems that are in place in order to determine if the origin and quality attributes of a specific sheep meat product can be traced back to the origin of production, in this case, the Karoo region.

2.3.4 Requirements for traceability systems

Interest in terms of traceability is rapidly growing within the food and agribusiness sector. To keep up with this growth, it is essential for stakeholders to adhere to certain requirements to try and develop a fully traceable supply chain. Industry members will have to invest in a good tracking and tracing system to allow for the tracking and tracing of products throughout the supply chain. By investing in these systems the supply chain becomes transparent, which in turn rebuilds consumer trust in a specific product. Proper traceability systems reduce costs, add to the flexibility of a supply chain and enhance management processes. Furthermore, proper traceability systems are required by government and policy makers to ensure the safety of food products for human and animal consumption (Trienekens & Van der Vorst, 2006:445).

Table 2.1 summarises the requirements in terms of traceability for the industry, government and consumers as set out by the Food Standard Agency (2002:14-19).

Table 2.1: Traceability requirements of various stakeholders

Stakeholders	Traceability requirements
Industry	• To comply with relevant legislation • To be able to take prompt action to remove contaminated products from sale and protect brand reputation • To minimise the size of any withdrawal and hence the costs incurred in recovering, disposing or reconditioning contaminated products already placed on the market • To diagnose problems in production and pass on liability where relevant • To minimise the spread of any contagious disease amongst livestock • To protect the food chain against the effects of animal disease • To assure meat and meat products and maintain markets and consumer confidence • To create differentiated products in the market place because of the way they have been produced

Stakeholders	Traceability requirements
Government	• Protect public health through the withdrawal of contaminated food products • Help to prevent fraud where analysis cannot be used for authenticity • Protect public health through the withdrawal of contaminated food products • Control zoonotic disease, for example, salmonella • Enable control with regard to human and animal health in emergencies • Control livestock diseases through the rapid identification of disease sources and dangerous contacts • Monitor and control livestock numbers for subsidy chains
Consumers	• Protect food safety by effective product recall • Enable avoidance of specific foods and food ingredients, whether because of allergy, food intolerance or lifestyle choice

Source: Food Standards Agency (2002:14-19)

Disney, Green, Forsythe, Wiemers and Weber as well as McKean (in Meuwissen *et al.,* 2003:169) proposed the following requirements for a traceability system to be adequate in the meat supply chain: (i) all partners and their individual roles in the supply chain should be identified, (ii) a unique animal identification system should be in place that can be transformed into a batch identification system once the processing level in the supply chain is reached and (iii) it is important that complete and credible information is transferred among all supply chain stakeholders.

Only after it is understood what the functions and purpose of traceability systems are, what information has to become transparent and what the requirements are to implement such systems, can the strategies for their implementation be explored.

2.3.5 Strategies for the implementation of traceability systems

It is important to understand exactly what level of traceability is required within a specific supply chain. Furthermore, the level of expertise within the supply chain should be known, to determine if the specific role player or supply chain as a whole will be able to cope with a specific strategy and have the skills necessary to implement such a strategy.

According to Hofstede (2011:4), information strategies have two components. These determine the type of strategy within a specific supply chain and the processes to enable a traceability system fit for the chosen strategy. These two components are: (i) connectivity, where people, teams, functions and organisations are connected by means of technology to work together and (ii) willingness, where information is power

and sharing information means relinquishing some of the power. If supply chains are not connected and there is no willingness to share information, there is no incentive to choose a strategy and implement a traceability system.

Wognum *et al.* (2011:70) and Trienekens and Van der Vorst (2006:451) identified the following three traceability strategies by realising that process and product information can also be used to reduce costs related to failures to raise productivity and/or guarantee product quality:

- **Compliance-orientated strategy**
  This strategy implies that only incoming and outgoing materials are registered for traceability purposes and that the process is left as a black box. What this means is that information is gathered and shared regarding products entering and exiting a process (for example, live sheep and sheep carcasses in a sheep abattoir) but what exactly happens in the abattoir (cutting up of carcasses and forming different batches) is not captured.

- **Process improvement-orientated strategy**
  Production-integrated measures assure that the organisation has control over the traceability of a product within the specific supply chain link. This strategy states that a sheep processing plant for example will have full control and traceability systems within its processing procedures (cutting up of carcasses and then what carcass is in what batch) but information is not necessarily shared with role players up and down the supply chain to make the entire chain fully traceable.

- **Market-orientated (branding) strategy**
  This strategy involves organisations implementing full traceability systems in order to gain a competitive advantage. Common goals and integration is of importance to successfully implement this strategy. Organisations throughout the supply chain will have traceability systems in place to gather information and this information will then be shared with role players up and down the supply chain, enabling chain-wide traceability.

Supply chains and role players within supply chains should determine which strategies are best suited for their needs, what traceability strategy is prefered by the consumer and which strategy will fit within the budget. This chosen strategy can then be implemented throughout the supply chain to ensure a certain level of supply chain traceability.

2.3.6 Traceability systems, techniques and technology

In order to incorporate a traceability system some sort of information system is needed to track and trace incoming products as well as outgoing products within a supply chain. In this section some examples of systems, techniques and technologies for traceability and quality management are discussed.

2.3.6.1 Systems to be considered

For meat supply chains, it is necessary to use visible identification for the identification of live animals; barcodes, numbered ear tags and/or tattoos can typically be used as a form of visible identification. European and some other countries have computerised central databases that have been set up to record information that can assist in dealing with some local food safety or food quality situations. The data that should be available for the effective use of such a computerised system are: farm location, the type of farm and the practices on the farm, owners of the animals, animal stock, movements of animals, the means of transport, documentation, authorities involved and their obligations, as well as information on the establishments where the animals are sold (Wognum *et al.,* 2011:72). It is important that these databases are kept consistent and up to date for quick and accurate responses to try and counter or stop the damage done by quality or food safety incidents.

To ensure proper traceability within the meat supply chain, it is required that animals are traceable back to the farm of origin or premises where they were raised and fed by means of an advanced animal identification system. This system consists of identification numbers for individual premises assigned by government (Bass, Pendell, Morris, Scanga, Belk, Field, Sofos, Tatum and Smith, 2008:30). According to

Bass *et al.* (2008:30), traceability also requires individual and group identification by means of ear tags. All animals should have ear tags that are approved, tamper proof, made of non-degradable material, easy to read and made to remain attached to the animal's ear without it being harmful to the animal. The country and the date of birth as well as a unique number should be marked permanently on this tag. If there is space available on the tag, a barcode can also be printed on the tag which can provide additional information. For large herds it is best to use electronic identification devices in addition to the ear tags. For detecting and tracking the movement of livestock, radio frequency identification devices (RFIDs) can be used (Bass *et al.* (2008:30). This has been successful in tracking the movement of large numbers of animals as it minimises economic losses and it improves the quality of information gathered. According to Bass *et al.*, (2008:30), identification by means of ear tags is known to be the most popular; however, currently it seems that identification by means of RFIDs is gaining ground and might be the more practical technology (depending on the cost benefit analysis) to use when it comes to traceability,

Figure 2.1 indicates the different traceability systems that can be distinguished within supply chains.

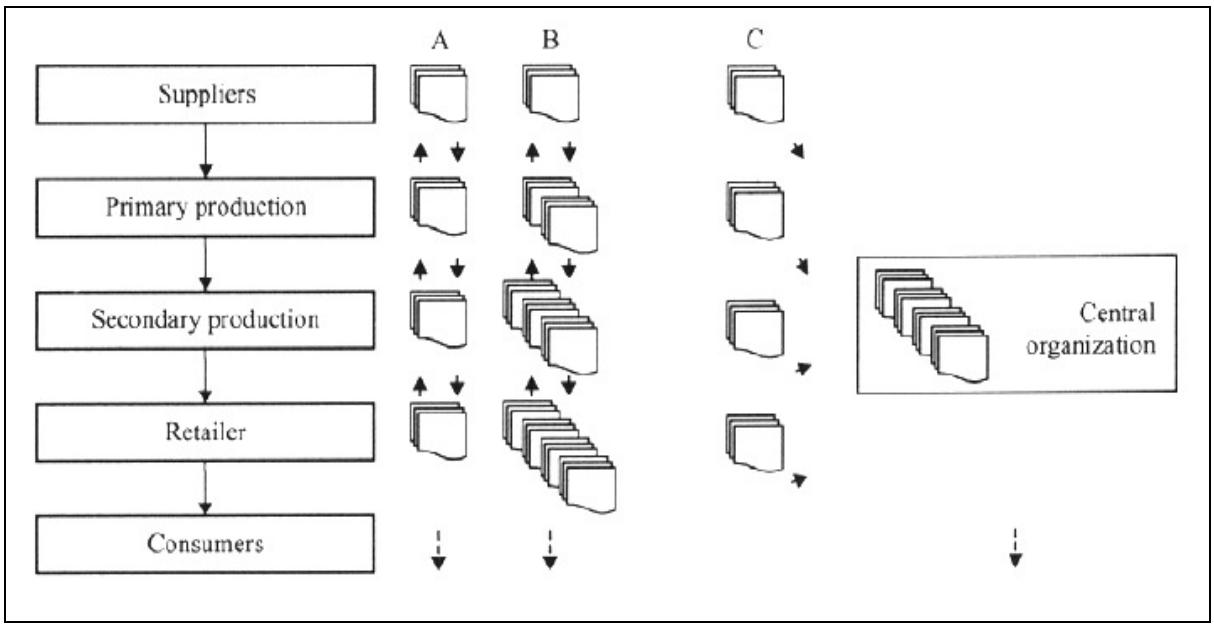


Figure 2.1: Traceability systems in supply chains
Source: Meuwissen *et al.* (2003:170)

The systems used in Figure 2.1 are explained in detail in Table 2.2.

Table 2.2: Explanation of traceability systems in supply chains (Figure 2.1)

System	Description of System	Advantages	Disadvantages
A	Each link in the supply chain gets its relevant information from the previous link. In case of an emergency, all links need perfect administration in order to have a quick response.	The amount of information communicated is small. This reduces transaction costs.	The system is based on trust; each link must trust the previous link on the quality and quantity of information passed along the supply chain.
B	Each link receives the relevant information from all former links.	The speed at which tracking and tracing can be done is much higher than with system A. The completeness of the information can be controlled due to the fact that all other members in the supply chain receive the information. The transparency of the system seems better than that of system A.	The information load increases per link in the supply chain.
C	Each link of the supply chain provides the relevant information to a separate organisation, which combines all the information for the entire supply chain.	Such organisation can resolve the matter of trust. This system provides for rapid tracking and tracing. The organisation is dedicated to the system; the danger of the system is not being well maintained because of lack of time or other resources are minimised.	Total costs may be larger.

Source: Meuwissen *et al.* (2003:170)

An example of an information system, similar to system C in Table 2.1 is illustrated in Figure 2.2. These systems are typically used in the European beef industry, where an animal can be traced back and tracked forward at any moment in time (Buhr, 2003:21). This information system is currently implemented by GildeNorge, a Norwegian slaughtering plant.

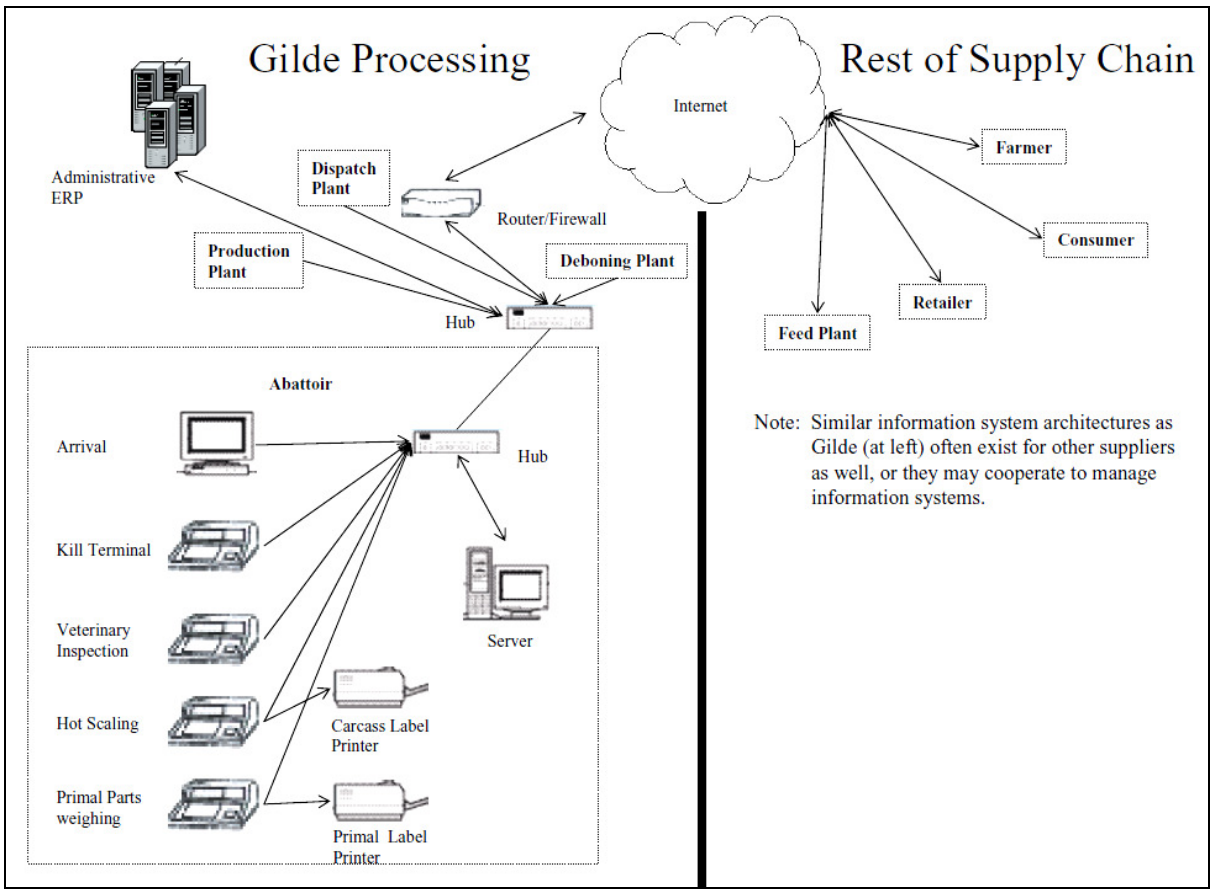


Figure 2.2: GildeNorge's information system
Source: Buhr (2003:21)

Figure 2.2 shows an overall product-supply chain including farms, ingredient suppliers (for simplicity, only feed, but can include seasonings at processing), the slaughter and processing plant itself and the retail or distribution stage and consumers. The vertical members of the supply chain all connect into the traceable information flow via the internet; there is typically a dedicated server that provides the interface and database for the traceability data. Each entity may maintain their own servers for their specific databases and simply allow queries through their firewall, or there may be a central system managed by one of the entities on behalf of the participants. The latter is often the case between farms and processors or feed suppliers, since few farmers have the information-technology access (knowledge or capital) to create an internal information system with internet capabilities. Underpinning the internet, which allows connectivity between firms, is each firm's internal information system or enterprise resource planning (ERP) systems. ERPs are simply the platforms on which company specific information resides (a prototypical structure is shown in Figure 2.2). The ERP will locally store all information regarding all activities electronically collected by the firm (Buhr, 2003:21).

In Figure 2.2 the left-hand side of the diagram illustrates the structure of Gilde's processing operations. The physical data of the product are recorded as a digital traceability record. In Gilde's processing operations, four main points exist where traceability is needed: the abattoir, deboning plant, production plant and dispatch plant. As can be seen from Figure 2.2, data of animals arriving at the abattoir are recorded by a computerised system. The animals are then killed and inspected by veterinarians. The warm carcass is then weighed and data pertaining to the carcass are recorded. The primal parts of the animal are also weighed and data associated with these parts are recorded. Labels with serial numbers of each individual animal are then attached to each carcass as well as to the primal parts. All digital data collected during the slaughtering process is then sent over a network to which an abattoir server is connected. This network is also connected to the other Gilde processing points. The rest of the supply chain (right-hand side of Figure 2.2), is connected to the Gilde processing points via the internet, through a router or firewall.

For these traceability systems to function properly, it is important that the techniques and technology used in conjunction with these systems are appropriate and cost effective. The techniques and technology should be at the skills level of the people or organisation responsible for their implementation, and the benefits gained from the implementation should outweigh the cost implication.

2.3.6.2 Technology and techniques to be considered

Due to the inconsistency of computerised central databases and the large administrative loads, industries tend to move towards the use of electronically readable devices such as RFIDs. These devices are cost effective and are proven to improve traceability from the farm to the abattoir. At the abattoir, DNA samples can be taken from each carcass and stored to allow full trace-back of meat products if needed. However, the use of DNA sampling is not yet cost effective (Wognum *et al.,* 2011:66).

Some established tracing and tracking technologies, also known as automatic identification and data communication technologies that are used within the meat industry (Mousavi *et al.*, 2002:10), are listed below:

- **Bar codes**

  This system consists of a label, a scanning device and a portable terminal. The barcode is a machine-readable code that consists of a series of bars and spaces printed in defined ratios. This code can contain information regarding the farm on which the animal was produced, the farm owner, the date of birth and the information in terms of feeding practices, or various other data.

- **Microcircuit cards**

  These cards are fixed to the product, the pallet or conveyor, and can store data about products moving through a production system (abattoir or processing plant). This is usually where the most interruptions regarding traceability of a chain occur since keeping certain batches of meat products and carcasses together proves to be difficult in an environment where processing speed is of the essence. Extra care should be taken to keep specific batches together and to prevent mixing them with other batches. Microcircuit cards attached to specific batches can deal with this specific traceability problem if implemented correctly.

- **RFIDs**

  Radio frequency identification devices monitor the movement as well as the location of containers, pallets or vehicles as they move through the chain towards the final receiver. They provide for automatic identification as they track movements or control assembly line operations. According to Fawcett *et al.* (2007:389), RFIDs makes it easier to know at all times exactly where as well as in what condition the product is.

- **Voice recognition systems**

  Voice recognition technology allows users to enter data on the status and location of items such as packages, pallets, containers, railcars, or vehicles directly into a computer simply by speaking into a microphone. This system

has some drawbacks; the most relevant for this study are the effect of background noise (especially within abattoirs and processing plants) on the quality of the information gathered and the problem with language recognition and pronunciation mistakes of words.

- **Bio coding**
  Bio code technology enables supply chain stakeholders to identify individual batches of products. This type of technology can provide the necessary means to track and trace different batches of meat products going through an abattoir, allowing the supply chain to link a specific meat cut to the specific carcass and original live animal.

- **Chemical markers**
  Chemicals added in tiny concentrations to tattoos or stamps are also able to retrieve and maintain information during supply chain processes. The use of chemical markers, if tested safe for consumption, can be used in ink for roller marks when it comes to marking carcasses and meat cuts within an abattoir to enable full trace back of meat cuts to carcasses.

Trienekens and Van der Vorst (2006:466) identified another technology that is currently not used extensively by the meat industry, but by other supply chains in the food industry, namely biometric procedures.

- **Biometric procedures**
  These include the DNA identification of animals. Carcasses going through an abattoir undergo DNA sampling; this information is then gathered and can be used to trace a specific meat cut back to the carcass. This procedure is still too expensive for large scale applications, however.

Automatic identification and data communication technologies have been developing fast and are applied extensively in all industries. Further extension of the possibilities of the different technologies for product identification and registration will be a strong incentive for the further development of tracking and tracing systems in food supply chains. Developments in bar coding, RFID technology and biometric procedures are

particularly promising in this regard. But new applications of other technologies can also be expected (Trienekens & Van der Vorst, 2006:467).

Technical developments are needed to catch the contamination of products early. It is possible that the ear-tag system will be replaced by RFIDs. DNA sampling may also be used in future to trace back meat products to individual animals. However, technological advances in current traceability systems can also be applied to provide additional information to consumers or to do detailed assessments of animal breeding programmes. The opportunities for the implementation of traceability systems in meat supply chains are endless (Meuwissen *et al.,* 2003:171).

2.3.7 Barriers to implementing a traceability system

Currently, there are numerous difficulties in the implementation of proper traceability systems within meat supply chains. Also, the relative newness of the topic, especially in South African context, means that there might be more barriers in terms of traceability that have not yet been discovered or studied.

The following are some of the current barriers that could be found in the available literature (Meuwissen *et al.*, 2003:178; Mousavi *et al.*, 2002:7-8,11; Trienekens & Van der Vorst, 2006:440-451; Trienekens & Zuurbier, 2008:108; Wognum *et al.*, 2010:67-70):

- Traceability within a supply chain is reached by different stakeholders of that particular supply chain, and because of this interdependency the traceability of the chain is as strong as its weakest link
- Traceability in terms of incoming and outgoing products is obligatory, but the supply chain stakeholders can decide if they want to implement horizontal or internal traceability
- A lot of time and effort is needed to implement traceability systems throughout the supply chain
- The available options and systems for successfully implementing a traceability system can be costly and there is still relatively little certainty that the costs are worth the benefits.

It is for these reasons that full traceability systems only exist in integrated or coordinated supply chains or supply chains that are less complex. Within these supply chains, information is shared more willingly due to higher trust amongst supply chain members and information flow is increased due to higher connectivity. Benefits are gained and lower costs are incurred by all members of the supply chain because it is vertically integrated and members operate as one in terms of setting and working towards achieving goals. However, these integrated and coordinated supply chains, like other supply chains, still face challenges when it comes to the implementation of a chain-wide traceability system.

2.3.8 Challenges to implementing a traceability system

The long and complex meat supply chain comes with its own set of challenges and problems. Various studies have shown that cattle are fully traceable from farm to abattoir and thereafter within the retail part of the supply chain. The only hindrance in the chain becoming fully traceable is the weak links, namely the abattoirs and processing plants (Mousavi *et al.*, 2002:8; Bulut and Lawrence, 2007).

Mousavi *et al.* (2002:8) listed the following main challenges that need attention to ensure a full traceability system within the meat supply chain:

- An intelligent material handling device should be designed that can store and transfer the information of a given piece of meat as it moves through the supply chain
- Production processes should be standardised and automated, tracking and labelling techniques should be enhanced and a proper control system should be in place to assist the system designer in solving the complexities of carcass disassembly
- A standardised database system with a uniform format from farm to fork may aid the integration of a proposed tracking system.

Dr G. C. Neethling (2011), manager of the Red Meat Abattoir Association, provides the following reason why there is a higher level of traceability in cattle supply chains compared to other red meat supply chains: In the cattle industry, calves are reared

on farms and then sold to feedlots. Most of these feedlots are registered at the South African Feedlot Association, which requires gathering, keeping and sharing of information in terms of where the feedlot animals originated from. From the feedlot, the animals are sold and transported under specific conditions to abattoirs registered at the Red Meat Abattoir Association. The abattoirs then gather, keep and share information regarding animals coming into the abattoir and carcasses or meat cuts exiting the abattoir. Animals are then transported to wholesalers or retailers and the existing flow of information is kept up to date.

The sheep industry, on the other hand, does not involve feedlots to the same extent as the cattle industry. Sheep are reared on farms and are sold and transported from the farm to the abattoir. This creates barriers for abattoirs to keep proper records in terms of exactly where each sheep originated from because sheep from a lot of different farms are required to fill the abattoir's capacity. Auctions further increase the probability of interruptions in supply chain traceability, as it is rarely noted exactly where the auctioned sheep came from. This reason is comparable to the reason mentioned by Mousavi *et al.* (2002:8).

In addition, Neethling says that the two main reasons for the implementation of proper traceability systems within South African meat supply chains will be: (i) consumer demand for a fully traceable supply chain, and (ii) the fact that not having a traceability system in place will cause a trade barrier to sheep meat exports. He furthermore mentions that a governing body will be needed to ensure that the traceability systems are properly implemented in the sheep meat supply chains.

It is therefore clear from the preceding sections that the implementation of proper traceability systems within the supply chain will need a great deal of effort, time, coordination and skill. However, supply chains that have proper traceability systems in place have some benefits compared to those that do not. Before a final decision can be made in terms of whether or not a traceability system should be implemented, the costs and benefits to the implementation should be thoroughly evaluated.

2.3.9 Potential benefits and costs of traceability systems

A large number of economic, legislative and technological bottlenecks still exist that hamper the smooth implementation of fully traceability systems. However, many stakeholders have recognised the benefits of traceability in food supply chains (Trienekens & Van der Vorst, 2006:447).

The potential benefits and costs of traceability systems are presented in this section, as a summary based on the detailed literature summary presented by Trautman, Goddard and Nilsson (2008:131-135) and supplemented with additional information from scientific literature. The discussion is presented according to the various role players in the meat supply chain from the consumer down to the primary producers (Table 2.3).

Table 2.3: Evidence from the literature

AGENTS	BENEFITS	COSTS
STAGE: FARM – Animals may go to feedlot, slaughter or distribution		
Animal and forage producers	• Increased transparency • Increased consumer demand with product differentiation • Reduced risk of liability claims • Price premium • Improved monitoring and control of individual animal health • Foster participation in the eradication of endemic diseases • Verification of credence attributes • Greater ability to sell stock by assuring low probability of disease • Maintaining consumer confidence during food safety scares • Reduced incentives to cheat • More effective recalls • More effective logistics • Positive effect on trade (?) • Enhanced licence to produce (?)	• Facilities modification • RFID (cost of animal identification), applicator, readers • RFID data accumulator and database software • Labour: RFID application, reading, data accumulation, training and record keeping • Internet services • Auditing fees • Organisation fees • Cost of product differentiation • May be used to place liability for unhealthy or low quality animals • Program administration fees • Costs to a third party for auditing procedures • Less flexibility

AGENTS	BENEFITS	COSTS
STAGE: FEEDLOT – Animals may go to slaughter or distribution		
Commercial and farmer feedlot. **Auction markets.**	• Assess and manage the risks associated with introducing livestock to herds • Greater ability to sell stock by assuring low probability of disease • Reduced risk of liability claims • Reduced information asymmetry o quality • More effective recalls • More effective logistics • Positive effect on trade (?) • Enhanced licence to produce (?)	• RFID readers • Data accumulator and database software • Labour: training • Tag loss replacement • Program administration fees • Monitoring upstream firms • Facilities modification • Internet services • May result in auction markets becoming obsolete (transparent price setters) • Costs to a third party for auditing procedures • Less flexibility
STAGE: SLAUGHTER – Meat may go to processing or distribution		
Abattoirs and cutting plants	• Reduces recall costs and amounts recalled • Assures quality control and food safety • Increase efficiency in tracking the flow of products; coordinates production • Reduces the cost of containing a food safety problem if one occurs • Reduced information asymmetry of quality • Reduces the transaction costs in monitoring the activities of upstream suppliers • More effective recalls • More effective logistics • Positive effect on trade (?) • Enhanced licence to produce (?)	• Facilities modification (EU certification or not) • RFID readers • RFID data accumulator and database software • Labour: training • Internet services • Inspection fee • Production chain changes, additional employees • Program administration fees • Licensing fees • Monitoring upstream firms • Costs to a third party for auditing procedures • Less flexibility
STAGE: PROCESSING – Meat goes to distribution		
Processing and packaging plants	• Reduces the cost of containing a food safety problem if one occurs • Identifies all sources of product and may reduce recall costs and amounts recalled • Increase efficiency in tracking the flow of products; coordinating production • Reduces the costs of containing a food safety problem if one occurs • Reduced information asymmetry of quality • Reduces the transaction costs in monitoring the activities of upstream suppliers • Reduces the facility's insurance premiums • More effective recalls • More effective logistics • Positive effect on trade (?) • Enhanced licence to produce (?)	• Facilities modification for EU certification • Inspection fee • Scanners, production chain changes, additional employees • Licensing fees • Monitoring upstream firms • Costs to a third party for auditing procedures • Less flexibility

AGENTS	BENEFITS	COSTS
STAGE: DISTRIBUTION		
Export	• Improved trade relations and increased cross border trade • Increase market access to importing countries requiring traceability • Positive effect on trade (?) • Enhanced licence to produce (?)	• Additional Residue Testing Program fee and testing costs (EU export) • Gross trade losses • Costs to a third party for auditing procedures
Meat wholesalers and traditional butchers. **Restaurants** **Supermarkets** **Independent grocers** **Direct sale outlets** **Foodservice co.**	• Labour savings of up to 5hours per week with Food Trace • Identifies all sources of product and may reduce recall costs and amounts recalled • Maintain consumer/buyer confidence • Reduce transaction costs in monitoring the activities of upstream suppliers • May reduce risk of exposure • Positive effect on trade (?)	• Advertising and promotion expenditures to reassure consumers of quality and safety • Information costs of consumers; the product quality • Monitoring upstream firms • Costs to a third party for auditing procedures • Less flexibility
Farmer's market	• Generates a common bond of safety and quality credibility • Increased trade • Enhanced licence to produce (?)	
Imported meat	• Reduced transaction costs of monitoring exporting firms • Increased trade	• Monitoring upstream firms (international or domestic)
STAGE: CONSUMER		
Consumer	• Food safety and quality control • Reduced information costs • Quality and credence attributes assurance • Focus of the industry on consumer requirements • Protect food safety by enabling effective product recall • Enable avoidance of specific foods and food ingredients, whether because of allergy, food intolerance or lifestyle choice • Increased transparency of processes within a supply chain	• Price premium (?) • Consumer privacy
Government or Public	• Reduction of food borne illnesses • Faster identification of the emergence and spread of new threats to animal and human health • Prevent entry of foreign animal disease • Reduce the risk of slaughter of older or at risk cattle • Reduced societal costs in case of a food safety event through reduced medical costs and reduced lost productivity • Research to improve industry quality	• Implementing one national traceability portal • Monitoring enforcement • Costs to a third party for auditing procedures

AGENTS	BENEFITS	COSTS
	• One national system is efficient and facilitates interprovincial trade • Protect public health through the withdrawal of food products • Help to prevent fraud where analysis cannot be used for authenticity • Monitor and control for subsidy claims • Positive effect on trade (?)	

Sources: Animal Health Australia (2003), Bracken and Matthews (2005), Buhr (2003), Disney, Green, Forsythe, Wiemers and Weber (2001), Fearne (1998), Food Standards Agency (2002), Gardner Pinfold Consulting Economists Limited (2007), Golan, Krissoff, Kuchler, Clavin, Nelson and Price (2004), Hobbs (2003), Hobbs and Sanderson (2007), Hobbs, Yeung and Kerr (2007), Loader and Hobbs (1996), McKean (2001), Meuwissen *et al.* (2003) and Souza-Monteiro and Caswell (2004) in Trautman *et al.* (2008)

Note the question marks at some of the costs and benefits as in the literature; these merely indicate that the magnitude of these aspects is debatable:

- "Positive effect on trade" is the first benefit denoted with a question mark. Traceability systems provide proof of the quality and background of a product – which is good. However, if countries do not trust each other and believe that traceability systems are set up to form a non-tariff barrier to trade this can also have a negative impact on trade.

- "Enhanced licence to produce" is in actual fact true. The question, however, is, for what period of time? New products might be introduced once the public become use to the upgraded market.

- Uncertainty exists about the benefit to producers of consumers paying a "price premium" for traceability. It has been proven that consumers in developing countries are willing to pay more for safer food. However, when the buying decisions of consumers were studied it proved that economic convenience matters the most and it is therefore difficult to determine if they will be willing to pay a price premium for products that are traceable.

To prevent undesirable allocations of resources, it is important to reflect on technological prospects and economic considerations before a decision is made in terms of the level of the traceability system considered. Furthermore, for a traceability

system within a supply chain to be fast and reliable, it is important to also consider the bottlenecks and the success factors.

2.3.10 Bottlenecks and success factors for implementing traceability systems

The most important bottlenecks in the meat, dairy, vegetable and fruit and grain supply chains, identified by Trienekens and Van der Vorst (2006:461-462), are:

- Indefinite and differentiated performance levels concerning traceability, resulting in a follow and wait policy of actors in the supply chain
- Little economic incentive; it is unclear what the exact benefits of traceability will be and it is also unclear what the costs of traceability are
- High investments in infrastructure for the implementation of full traceability systems
- Lack of chain organisation and chain transparency
- Traceability of products in quality assurance schemes is restricted; these schemes usually focus on parts of the supply chain and not the entire supply chain
- Lack of standardisation reduces the ease and ability with which data is exchanged
- Businesses in food supply chains have such specific characteristics that each supply chain has its own specific elements, which makes standardisation difficult.

Trienekens and Van der Vorst (2006:463) also identified a number of success factors within the above-mentioned supply chains:

- Unmistakable definition of the legally required functionalities of traceability systems in food supply chains and the minimal performance requirements
- Identification, registering and exchange of data in all links of a supply chain according to a uniform standard and at the same level of detail (tracing unit)
- Implementation of risk assessment within the supply chain and a focus on the main risks

- Making the added value of traceability visible to everyone depending on the functionality (such as product recall and logistical optimisation)
- Use of a joint approach by all chain participants in the development of a functional and modular basic design for a traceability system that is suitable for a large number of specific situations in food supply chains
- Reduction in the number of suppliers and the commingling of products in the supply chain make the chain transparent.

Even though traceability systems have a lot of advantages and success factors it is still unclear if the benefits of having full traceability systems in place outweigh the costs related to their implementation. The required level, depth and breadth of traceability systems that are needed differ between industries' products and the specific outlet markets served. It is therefore important to compare traceability systems within industries producing the same or similar products and supplying these products to the same outlet markets. Furthermore, supply chains that are integrated and/or coordinated are often expected to have a higher level of success with the implementation and maintenance of proper or chain-wide traceability systems.

2.3.11 The impact of vertical integration and coordination on traceability systems

The VanDrie group of veal producers in the Netherlands have one of the best traceability systems implemented worldwide. They have the ability to track individual animals from birth to the final retail portion cut. In order for the VanDrie group to implement such an advanced traceability system, they had to become fully vertically integrated. The VanDrie group owns most of the veal supply chain, from the production of powdered milk for the calves up to the abattoirs and processing plants as well as the distribution of products between the links. Most of the studies done on European meat supply chains proved that vertical integration and coordination is complementary to chain-wide traceability. These studies also found that traceability information systems will lead to tighter vertical relationships and more hierarchical governance structures (Buhr, 2003:20).

Currently, the rest of the European beef industry has a traceability system in place where each package of beef contains information about the country of origin, growing, slaughtering and butchering. An animal can be traced back and tracked forward at any moment in time. Alert systems like these can generally tackle a contamination problem at an early stage, but not nearly early enough to protect the public from consuming a contaminated product (Meuwissen *et al.,* 2003:170-171).

2.4 SUMMARY

Chapter 2 provided an overview of the available literature regarding transparency and traceability systems. Consumers throughout the world are becoming more aware of the importance of traceability systems within meat supply chains. Having fully traceable meat supply chains will provide safe and high quality food to the consumer with respect to origin, processing and other extrinsic quality attributes. From the existing literature it is clear that the importance of traceability, especially in food supply chains and in this case meat supply chains, cannot be emphasised enough.

Following the literature on transparency and traceability, Chapter 3 presents an overview of the South African sheep meat supply chain, followed by the characteristics of a general meat supply chain as well as the unpacking and discussion of some of the specific sheep meat supply chains in South Africa.

CHAPTER 3

SHEEP MEAT SUPPLY CHAINS IN SOUTH AFRICA

3.1 INTRODUCTION

Chapter 3 focuses on the sheep meat supply chains in South Africa. This will include an overview of the sheep meat industry with regards to the sheep meat production, consumption, trade and price formation and trends. The required laws and regulations in place at the abattoir level will also be briefly touched on. The rest of Chapter 3 will be dedicated towards illustrating the characteristics of a general meat supply chain as well as the unpacking of various sheep meat supply chains present in the industry. The chapter will conclude with a brief summary.

3.2 OVERVIEW OF THE SHEEP MEAT INDUSTRY

3.2.1 Sheep meat production

Sheep are reared throughout South Africa, particularly in the more arid parts of the country – the Eastern Cape, Northern Cape and Western Cape. There are about 8 000 commercial and 5 800 communal sheep farms in South Africa with a total estimated, 24 550 000 head of sheep. The most popular breeds of sheep for meat production are the Damara, Dormer, Dorper, Ille de France, Meatmaster, Mutton Merino, Suffolk, Vandor and Van Rooy (DAFF, 2012a:1; DAFF, 2011:3).

In the recent annual newsletter (February, 2012) the South African Department of Agriculture, Forestry and Fisheries (DAFF) (DAFF, 2012a:1) reported an estimated 24 550 000 head of sheep at the end of November 2011, 0.24 % less than the estimated 24 608 000 head in 2010. The decline in sheep numbers was mainly due to predation and stock theft, which in turn caused farmers to explore and switch to alternative farming enterprises. The Red Meat Producers Organisation (RPO) is of the opinion that sheep numbers will continue to decline in the years to come, as a result of this (Cornelius, 2011:3).

The provincial distribution of sheep in South Africa as a percentage of the total number of sheep is illustrated in Figure 3.1. From the statistics released by the DAFF, it is clear that the major sheep producing provinces are the Eastern Cape, the Northern Cape and the Free State (DAFF, 2012a:1).

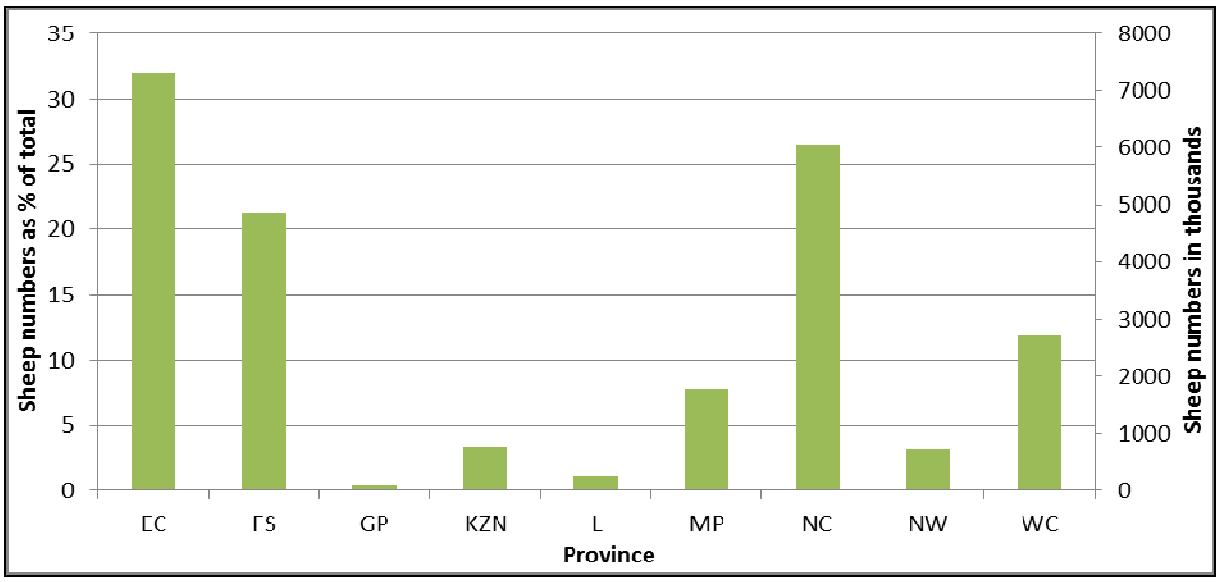


Figure 3.1: Estimated sheep numbers in the SA provinces (November 2011) in thousands and as a percentage of the total number of sheep

Source: DAFF (2012a:1)

There are approximately 488 abattoirs in total in South Africa, ranging in species slaughtered (cattle, sheep, goats, pigs, horses and ostriches) and slaughtering capacity (2 to 3 units per day to more than 1 500 units per day). Of these 488 abattoirs, only 284 are sheep slaughtering abattoirs (RMAA, 2012).

Abattoirs can be classified into low throughput and high throughput abattoirs. Low throughput abattoirs slaughter between 1 and 20 units per day and high throughput abattoirs slaughter between 20 and 100 or more units per day, where 1 unit is equal to 1 beef animal, 6 sheep, 5 pigs, 4 ostriches or 2 horses. Figure 3.2 shows the number of sheep slaughtering abattoirs per province classified in terms of high throughput and low throughput abattoirs.

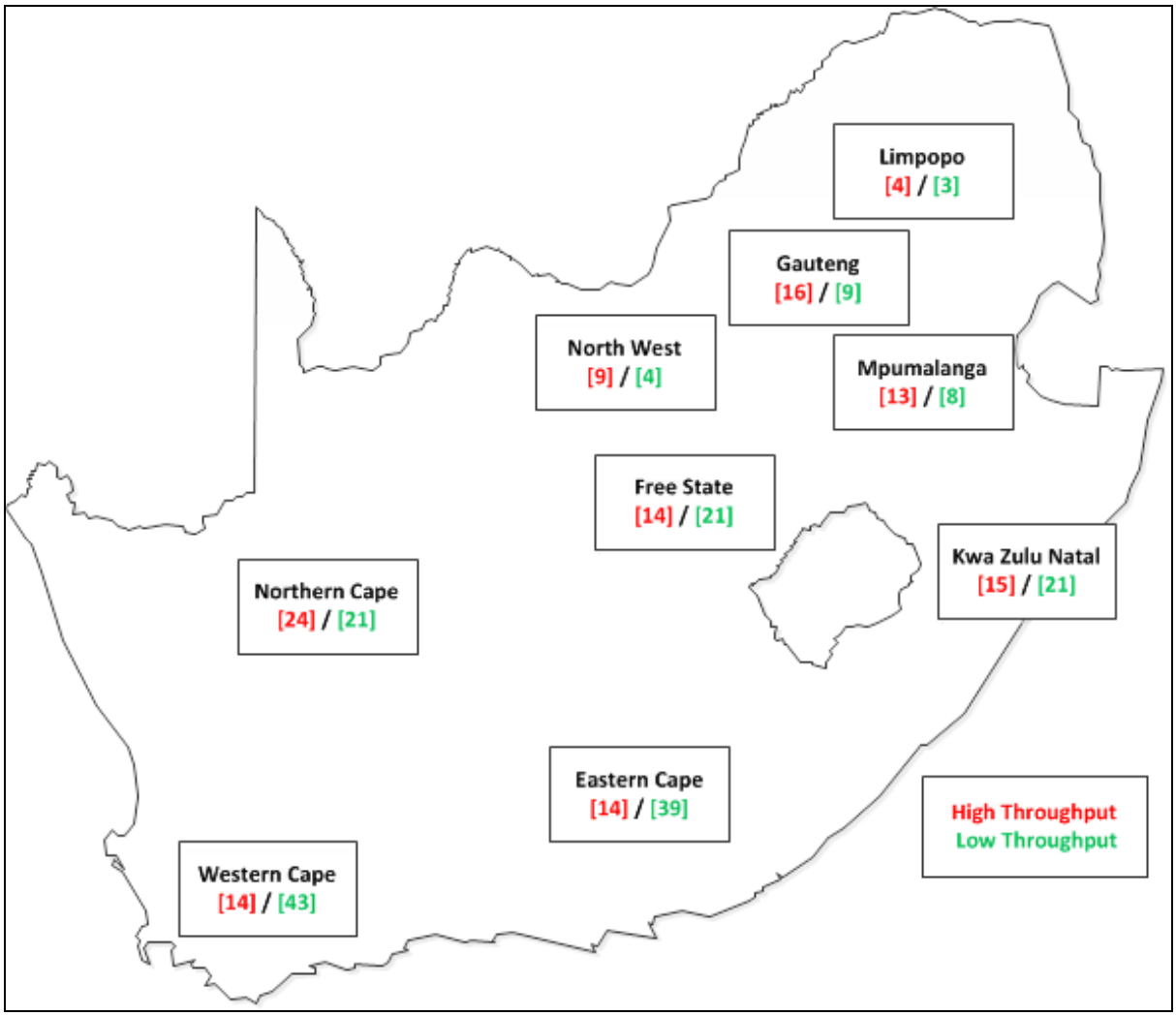


Figure 3.2: Abattoir distribution per province
Source: RMAA (2012)

From Figure 3.2, it is clear that South Africa's high throughput sheep slaughtering abattoirs are situated mainly in the Northern Cape (24) followed by Gauteng (16), KwaZulu-Natal (15), the Free State (14), the Western Cape (14) and the Eastern Cape (14). In terms of the total abattoir population, the Western Cape, Eastern Cape and Northern Cape provinces are the most important with a total of 57, 53 and 45 abattoirs (high and low throughput) respectively.

Figure 3.3 illustrates the number of sheep slaughtered at abattoirs per province for the period April 2010 to April 2012. From the data it is clear that the majority of sheep are slaughtered in the Northern Cape followed by the Western Cape, Free State, Gauteng and Eastern Cape. Furthermore, a seasonal trend can be seen from the graph between November and January in both 2010 and 2011 with slaughtering

reaching a peak during December and April of each year (Christmas and Easter holidays).

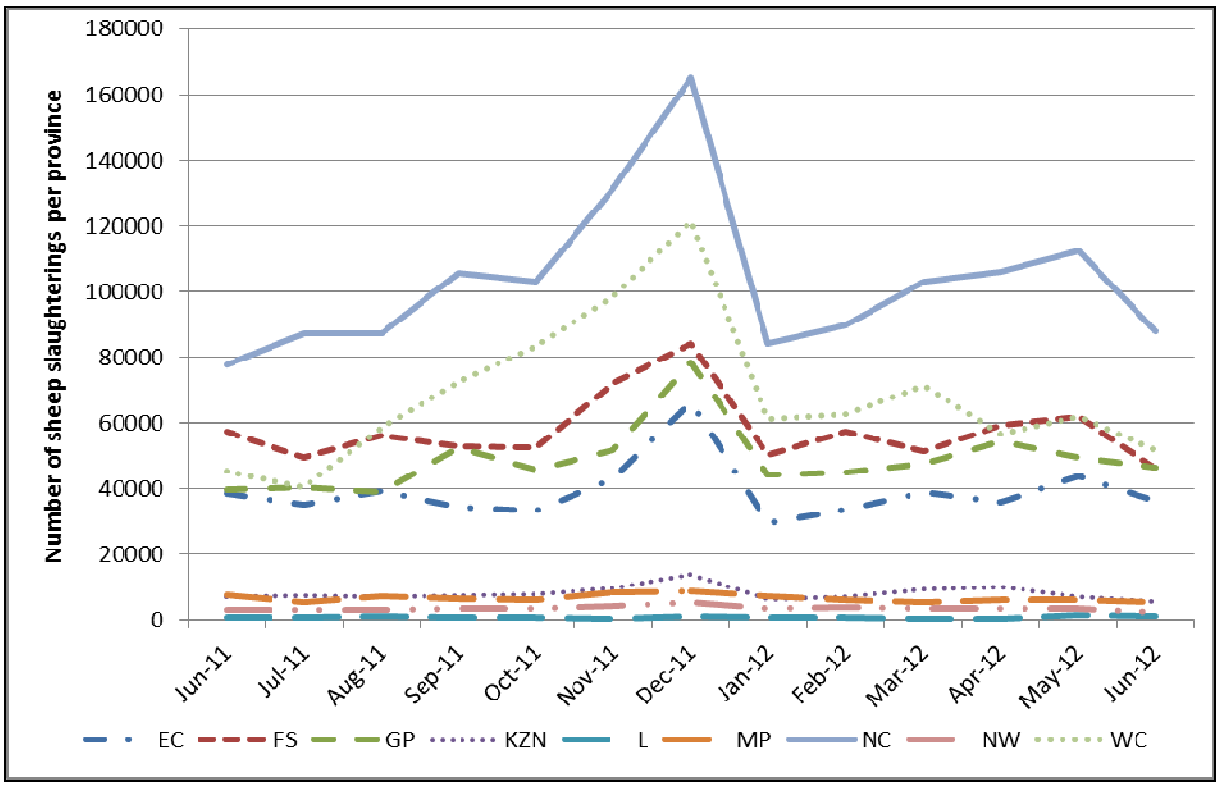


Figure 3.3: Number of sheep slaughtered per province (07/2011 to 07/2012)
Source: RMLA (2012a, 2012b, 2012c)

3.2.2 Sheep meat consumption

Figure 3.4 indicates the total South African sheep meat consumption in 1 000 t as well as sheep meat per capita consumption in kg/capita. Consumption decreased from 225 300 t in 1984 to reach a low of 116 680 t in 2011, a decrease of 48.2 % over the period. Per capita consumption dropped from a high of 8.71 kg/capita in 1982 to a low of 2.31 kg/capita in 2011.

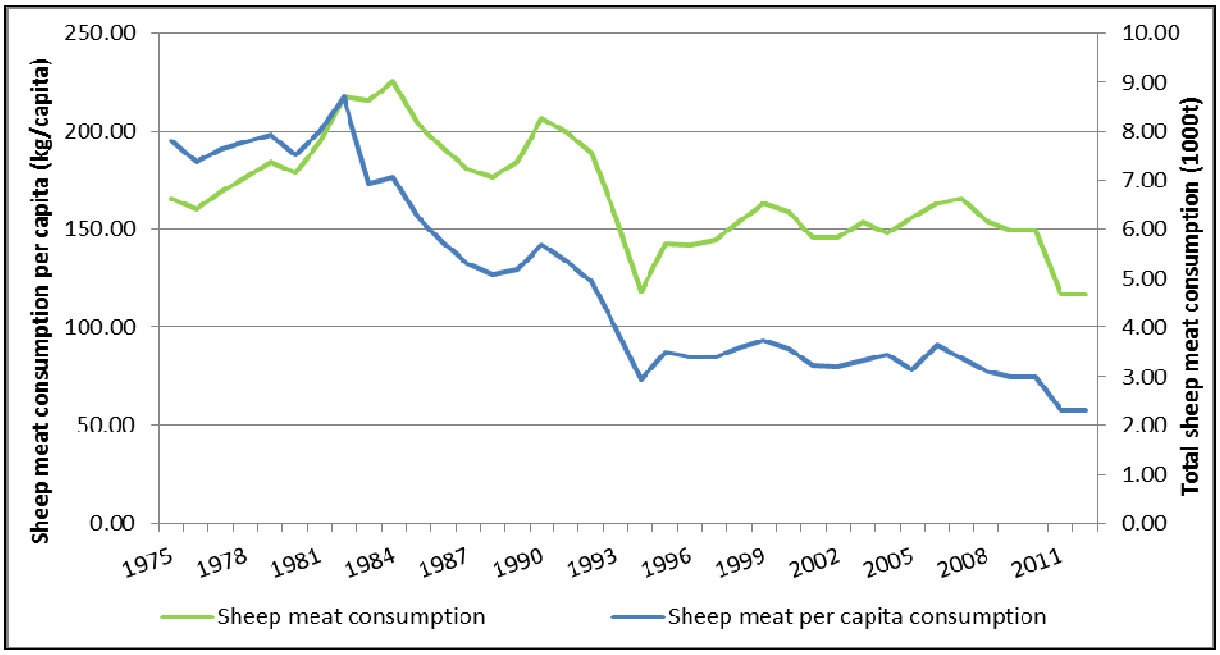


Figure 3.4: Total sheep meat and per capita consumption (1975–2011)
Source: BFAP (2012)

3.2.3 Sheep meat trade

Due to the mismatch between sheep meat production and sheep meat consumption (Figure 3.5) South Africa needs to import sheep to be able to provide for the required demand.

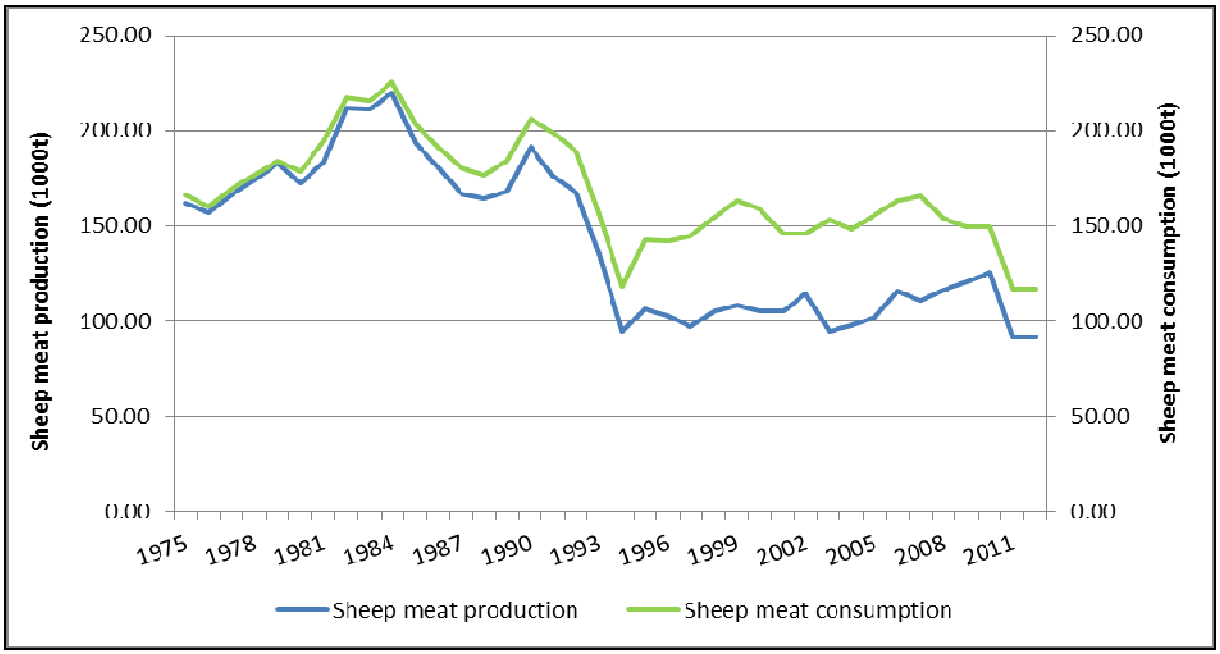


Figure 3.5: Production and consumption of sheep meat (1975–2011)
Source: BFAP (2012)

The amount of sheep meat imported as well as exported is illustrated in Figure 3.6.

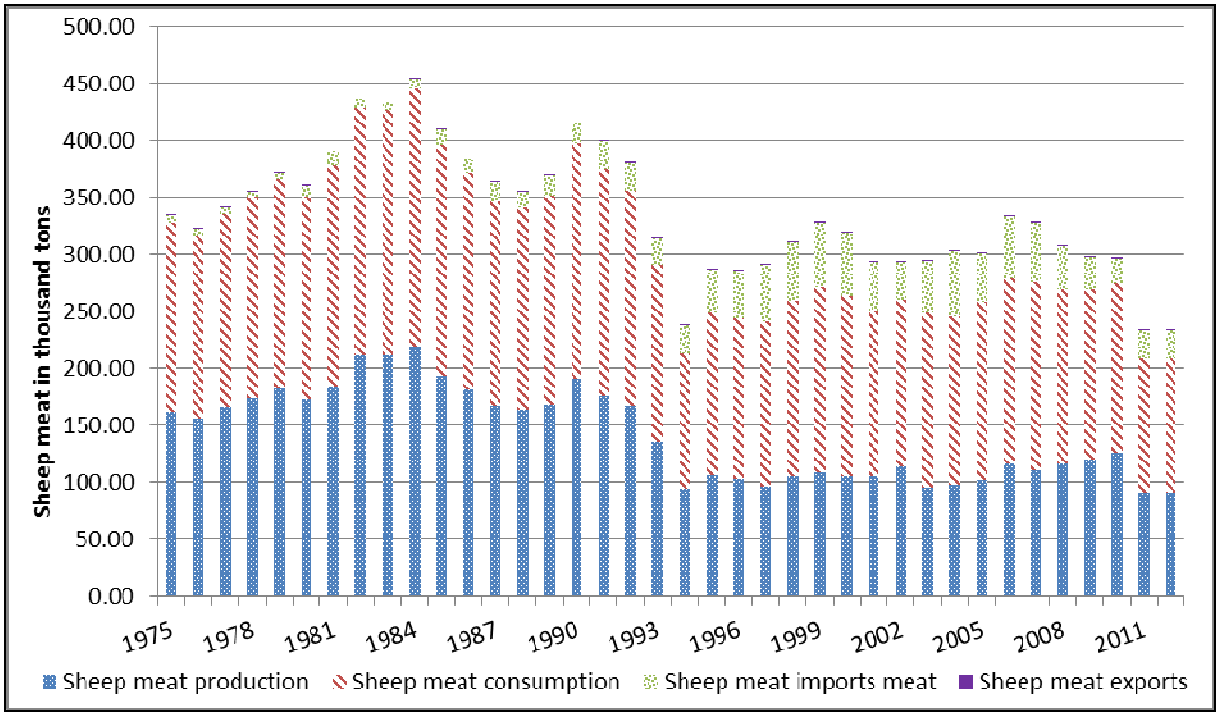


Figure 3.6: Production, consumption, imports and exports of sheep meat (1975–2011)

Source: BFAP (2012)

Figure 3.7 indicates the countries from which South Africa mainly imports sheep meat. The sheep meat can be in any of the 9 categories, namely; live sheep, lamb carcasses and half lamb carcasses, fresh, chilled or frozen; sheep carcasses and half sheep carcasses, fresh, chilled or frozen; and sheep cuts, boneless and with bones, fresh, chilled or frozen. South Africa mainly imports sheep and lamb carcasses or half carcasses, frozen; sheep cuts with or without bones, fresh or chilled and frozen. The main importing countries are Australia and New Zealand.

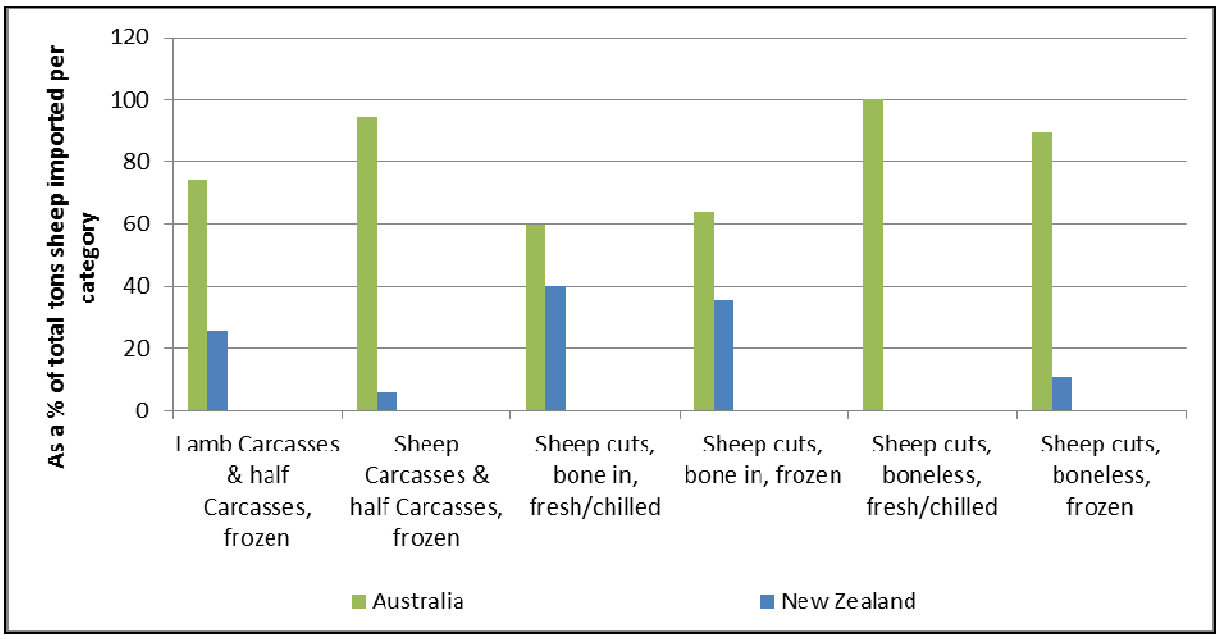


Figure 3.7: Countries of origin for sheep imports (2009-2011)
Source: Trademap (2012)

Figure 3.8 shows the export destinations for South African sheep meat from 2007 to 2011. The exports of South African sheep meat is classified according to various forms of meats exported: live sheep, lamb carcasses and half lamb carcasses, fresh or chilled and frozen, sheep carcasses and half sheep carcasses, fresh, chilled or frozen, sheep cuts, boneless and with bones, fresh, chilled or frozen, as well as the destinations for these products. Most South African sheep meat exports over the last five years were destined for ship stores and bunkers, followed by Mozambique the Democratic Republic of the Congo, Nigeria and Gabon.

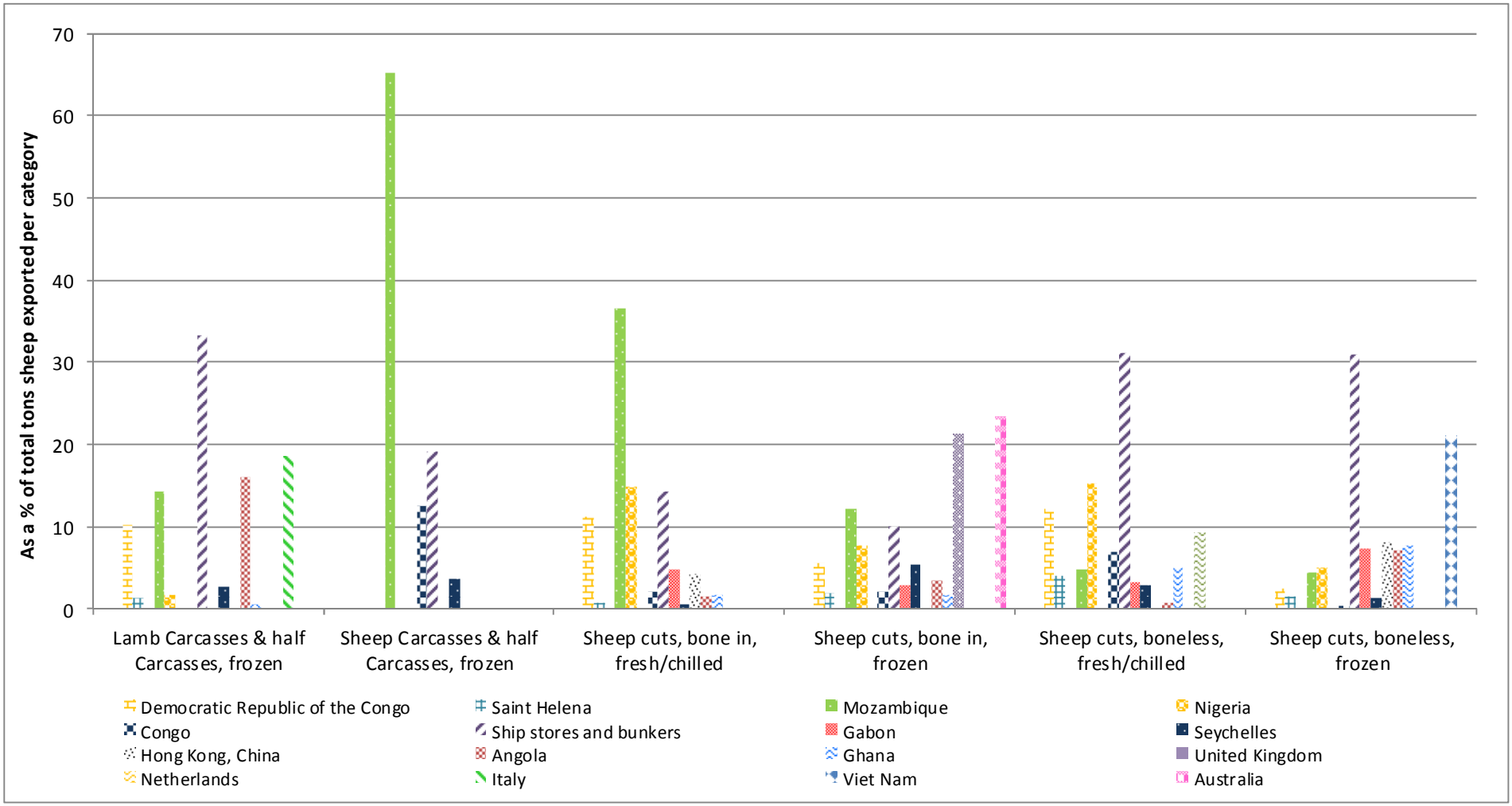


Figure 3.8: Sheep meat export destinations (2009–2011)
Source: Trademap (2012)

3.2.4 Price formation and trends

Mr N. Carstens, (2012) manager of a South African abattoir, explained that the per kilogram carcass price to be paid to their supplying farmers is based on the weekly market prices. However, they also use the local auction prices to verify these prices. He mentioned that the 5th quarter, which is the hide and offal, further influences the buying price offered to sheep farmers.

Table 3.1 indicates exactly how carcasses are classified and priced, based on the classification. Basically, carcasses can be divided into four categories according to age, which is determined by the number of permanent incisors, and into six categories as determined by the level of subcutaneous fat. The optimum fat content level is 2 to 3 and the optimum age category is sheep in the A category. The younger the sheep, the more tender the meat and the more popular the meat cuts are among consumers prepared to pay a higher price. This makes the A2 and A3 carcasses the most popular among consumers and the most preferred by abattoirs.

Table 3.1: South African sheep meat carcass classification

Trait	Red Meat (Beef/Sheep/Goats)						
Age	A		AB		B		C
Number of permanent incisors	0		1-2		3-6		>6
Roller mark	AAA		ABAB		BBB		CCC
Colour of roller mark	Purple		Green		Brown		Red
Tenderness	Least tender		Least tender		Least tender		Least tender
Fat grade	0	1	2	3	4	5	6
Sheep fat thickness (mm)	0	<1	>1<4	>4<7	>7<9	>9<11	>11

Source: SAMIC (2006)

According to Carstens (2012), it is quite easy to sell a sheep carcass for less than the cost price. This makes the 5th quarter is extremely important when calculating the carcass price per kilogram to be charged to butcheries or wholesalers. A decrease in the price of the 5th quarter results in an increase in the purchase price and a decrease in the selling price, resulting in a lower profit. He illustrated the abattoir selling price determination process as follows (Figure 3.9).

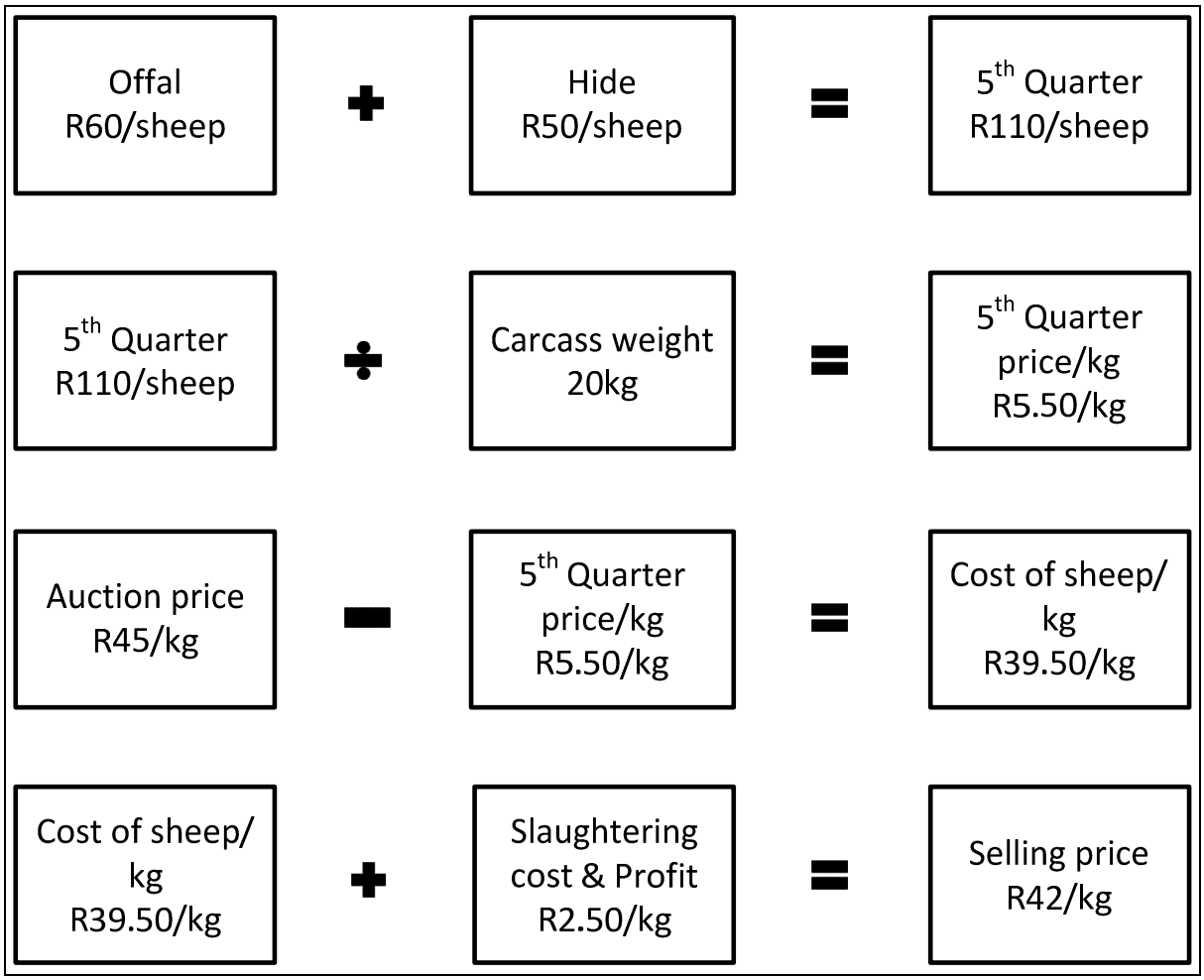


Figure 3.9: Abattoir selling price determination per kg carcass
Source: Carstens (2012)

The selling price is based on the 5th quarter (sum of the price of the offal and the price of the hide) price, equal to R110/sheep. In the case of a typical 20 kg sheep carcass, this amounts to R5.50/kg for the sheep's 5th quarter. The abattoir then takes the buying price (local auction price) for the carcass, which is R45/kg, and subtracts the 5th quarter price from it to get the cost of the sheep, equal to R39.50/kg. The slaughtering cost and a low profit margin of approximately 6 % (R2.50/kg) are then added to the cost of the sheep, resulting in a R42/kg selling price. This selling price is lower than the purchase price of R45/kg. The abattoir in effect only paid R39.50/kg to the farmer for the carcass even though the local auction price was R42/kg. This results in a profit to the abattoir of R2.50/kg on the carcass. The abattoir will realise a further profit by selling the 5th quarter.

However, Carstens (2012) explained that when sheep are bought at an auction or from a farmer, the sheep have to be slaughtered first to enable the abattoir to determine a purchase price. In this case, the dressing percentage and the number of odd grades (grades other than the popular A2 and A3) become extremely important.

Carstens (2012) also shed some light on the wholesale selling prices. Retail prices are usually more expensive than wholesale prices but can fluctuate due to seasonality. This price difference is due to the fact that wholesalers source their carcasses from abattoirs in remote areas. Due to a high sheep supply in these areas the abattoirs have the advantage of paying less for their sheep. These abattoirs are situated in a less competitive environment with a relatively small number of competitors when sourcing sheep from farmers, compared to abattoirs closer to their market outlets. These remote abattoirs, on the other hand, have the disadvantage of not being able to sell their product exclusively to retailers due to the high transport costs related to deliveries to the various retailers. It is for this reason that wholesalers prefer buying carcasses from remote abattoirs at relatively lower prices due to a high supply of sheep and a low demand for sheep carcasses in these remote regions. Typically, wholesalers take around R2/kg (R1 for delivery and R1 for profit).

The popularity of the A2 and A3 carcasses justifies the monthly average carcass purchase price (price paid by abattoirs to farmers or feedlots) for A2 and A3 carcasses from January 2010 to March 2012 in Figure 3.10.

Figure 3.10: Purchase prices of A2 and A3 carcasses per kg
Source: RMAA (2012)

Over the past year, South African sheep meat prices increased significantly compared to other types of meat as local sheep meat production could not keep up with local demand. The fact that South Africa is a net importer of sheep meat makes local sheep meat prices very sensitive to international sheep meat prices and weakening exchange rates (BFAP, 2011:34). Import parity prices have increased sharply on the back of high international prices, which have reached record levels, resulting in high local sheep meat prices.

The South African sheep meat industry is under some pressure regarding livestock theft as well as livestock lost through predation. The sheep meat prices are increasing, however, which makes the industry tempting to producers who gave up sheep farming in the past. It is expected that South African sheep meat production will increase due to high profit margins, which exceed those of grain farming. The increase in production will be due to the restocking of sheep in the Western and Northern Cape areas where stock theft is limited (BFAP, 2011:34).

3.2.5 South African abattoir legislation

Above and beyond implementing traceability systems that will protect, manage and govern the food of origin attributes of Karoo sheep meat in the South African sheep meat supply chains, national and international legislation should also be in place. These laws and regulations as indicated by the International Meat Quality Assurance Services (IMQAS), the South African Meat Industry Company (SAMIC) and the Red Meat Abattoir Association (RMAA) as well as detail pertaining to the Acts are discussed in the sections to follow.

3.2.5.1 The Meat Safety Act 40 of 2000 and regulations thereto, pertaining to the implementation of a hygiene management system

The Meat Safety Act (40/2000) promotes the safety of meat and animal products and establishes and maintains national standards concerning abattoirs. The Act further states that inspection at approved abattoirs is compulsory. The Hygiene Management System (HMS) includes a collection of abattoir actions such as records, flow diagrams, work instructions and schematic plans to ensure the safety of produced meat and also forms part of the Meat Safety Act, 2000 (Act 40 of 2000).

3.2.5.2 Red Meat Regulations (R1072) issued under the Meat Safety Act 40 of 2000

The Red Meat Regulations include regulations pertaining to the following: (i) the Registration of Red Meat Abattoirs (Section 11(1)(a)), (ii) Hygiene Management and Evaluation Systems, (iii) Hygiene Requirements for Persons Entering the Abattoirs, (iv) Humane Treatment of Animals and Slaughter Process, (v) Meat Inspections, (vi) Marks and Marking, (vii) Treatment of Condemned Material, (viii) Export Regulations, (ix) Import Regulations and (x) Slaughter of animals for own consumption and for religious and cultural purposes.

3.2.5.3 Agricultural Product Standards Act 119 of 1990

The Agricultural Product Standards Act (119/1990) addresses the classification and marking of meat intended for sale in South Africa. The standard of classification is a voluntary standard and is monitored throughout South Africa by SAMIC. The Act furthermore offers control over the sales and exports of certain agricultural products as well as the sales of imported agricultural products and control over related products.

3.2.5.4 Foodstuffs, Cosmetics and Disinfectants Act 54 of 1972, in particular R908 issued thereunder, and which pertains to the implementation of HACCP and GMP

The Foodstuffs, Cosmetics and Disinfectants Act (54/1972) involves the development of a hazard analysis which entails the development of a list of hazards that are of such significance that they are reasonably likely to cause injury or illness if not effectively controlled. Within the hazard analysis it is important to consider the ingredients and raw materials, each step in the process, product storage and distribution and final preparation and use by the consumer. A hazard is defined as a biological, chemical or physical agent that is reasonably likely to cause illness or injury in the absence of its control.

After the hazards have been identified, critical control points (steps at which control can be applied and which are essential to prevent or eliminate a food safety hazard or reduce it to an acceptable level) need to be identified, and a critical limit should then be determined. This limit is used to distinguish between safe and unsafe operating conditions at a critical control point. The limit is a maximum and/or minimum value to which a biological, chemical or physical parameter must be controlled at a critical control point to prevent, eliminate or reduce to an acceptable level the occurrence of a food safety hazard. The establishment of a verification system is necessary to monitor whether a critical control point is under control and to produce accurate records for future use in verification, followed by record keeping and documentation procedures used for effective food safety management and the

management of deviations from the critical control points. These are the minimum control measures, procedures and actions to produce a constant quality product that conforms to local health regulations and in-house specifications. These include personnel practices, pest control, cleaning and sanitation, construction and maintenance and process control.

3.2.5.5 ISO9000:2000

This is a quality standard developed by the United Kingdom and has been expanded worldwide. It includes the customer's quality and regulatory requirements at the same time enhancing customer satisfaction to achieve continual improvement of its performance. However, very few South African abattoirs have ISO9000:2000 or any related ISO quality standard in place, since it is not required by law.

3.2.5.6 Consumer Protection Act 68 of 2008

This Act promotes a fair, accessible and sustainable marketplace for consumer products and services and for that purpose to establish national norms and standards relating to consumer protection. The Act also provides for improved standards of consumer information; it prohibits certain unfair marketing and business practices and promotes responsible consumer behaviour. The Act furthermore promotes a consistent legislative and enforcement framework relating to consumer transactions and agreements. This Act is one of the main reasons why traceability systems within supply chains exist.

The remainder of Chapter 3 focuses in more detail on specific supply chains in the South African sheep meat industry with specific focus on the traceability systems at various links or role players in the supply chain.

3.3 SOUTH AFRICAN SHEEP MEAT SUPPLY CHAINS

Meat supply chains are usually long, complex chains with a large number of role players and ample opportunities for contamination of feed, carcasses and meat cuts, at various stages of the meat supply chain. This sub-section includes the characteristics of a general meat supply chain followed by a summary of the record keeping process and will conclude with the unpacking of the different South African sheep meat supply chains.

3.3.1 Characteristics of a general meat supply chain

The general meat supply chain as illustrated in Figure 3.11 shows six different stages or links in the supply chain: input companies, livestock farms, abattoirs, meat processing plants, distribution centres and retailers or butcheries.

The meat supply chain can have different final markets or market outlets depending on the final product or the needs of the final customer. Figure 3.11 shows three offset markets receiving very different products (i) carcasses are directly transported to independent butcheries or retail butcheries from the abattoir, (ii) carcasses are processed and packed at meat processing plants after the abattoir stage and distributed directly from the processing plant to the retailers, or (iii) the processed and packaged meat cuts from the meat processing plants are first sent to a distribution centre and then packed at the distribution centre to go to retailers.

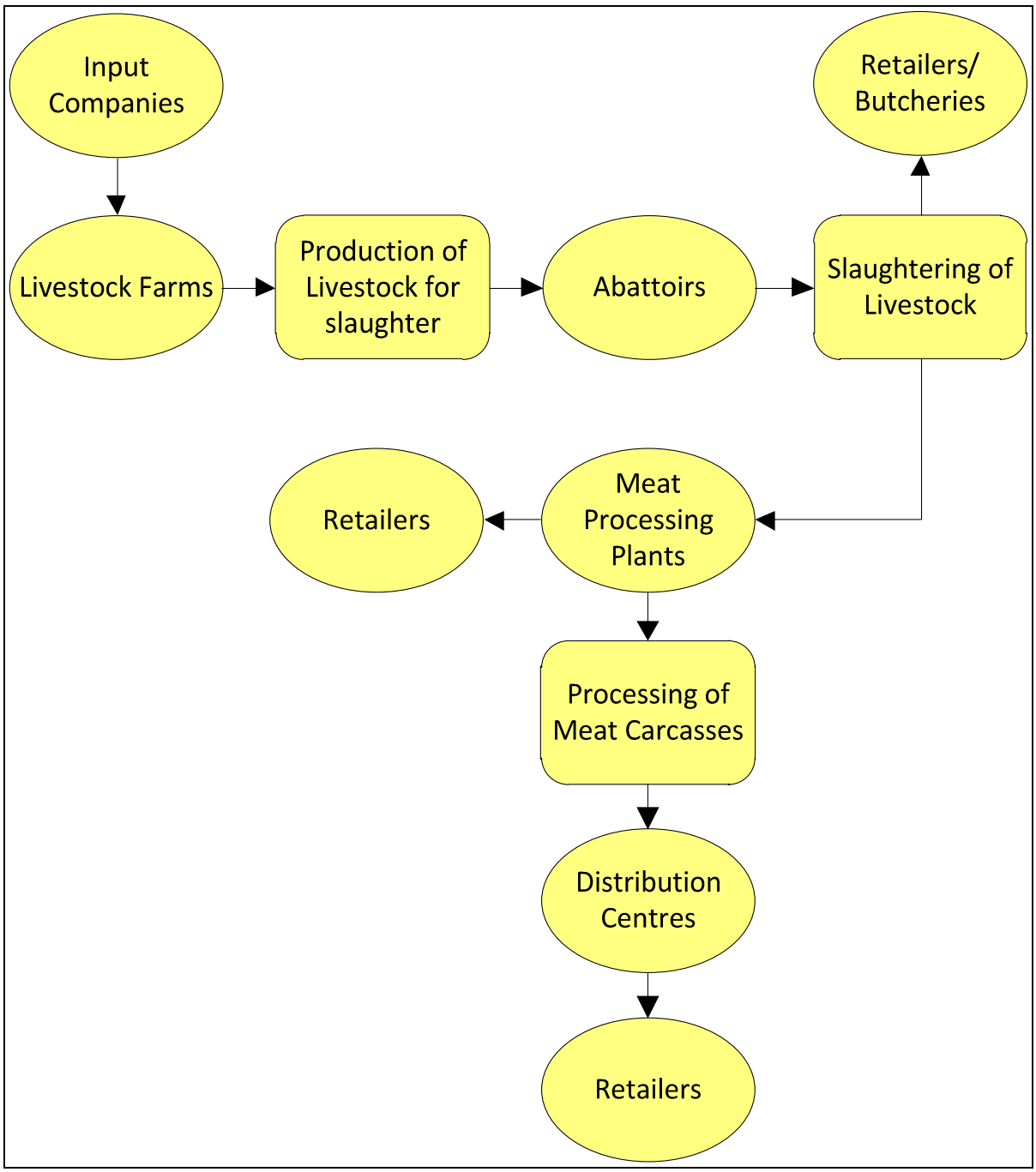


Figure 3.11: A general meat supply chain
Source: Coff *et al.* (2008:86); Trienekens, Petersen, Wognum and Brenkman (2009:134,159); Wognum *et al.* (2011:71)

3.3.2 Record keeping

In South Africa, record keeping at the farm and abattoir level in the sheep meat industry and information sharing between the two are relatively similar in all the supply chains. It is only after the abattoir level that record keeping and information sharing might change.

At the farm level

On the farm, farmers are requested by law, in terms of the Animal Identification Act (Act No. 6 of 2002), to mark all cattle, sheep, goats, pigs and ostriches. All farmers are required to register an identification mark at the National Register of Animal Identification System (AIS).

On the farm level the following information is typically captured (South African DoA, 2008:9):

- In the case where animals were bought from outside:
  - The name and address of the previous owner
  - The number of animals and the breed of animals that were bought
  - The date the animals were bought
  - The old identification numbers of the bought animals as well as the new identification numbers.
- In the case where animals were born on the farm:
  - The birth date of the animals
  - The breed of the new-born animals
  - The parents of the new-born animals
  - The identification numbers of the new born animals.
- In the case where animals were sold, lost to predators or stolen:
  - The name and address of the person or institution to whom the animals were sold
  - The date when the animals were sold
  - The number of animals sold and their identification numbers
  - The identification numbers and the number of the animals lost to predators or stock theft.

- During the marking of new animals (either bought in or born on farm), the following information should be captured:

  - The date the animals were marked
  - The type of breed that was marked
  - The number of animals that were marked
  - Each animal's identification number should be captured
  - The method that was used for marking.

The marking of animals can be done by means of (South African DoA, 2008:9, 13-14):

- Hot iron branding or freeze branding:

  - The mark may not be larger than 40 mm x 100 mm
  - Branding should be done by the age of 6 months
  - The mark of the first owner should be on the left hind leg, the mark of the second owner should be on the left shoulder, the mark of the third owner should be on the right hind leg and the mark of the fourth owner should be on the right shoulder.

- Tattooing:

  - The mark may not be larger than 20mm x 20mm
  - Tattooing should be done by the age of 1 month
  - The first owner should put his tattoo on the left ear and the second owner should put his tattoo on the right ear.

Different types of marks are used for different animals. For cattle and ostriches it is common to use branding or tattoos, while for pigs, sheep and goats tattoos are preferred (South African DoA, 2008:14-15).

At the abattoir level

The type of records kept and the information gathering process at the abattoir level differs to some extent between abattoirs. The differences are mostly in terms of the different types of traceability systems used for information gathering and the level and depth of the information gathered.

Most abattoirs at least keep records of the following:

- Information on the farmer and the farm where the animals originated from
- The number of animals offloaded at the abattoir and slaughtered per day
- The livestock removal certificates that accompany every batch of animals offloaded for slaughter
- The declaration of health that declares that the animals are free of antibiotics and/or growth hormones
- The species and breeds of animals slaughtered per day
- The date of slaughter and in some cases the time of slaughter
- The live weight of the animals
- The warm carcass weight
- The classification in terms of age and grade of the carcass
- The cold carcass weight
- The first point of sale of the carcass as well as the date of sale.

The above serve merely as an overview in terms of the general data collected by farmers and by abattoirs. More specific information or more detailed information that is recorded in specific supply chains is discussed when the particular supply chain is unpacked.

3.3.3 Unpacking different South African sheep meat supply chains

To better understand and to grasp the diversity of the different chains in this sector, this section focuses on unpacking the following South African sheep meat supply chains:

- Free range sheep meat supply chain
- Feedlot sheep meat supply chain
- Sheep meat supply chain supplying to butcheries or delicatessens
- Sheep meat supply chain supplying to Woolworths
- Certified Natural sheep meat supply chain supplying to Checkers
- Cavalier Group sheep meat supply chain

Free range

In the free-range supply chain (Figure 3.12) sheep are reared on natural veld with some supplementary feed during winter.

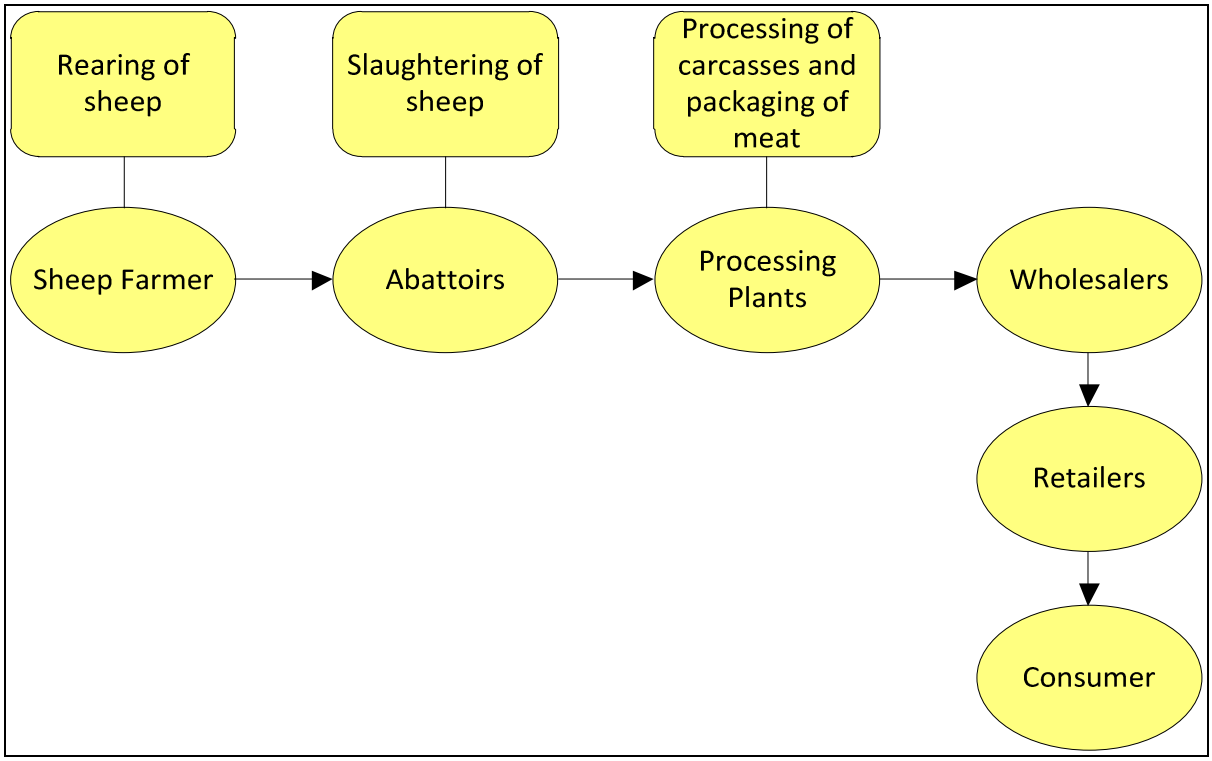


Figure 3.12: Free range supply chain

Farmers keep records of their sheep on farm as well as sheep lost due to predators, natural death and theft for their own use. Farmers then sell their marketable stock to abattoirs, which perform the slaughtering function. At the abattoir level, sheep arrive in batches and these batches are kept in pens, with care not to mix batches of sheep from different farmers. Sometimes farmers are registered at the abattoir as a supplier and the farmer's contact details are already on the system. In other cases the contact details of the farmer need to be noted as well as information regarding the batch of animals offloaded. This information includes detail in terms of the overall health of the animals, the breed and age of sheep as well as the number of male and female sheep. It is required by law that a livestock removal certificate and a declaration of health certificate accompany each batch of animals offloaded at the abattoir.

Other information that might be captured is whether the animal was reared in the veld (free range) or fed in a feedlot. In an abattoir where both free range and fed sheep are slaughtered, these batches are kept separate during the entire slaughtering process and that they are tagged and marked to enable the abattoir to distinguish between the free-range and feedlot carcasses when they are moved to the cold-rooms. It is of extreme importance that these batches are kept separate if the meat is to be marketed as free range or feedlot. After slaughtering and cooling these carcasses are then sold to either wholesalers and then to retailers or directly to butcheries or retail butcheries where the traceability systems are maintained in order to guarantee the free-range attribute of the sheep meat product.

Feedlot

The feedlot supply chain (Figure 3.13) works on the same principle as the free-range supply chain from the abattoir downstream. The difference between the two chains is with regards to the upstream supply chain members.

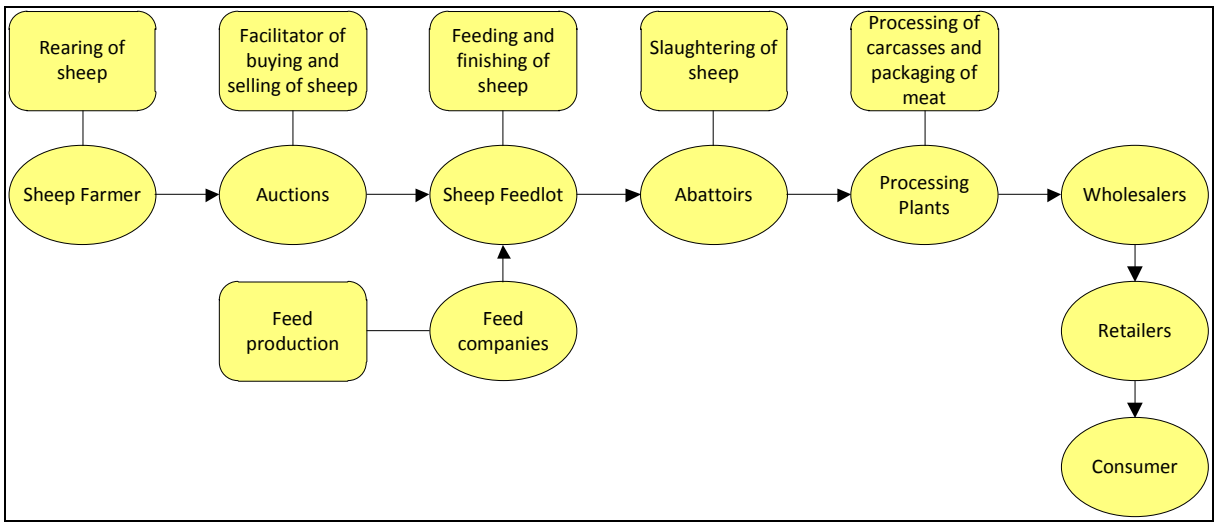


Figure 3.13: Feedlot supply chain

The feedlot supply chain includes a sheep farmer, auctions and a sheep feedlot as part of the upstream supply chain members. The sheep farmer rears sheep and either sell them at auctions or moves them into a feedlot to be fed or finished off before selling the sheep to the abattoir. According to Carstens (2012), in the case of auctions, traceability systems are impossible to maintain. Auctions bring together a lot of buyers and a lot of sellers. Feedlotters usually buy numerous sheep from different farmers at an auction to fill up the feedlot and because of this, getting and maintaining records of where each sheep originated from becomes extremely difficult. After the sheep are finished off to be slaughter ready, they are sold to abattoirs for slaughter and distribution.

The abattoir collects similar information as in the free-range supply chain. However, during the slaughtering and grading process, the carcasses are tagged and marked as being “Fed” or “Grain Fed”. These carcasses are then moved to the chillers to be cooled after which they are distributed to wholesalers, butcheries and/or retail butcheries. Keeping the traceability system intact now becomes the responsibility of the downstream supply chain members.

Butcheries or delis supply chain

The butcheries’ or delis’ supply chain as illustrated by Figure 3.14 works in the same way as the free range and the feedlot supply chains, with the only difference that the

carcasses end up only in a butchery or deli, usually in smaller quantities than in a retail butchery.

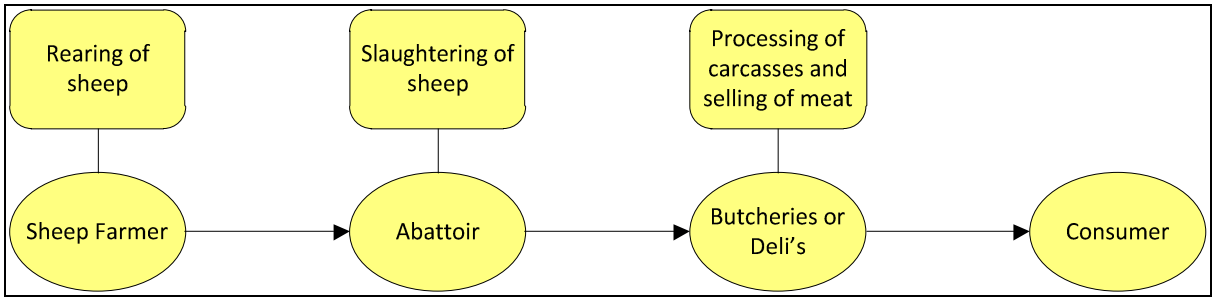


Figure 3.14: Butcheries or delis supply chain

In this specific supply chain the sheep farmer can therefore be either a free-range farmer or a feedlot farmer depending on the butchery or delis' customers' needs. It was found that in the more rural areas (where delicatessens are not common) not a lot of effort is made to try and keep up a traceability system, whereas in the more urban areas some effort is made to try and keep up a traceability system where the more sophisticated customers can be made aware of, for instance, the origin (Karoo) or the rearing conditions (either veld or feedlot) of the sheep. Furthermore, butcheries and delis do not buy large amounts of sheep carcasses due to limited space, possible loss due to power cuts and, especially in the case of rural butcheries, due to limited daily sales. This means that butcheries normally buy one or two types of carcasses from one abattoir and then rely heavily on the traceability system of the abattoir in the case of, for instance, a food safety problem. It is therefore usually not necessary for a butchery or deli to have a proper traceability system in place due to the small volumes of carcasses bought.

Woolworths supply chain

The role players in the Woolworths supply chain are illustrated Figure 3.15 and include:

- Sheep farmers (South African and Namibian sheep farmers)
- Abattoirs (mainly the abattoir at Carnarvon)

- QK processing plant in Johannesburg
- Excellent Meat processing plant in Cape Town
- The various Woolworths distribution centres
- The Woolworths Food retail outlets

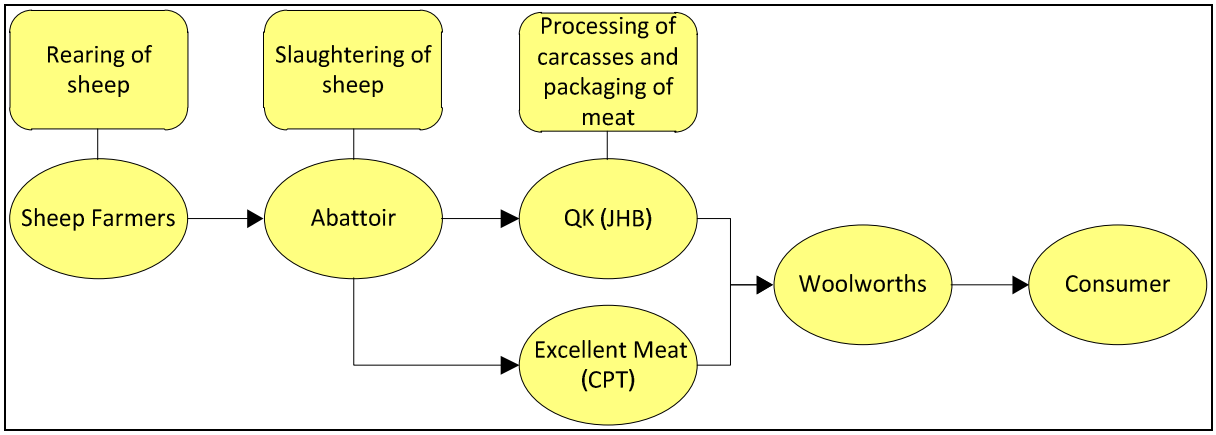


Figure 3.15: Woolworths supply chain

Sheep slaughtered for the Woolworths supply chain are sourced from both South African farmers, mostly in the Karoo region, as well as from Namibian farmers, and are reared on natural pastures. The sheep reared on these farms are then transported to the abattoirs (mainly the abattoir in Carnarvon) for slaughtering.

Most of the sheep slaughtered for Woolworths are slaughtered by the Carnarvon abattoir. The Carnarvon abattoir uses the Abaserve traceability system, which enables the abattoir to track and trace any carcass up and downstream from the abattoir either to the sheep farmer or to the meat processing plant. The Woolworths traceability system has one shortcoming; they cannot trace the carcass back to the specific farmer without difficulty. They do, however, keep batches from different origins in terms of feeding systems apart to be able to guarantee a claim such as free range. From the abattoir, the carcasses are transported to the meat processing plants for processing, packaging and labelling. In the Woolworths supply chain, the processing plants are QK Meats in Johannesburg and Excellent Meat in Cape Town.

QK Meats, in Johannesburg, is the largest deboning and packing facility on the African content. It has five distinct operating divisions in City Deep, Johannesburg

with a capacity of over 18 000 mt. QK meats has implemented the highest European quality standards, is Halal certified, has obtained a high level approval certificate of inspection or EFFSIS certification, is certified by the British Retail Consortium, has EU and ZA export certification and has an onsite Campden-accredited laboratory (QK Meats, 2012).

QK Meats' modern deboning facility has a deboning capacity of 12 000 t of beef and 9 000 t of lamb (bone in) carcasses per annum. To ensure high, consistent quality products, premium quality raw materials are selected, properly handled and matured to meet the specific requirements of customers. QK Meats is also responsible for providing Woolworths with processed meats such as mince, burgers and sausages as well as frozen, dried and cooked meats to add convenience and value addition to the end user (QK meats, 2012).

In partnership with Woolworths, QK meats has established a large scale avant-garde packaging facility that includes Modified Atmospheric Packaging (MAP) and Darfresh packing systems to increase the shelf life, possibly increase the quality of the product and decrease wastage. QK Meats also has a cold storage facility with a capacity of 10 000 mt that offers a full logistics service from freezing and storage, to order packing. From this plant, Woolworths distributes 250 t of bone-in, deboned or processed packed meat (both beef and lamb) per week across South Africa (QK Meats, 2012).

At Excellent Meat, situated in Cape Town, carcasses are individually checked and run through a five-point quality process on arrival to ensure customer fulfilment. They adhere to all industry standards and legislation to deliver the best possible product, safely and hygienically. Microbiological testing at critical intervals in the supply chain verifies hygiene and safety of the meat products. Their systems and processes are passed through all quality audits and standards of GMP. Processes are clearly defined, controlled and validated to ensure consistency and compliance. Excellent Meat has also implemented a Total Quality Management System (TQM). The objective of this system is to prevent errors during meat processing, increase

customer satisfaction, streamline supply chain management, and constantly keep abreast of new and improved processing equipment (Excellent Meat, 2012).

According to Excellent Meat, an uninterrupted cold chain and an excellent logistics system is vital to maximise shelf life and to safeguard the quality and hygiene aspects of the products. Excellent Meat has their own delivery fleet with dedicated temperature monitoring systems in the truck, ensuring an uninterrupted cold chain, continuation of supply and a lower turnaround time (Excellent Meat, 2012).

The success of both QK and Excellent Meat is based upon the understanding of their direct customer (Woolworths) and the needs of the final customer as well as the delivery of the highest standards of quality and flexibility, as well as personal service, supported by sustained investment in cutting edge technology and an uninterrupted cold chain.

The traceability systems at QK and Excellent Meat are much stricter than the ones at the abattoir level and provide full traceability of all meat products. To enable farm to fork traceability, products are tracked and traced through barcodes and other tracking media. During the processing stage, Woolworths do not only require the processing plant to keep track of incoming carcasses but they also need to keep track of outgoing meat cuts. At the processing stage, it is possible to identify by precise date and exact location all processes of a specific product in transit to the customer.

From the processing stage (QK and Excellent Meat), packaged meat products are sent to the Woolworths distribution centres for retail packing. Within the distribution centre barcodes are again used as the main method of traceability to keep track of where every batch of meat cuts originated from as it enters the distribution centre as well as to what retailer it is sent to when leaving the distribution centre.

Shoprite Checkers (Certified Natural) supply chain

The vision of Certified Natural is to produce a high quality red meat product that is healthy and naturally produced with the environment in mind. Figure 3.16 illustrates the Certified Natural supply chain with all the parties involved in the supply chain.

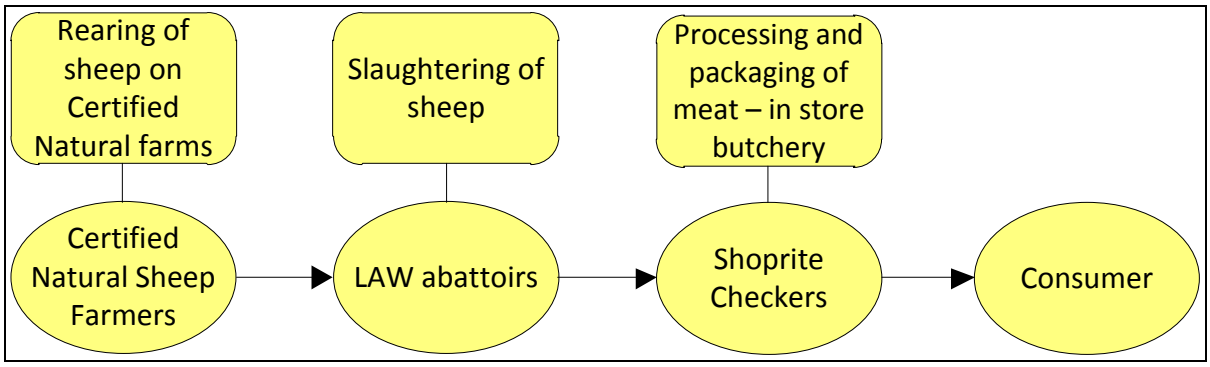


Figure 3.16: Certified Natural (Checkers) supply chain

The 'Natural' brand is a registered brand name of Certified Natural (Pty) Ltd. This brand name is fully certifiable through scientific audits and quality assurance and management systems (HACCP and ISO9001) and is regularly verified by IMQAS and SAMIC (Certified Natural Meat, 2012).

Farms must conform to health and environmental standards and assessments are carried out for stocking rates, pasture health, the safe use of anti-parasitic drugs, with the environment in mind and good farm management practices. These assessments are done by means of scientific analysis by the University of Pretoria and form part of the audit system of the ISO9001 quality assurance programme. To supplement these audits, samples of sheep kidneys and urine as well as water, feed and soil are regularly taken and sent for laboratory tests to analyse and ensure compliance to the system.

The sheep are then sold to the LAW abattoirs in De Aar and/or Groblershoop for slaughtering. At the abattoir level, the utmost care is taken to deliver a consistently high quality meat product. Records of temperature readings, visual inspections and independent hygiene audits are maintained; part of the hygiene audit includes swabs of staff members' hands and swabs of handling equipment. This forms an integral

part of the quality system. Throughout the slaughtering process, the trail of information is kept by means of the Abaserve traceability system and the utmost care is taken to keep generic sheep meat and Certified Natural sheep meat separate. To aid in this, the Certified Natural carcasses are tagged with a Certified Natural tag and roller marked with the Certified Natural mark. The carcasses are then moved to the LAW processing facility in Groblershoop for processing and packaging.

At the processing facility, carcasses are deboned and value is added. The facility produces approximately 3 500 kg deboned meat and 4 500 kg value added products. All the products are sourced from LAW abattoirs, prepared according to customer specifications, packed and shipped. The processing facility uses state of the art packaging such as vacuum shrink-wrapping, cryovac, layer and stock netting, in accordance to customer requirements (Certified Natural Meat, 2012). The Abaserve traceability system uses barcoded labelling to ensure traceability and details captured on the label are: slaughter and production date, best before date, mass and net mass, product description and code, barcode, country of origin and factory registration number. After packaging and labelling, the products are kept either in cold rooms or freezer facilities, depending on the customer requirement, and transported to Shoprite and Checkers retail stores either by refrigerated LAW trucks or by Hestony Transport, a transport contractor.

Cavalier (Pick ’n Pay – Country Reared) supply chain

The Cavalier Group of Companies focuses on creating the shortest and most cost effective supply chain for red meat products. Cavalier has identified the need for a one-stop supplier of superior quality meat and carefully monitors the quality of the meat from the farmer to the consumer. The group consists of (Figure 3.17):

- Cavalier Veevoer
- Cavalier Livestock
- Cavalier Farms
- Cavalier Abattoir
- Cavalier Foods

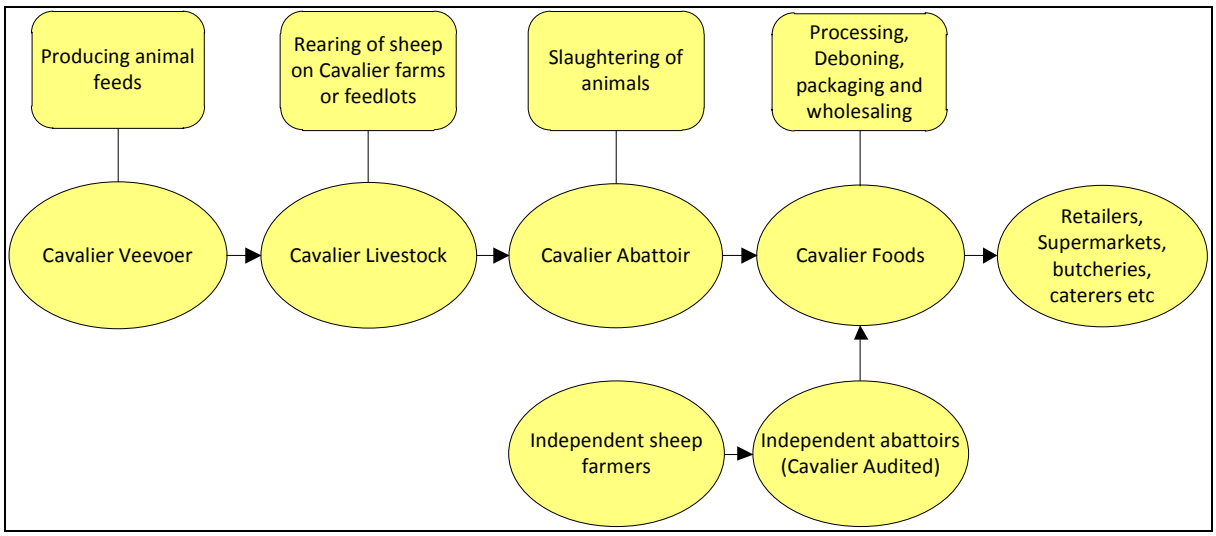


Figure 3.17: Cavalier supply chain (Country Reared – Pick 'n Pay)

The Cavalier company has a streamlined operation, with a turn-around time from farmer to consumer of less than 24 hours, which can adapt to market forces quickly and efficiently because the group is vertically integrated along the supply chain. Quality is always ensured and is of utmost importance. Product quality is controlled throughout the processing stage by means of HACCP and the ISO22000 quality management systems.

Cavalier Veevoer is situated in Upington and specialises in the production of animal feeds. These animal feeds are scientifically formulated either as supplemental feed or as a complete replacement diet to fulfil in the dietary requirements of the animals, to be used by the Cavalier Feeders or Cavalier Livestock (Cavalier Foods, 2012).

Cavalier Livestock is a livestock trading house that trades more than 500 000 animals and transports more than 11 million kilograms of livestock per annum. Cavalier Farms include over 19 000 ha of farmland in the Northern Cape where most of the "Country Reared" sheep and lambs are reared. Animals are sourced from a number of trusted farmers as well as their own farms to ensure quality at the first level of production (Cavalier Foods, 2012).

When animals arrive on the Boekenhout farm just outside of Pretoria, they are sorted according to size and quality and weighed in the presence of the farmer. The animals are then separated, based on their weights, between slaughter ready animals and

animals that require further feeding. Animals that are destined for slaughter then move to the Cavalier Abattoir on the Boekenhout premises and animals destined for feeding move to the Cavalier Feeders, also on the premises, where they are fed. The feeder can house up to 20 000 head of sheep and is used to add final growth to the lambs before they enter the meat production chain. The feeder has its own feed factory where scientifically formulated rations of the Cavalier Veevoer are mixed to satisfy specific requirements (Cavalier Foods, 2012).

Once the animals are ready for slaughter, they are moved to the Cavalier Abattoir, 900 m from the feedlot. This minimises stress and the build-up of lactic acid, which has a negative effect on the quality of the product. The animals are slaughtered at a high throughput abattoir (1 500 sheep/day) and the carcasses are inspected by an independent inspection organisation, the International Meat Quality Assurance Services (IMQAS), then weighed and tagged, enabling the company group to track and trace a carcass up and down the integrated supply chain (Cavalier Foods, 2012).

Both Cavalier Abattoir and Cavalier Foods use the CSB international system for traceability purposes. On arrival of the animal at the abattoir, the details of the supplier and animals are entered electronically into the system and a batch number is allocated to the supplier. This system uses tags with item numbers, weights, batch numbers and serial numbers. Each serial number indicates the user identification number, the week of the year, the work station as well as the date and time of slaughter. Every tag also contains a barcode, pin pointing the origin of the animal, and these details are cross-checked and scanned upon departure (Cavalier Foods, 2012).

The carcasses are then transported to Cavalier Foods for direct selling to retailers or butcheries or for processing and selling to retailers, supermarkets and caterers. Cavalier Foods therefore act as the final processing and distribution centre before the product is displayed in retail outlets across South Africa. On arrival at Cavalier Foods, carcasses pass through a scanner to a central warehouse, where they are sorted into batches destined for wholesale and retail. Sheep carcasses are cut into primals, tagged with a reference number and then cut into meat cuts. The meat product is

now packaged, weighed and labelled in a streamlined, automated system. Cavalier Foods uses MAP to fight bacterial growth and to help the meat retain its bulk. The MAP process is tested for consistency to ensure a long-lasting succulent looking product. On the product label, information such as the item name, packaged date, weight, batch number and reference number as well as the barcode can be found. The reference number can be used throughout the chain to ensure backward and forward traceability.

On arrival at the abattoir and through the slaughtering process, sheep to be slaughtered under the “Country Reared” brand are kept in separate batches. The “Country Reared” roller mark is rolled onto the carcass and a tag with “Country Reared” is attached to the carcass ensuring that these carcasses are distinguished from the generic carcasses. These carcasses and meat cuts then go through the same systems and processes as the generic carcasses.

3.4 SUMMARY

The South African sheep meat industry has numerous complex supply chains. Additionally, it is an industry with a lot of issues in terms of stock theft and predation, which may be the main cause for the drop in sheep production regardless of the high sheep meat prices. This keeps South Africa at a net importer status, resulting in even higher prices, spiralling upwards, on the back of high international prices, which in turn further reduces consumption (BFAP, 2011:34).

It can be concluded that the abattoirs in the above-mentioned supply chains have effective traceability systems in place. However, supply chain members downstream from the abattoir have limited traceability systems, even though they are the parties pressuring abattoirs to put traceability systems in place. In a lot of cases, abattoirs are eliminated from the ‘suppliers to retailers’ game because of their lack of traceability systems. Many retailers use the absence of traceability systems at the abattoir level as an excuse not to buy carcasses from these abattoirs, eliminating them as possible retailer suppliers. One reason that has come to light why retailers prefer abattoirs to have traceability systems in place is because they regard them as

a guarantee of good hygiene management systems and that the abattoir's meat is therefore safe to consume. Abattoirs are therefore forced to invest in proper traceability systems to comply with retailers' requirements and to remain part of the market, even though, in many cases, retailers might not maintain the traceability systems initiated by the abattoirs when the carcass arrives at the retailer.

Therefore, in terms of record keeping, both abattoirs and farmers engage in proper record keeping and abattoirs mostly have proper traceability systems in place. The question remains, however, how downstream members are doing in terms of the implementation of traceability systems and whether they are perhaps the weak links in the sheep meat supply chain.

When it comes to legislation, a lot of the abattoir operators are of the opinion that the South African government does not have the knowledge, capital or people to regulate implementation or obedience to legislation at the abattoir level.

Chapter 4 follows, where the hypotheses are tested using Fisher's exact test and a descriptive analysis of the data collected regarding the current state of traceability systems within the South African sheep meat supply chains, specifically at South African sheep abattoirs.

CHAPTER 4

A DESCRIPTIVE ANALYSIS OF THE CURRENT TRACEABILITY SYSTEMS IMPLEMENTED IN SHEEP MEAT SUPPLY CHAINS IN SOUTH AFRICA

4.1 INTRODUCTION

This chapter focuses on the quantitative and qualitative analyses of the collected data. The chapter kicks-off with a brief summary of the sample as well as the problems encountered during the sampling and/or data collection process. The chapter progress to include a qualitative analysis that mainly includes the calculation of averages, frequencies and the visual illustration of the data by means of charts. This section furthermore includes a process map of the slaughtering and record keeping processes in the abattoir. The quantitative analysis follows and is basically done by means of Fisher's exact test to test the five hypotheses. This aims to establish which factors play an important role during the abattoirs' decision making process to implement traceability systems. After the quantitative and qualitative data analysis discussion, a detailed summary of the open ended questions, discussions and observations during the data collection process follow.

4.2 THE SAMPLE

As mentioned in Chapter 1, the population of abattoirs in the study is limited to abattoirs in South Africa that slaughter sheep. A random sample of 55 abattoirs from the total population of 284 sheep slaughtering abattoirs listed at the RMAA was drawn to participate in the study. The study is based on qualitative and quantitative data analysis and data collection is mainly done by means of interviewer-administered interviews; contacting and visiting the 55 randomly selected participant abattoirs and conducting surveys based on structured questionnaires. Additionally, direct observations of the activities within the abattoirs or processing plant and unstructured interviews, where the participant was allowed to speak freely on the

topic being explored, were also used in an attempt to enrich the primary data collected.

Some difficulties were encountered during the data collection process. It came to light that the RMAA's list of registered abattoirs is out-dated. When the 55 randomly selected abattoirs were contacted, only 39 responded positively. Of the 55 contacted 12 did not exist anymore or did not slaughter sheep anymore and 4 were unwilling to participate. According to the RMAA the list can only be updated if information regarding a closure, change in capacity or species come from the abattoir itself or from DAFF. The quality of the abattoir information on the list is therefore not the sole responsibility of the RMAA.

Figure 4.1 shows the number of abattoirs randomly selected per province. The Eastern Cape was the best represented province, followed by the Northern Cape, Free State and Western Cape.

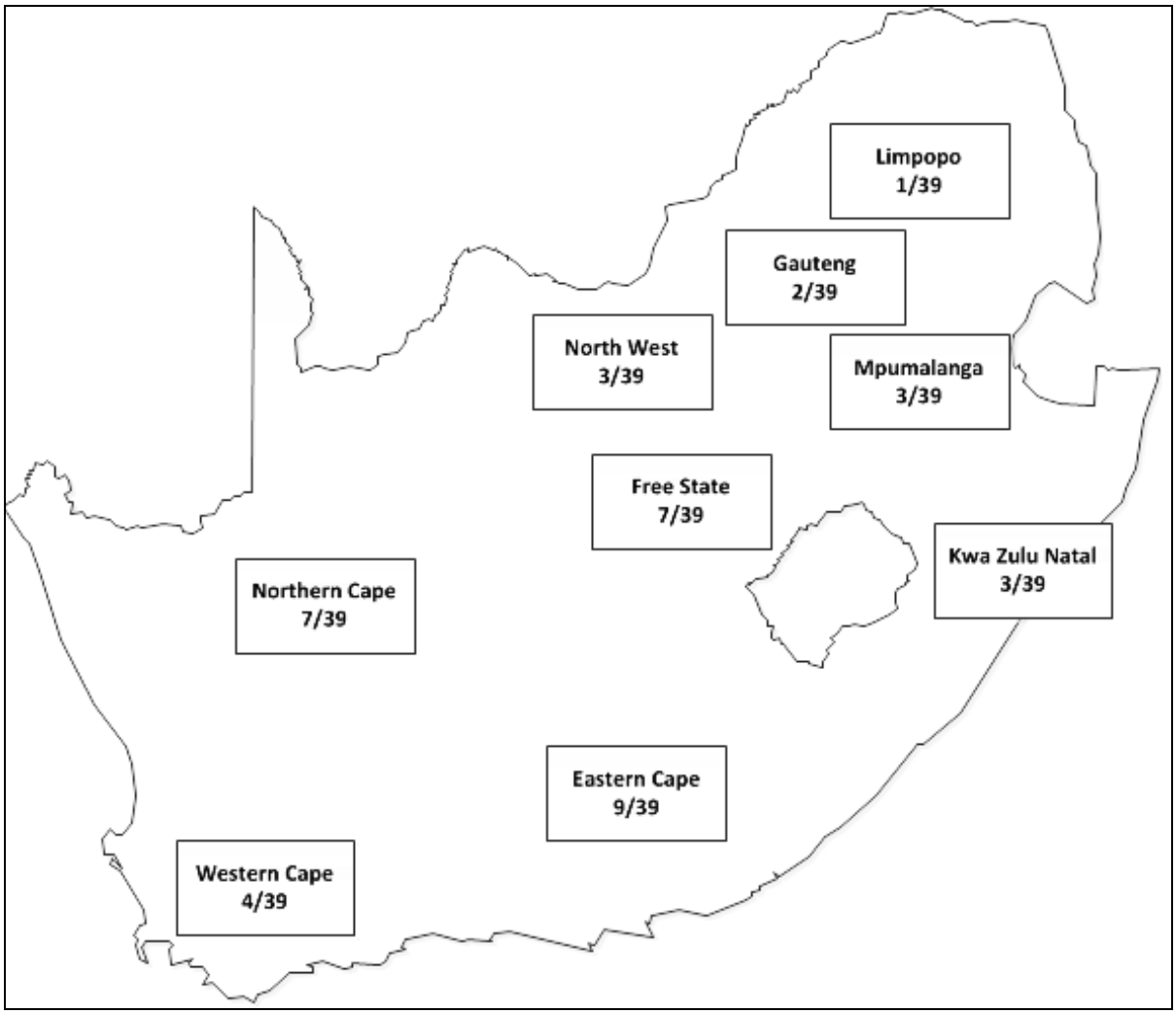


Figure 4.1: Sampled abattoirs per province

Due to the fact that the Eastern Cape, Northern Cape, Free State and Western Cape have more abattoirs that slaughter sheep than other provinces, these abattoirs had a higher representation in the random sample.

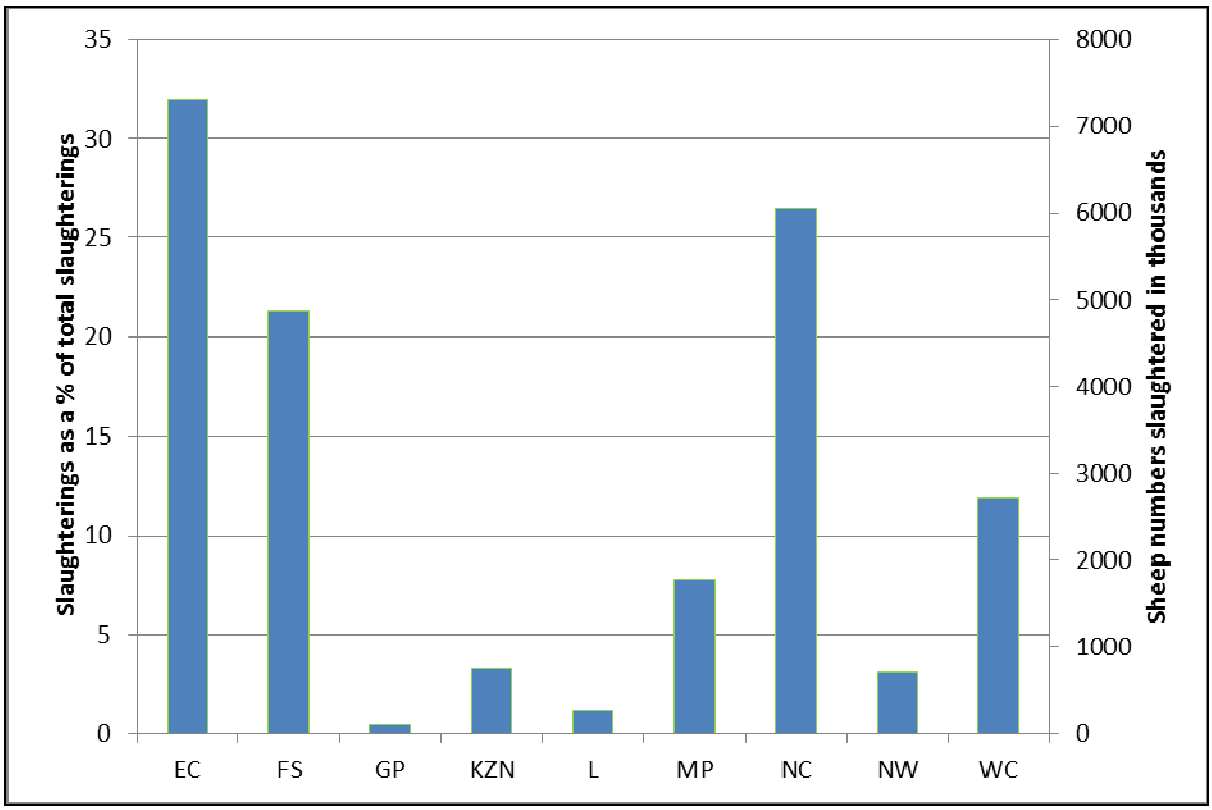


Figure 4.2: Sheep numbers per province (November 2011)
Source: DAFF (2012:1)

According to DAFF (Figure 4.2), the Eastern Cape, Northern Cape, Free State and Western Cape contribute most to sheep production in South Africa, and according to the Red Meat Levy Admin (RMLA) (Figure 4.3), the Northern Cape, Western Cape, Free State, Gauteng and Eastern Cape represented 94 % of the total of sheep slaughtered in South Africa between July 2011 and June 2012. These provinces were the best represented by the participant abattoirs in the random South African abattoir sample (Figure 4.1).

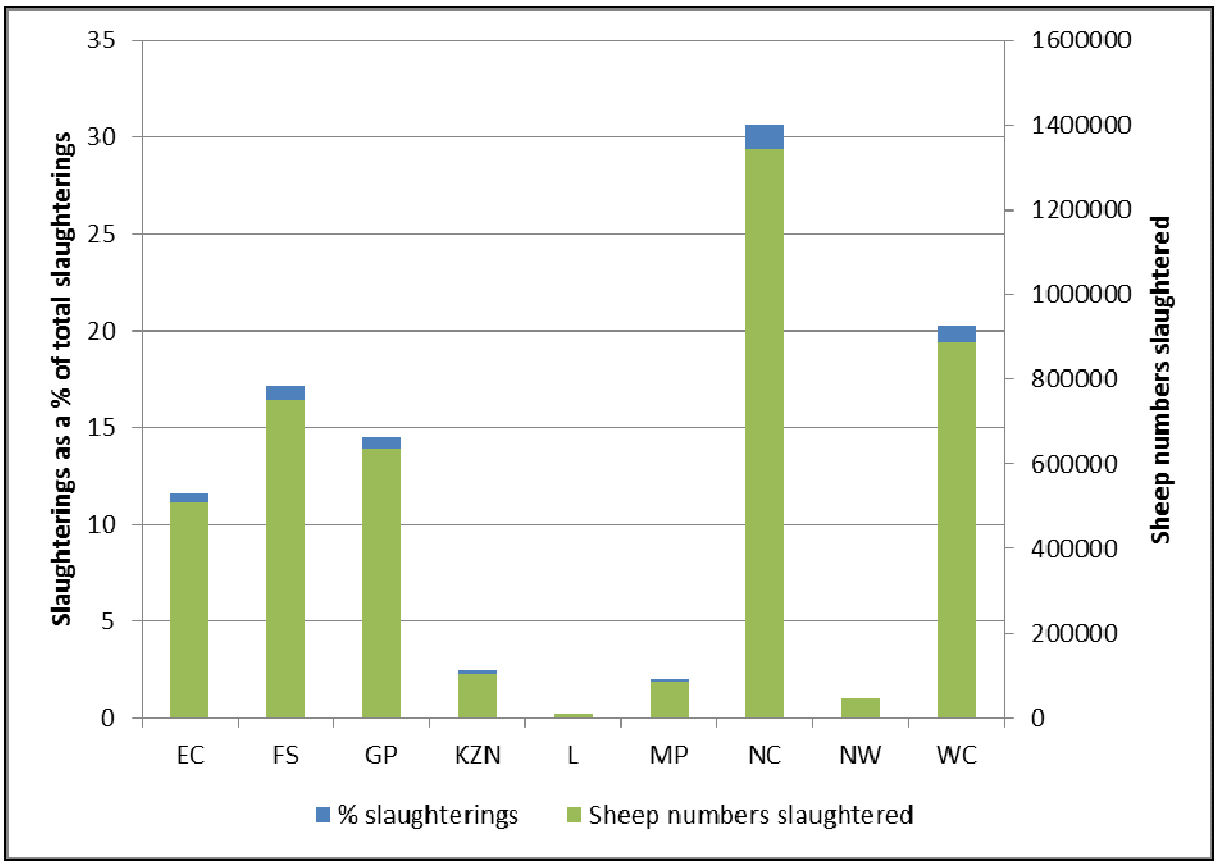


Figure 4.3: Total sheep slaughterings per province (July 2011 to June 2012)
Source: RMLA (2012)

Figure 4.2 and Figure 4.3 make for interesting comparisons. Figure 4.2 indicates the number of sheep in each province in South Africa and Figure 4.3 indicates the number of sheep slaughtered in each province in South Africa from July 2011 to June 2012.

The Eastern Cape, Northern Cape, Free State and Western Cape have the highest number of sheep per province in South Africa (Figure 4.2). When looking at the number of sheep slaughtered per province, the numbers look somewhat different. In this case, the Northern Cape, Western Cape, Free State, Gauteng and Eastern Cape have the highest number of sheep slaughtered per province in South Africa (Figure 4.3). It is not a given, however, that sheep sourced in a specific province are slaughtered in that province. Abattoirs admitted that in times of low sheep supply, for example, during the Rift Valley fever problem or during times of high demand (Christmas and Easter holidays), they can travel large distances of up to 400 km to source sheep.

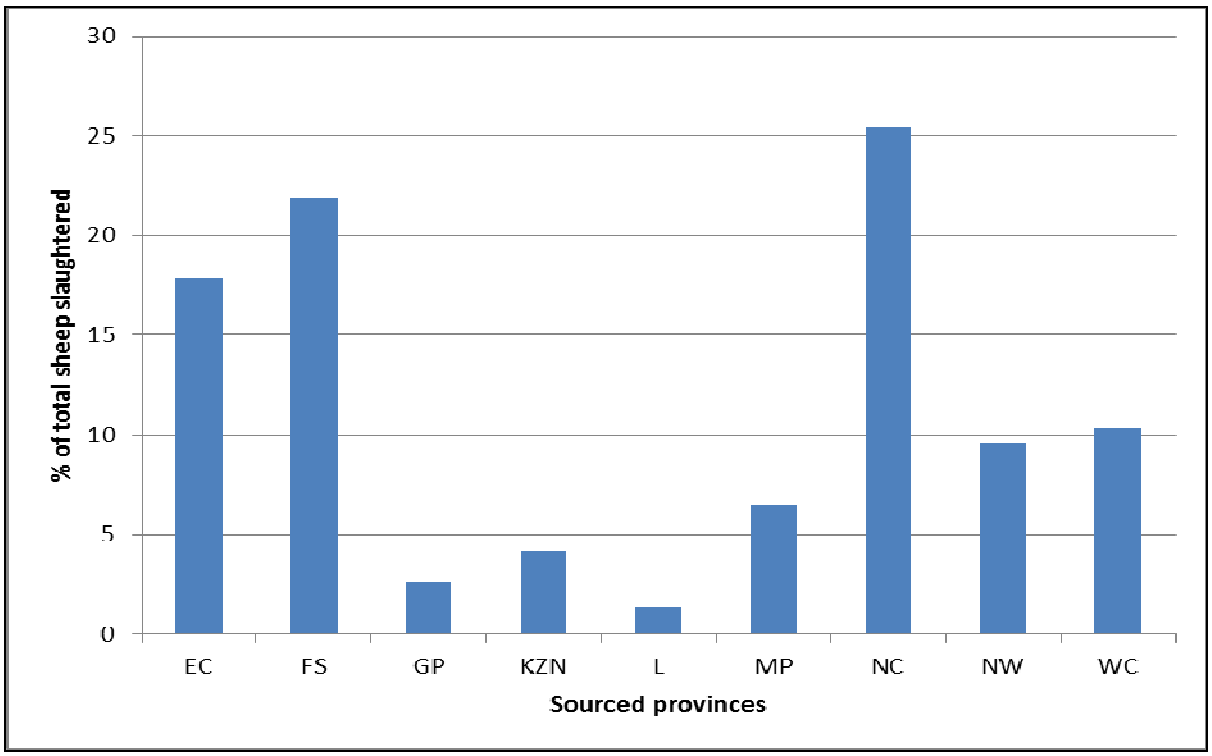


Figure 4.4: Origin of sheep slaughtered by sample abattoirs per province (%)

The main question arising from this comparison would be: "From which regions or provinces do abattoirs then source their sheep?" Clearly, sheep are not only sourced from the provinces in which slaughtering takes place. Figure 4.4 provides an answer to this question: 26 % of the sheep slaughtered by participant abattoirs are sourced from the Northern Cape, followed closely by the Free State and the Eastern Cape.

4.3 ABATTOIR PROCESS MAP

As required by law, most South African abattoirs perform the same processes during slaughtering. The only real difference on the slaughtering floor is the way in which information is captured and stored, the type of information that is captured and the level of information gathered and shared. During visits to the abattoirs and conversations with the managers and the owners of these abattoirs, the following process map (Figure 4.5) was constructed to indicate the general way in which animals and carcasses move through the abattoirs' processing stages to the customer, as well as details pertaining to the information gathered at various points in the slaughtering process.

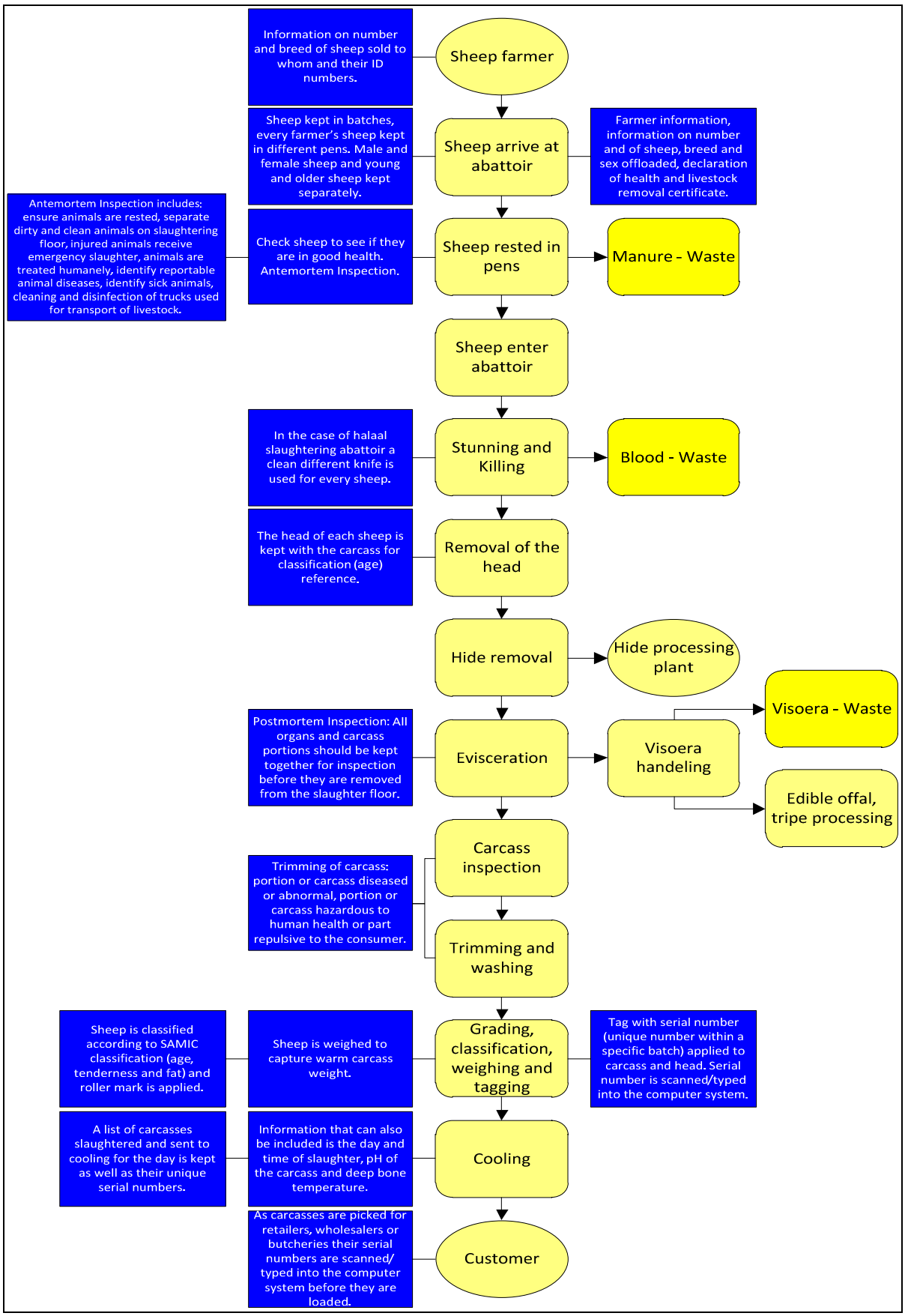


Figure 4.5: Process map at the abattoir level
Source: Abattoir visits (2012)

4.4 DESCRIPTIVE OVERVIEW OF ABATTOIRS SURVEYED

The study found that most of the South African participant abattoirs are irreplaceable due to the high capital investment. Figure 4.6 indicates the abattoir capital replacement value by means of a histogram. A total of 6 of the participant abattoirs had a replacement value of R20 to R60 million, 12 participant abattoirs had a replacement value of R3 to R8 million and 5 participant abattoirs had a replacement value of less than R3 million. Only 1 abattoir had a replacement value of more than R100 million. The maximum abattoir replacement value was R110 million and the minimum replacement value was R1 million with an average of R21 million rand.

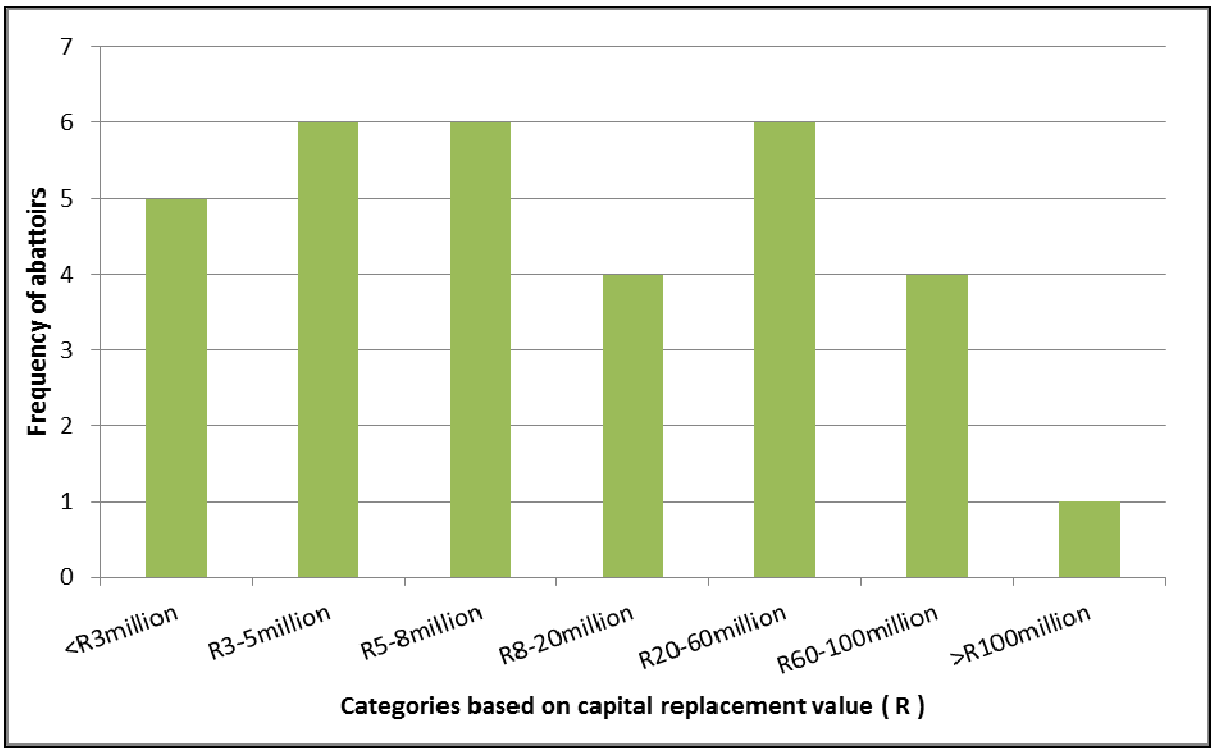


Figure 4.6: Abattoir capital replacement value (R)

These participant abattoirs have a maximum slaughtering capacity of 3 600 sheep per day and a minimum slaughtering capacity of 2 sheep per day. The average slaughtering capacity of all the participant abattoirs is 664 sheep per day. Figure 4.7 indicates that 13 abattoirs slaughtered between 150 and 600 sheep per day followed by 9 abattoirs that slaughtered between 600 and 3 000 sheep per day. Only 5 abattoirs slaughtered between 1 and 50 sheep per day and only 1 abattoir slaughtered more than 3 000 sheep per day.

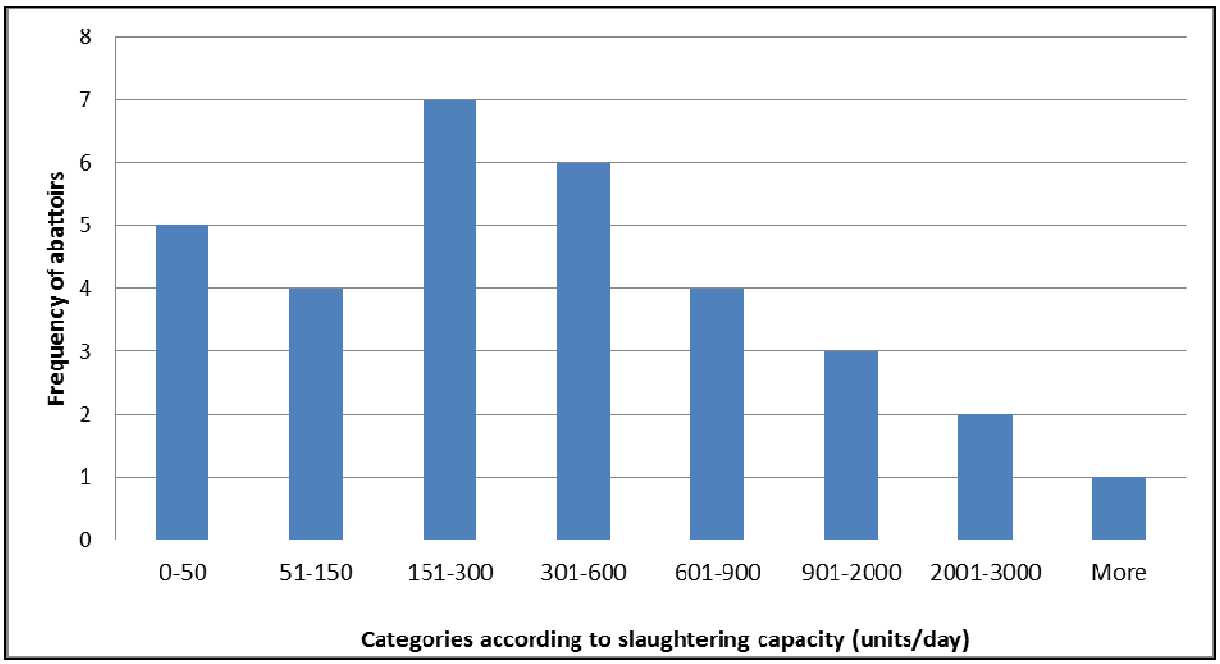


Figure 4.7: Abattoir capacity (number of sheep slaughtered per day)

Of the participant abattoirs, 87 % are privately or independently owned and not group owned by a mother company. Figure 4.8 indicates the level of vertical integration of participant abattoirs. Of the participant abattoirs, 84% are vertically integrated. In some cases, abattoirs owned both a sheep farm or feedlot and butchery.

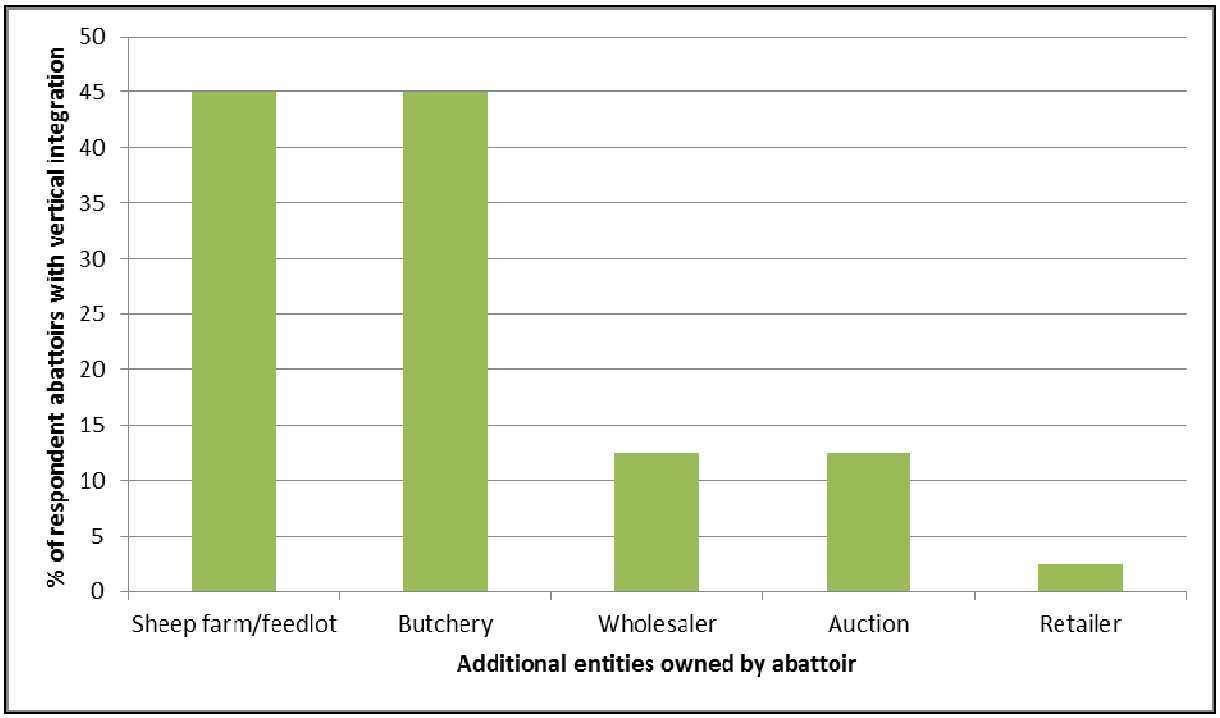


Figure 4.8: Level of vertical integration at participant abattoirs

The bulk of carcasses sold by abattoirs are destined for wholesalers, followed closely by retailers and butcheries (Figure 4.9). Abattoirs were hesitant to reveal information regarding exactly who these wholesalers, retailers or butcheries are or where they are situated. Of the carcasses, 90 % are generic carcasses. This means that these carcasses are not marketed or sold with a free-range, organic or any other credence attribute attached to them. The remaining 8 % of abattoirs only provide a slaughtering service and never take ownership of the carcass. This slaughtering service is usually provided to wholesalers and butcheries.

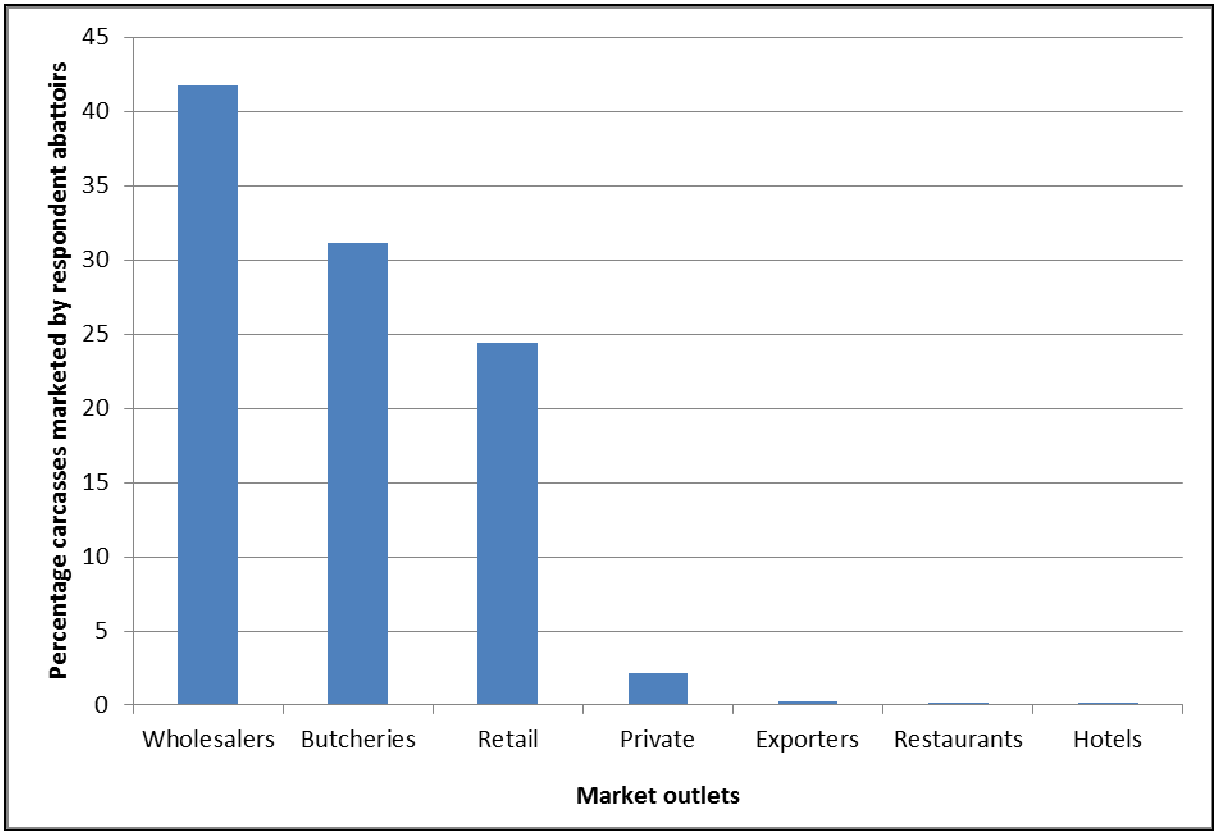


Figure 4.9: Abattoir sheep carcass outlet markets

From the data gathered, coded and analysed, the following conclusions can be made in terms of the participant abattoirs' adherence to government regulations:

- 90 % of the abattoirs had HAS in place and adhered to government regulations
- 38 % of the abattoirs had HACCP standards in place
- 3 % of the abattoirs had the ISO22000 quality management system in place

- 10 % of the abattoirs had no standards in place and had not been tested for adherence to government regulations – this is worrisome
- 18 % of the abattoirs slaughter sheep that have no form of identification (tattoos or ear tags); this is a contravention of the Animal Identification Act, 2002.

During the research the participant abattoirs stated that government institutions rarely do annual audits to ensure that they are still operating according to the Meat Safety Act of 2000 and therefore with HAS in place. From this statement the following questions arise: How safe then, are the meat products that are consumed? Which government institution is responsible? Why are the sheep meat abattoirs not regulated?

4.5 AN OVERVIEW OF TRACEABILITY SYSTEMS ADOPTED BY SAMPLED ABATTOIRS

The study showed that 92 % of all the participant abattoirs had some sort of traceability system in place. The abattoirs are of the opinion that the weak links in the traceability of the sheep meat supply chains are the meat processing and/or packaging plants, wholesalers and retailers. The 3 (8 %) abattoirs that do not have traceability systems in place are in the Northern Cape and Eastern Cape. This might become problematic, since sheep from these regions are often marketed as Karoo Lamb. Without proper traceability systems in place, this credence attribute cannot be guaranteed.

Figure 4.10 illustrate the types of different traceability systems in place at the abattoir level. This figure proves the point made by the participant abattoirs that they prefer IT-based traceability systems. It was noted that high throughput abattoirs are more likely to have sophisticated traceability systems, such as the Abaserve system. Abattoirs managers are generally of the opinion, however, that a web-based system, where a consumer can trace a product back to the farm of origin or back to the abattoir or processing plant, is farfetched.

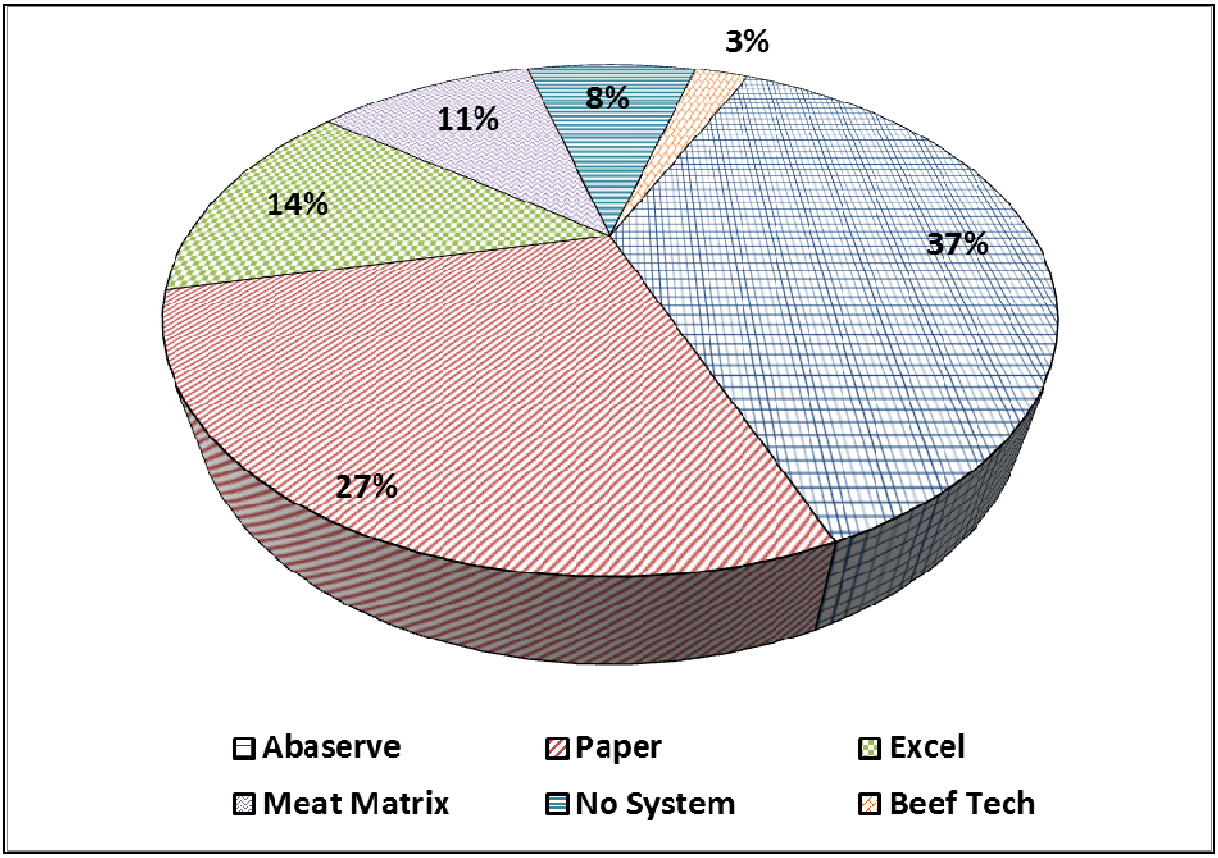


Figure 4.10: Traceability systems at the abattoir level

These traceability systems should be able to protect, manage and govern origin attributes of a meat product. It was found that these traceability systems are at least able to capture the following:

- The name of the farmer or manager and the farm or feedlot where the animal was reared
- The date and time of slaughter
- The batch number in which the specific animal was slaughtered
- The live weight, slaughter weight, cold weight, moisture content, temperature and pH of the carcass
- The grade and class of the carcass
- Basic information on the first point of sale.

During the study, it was decided to categorise the participant abattoirs into four different groups based on the traceability system that they have in place, to try and

gain a better understanding of the dimensions of why specific abattoirs have a particular system in place.

- **Type 1 Abattoirs**
  Abattoirs with no traceability system in place
- **Type 2 Abattoirs**
  Abattoirs with only paper-based traceability systems
- **Type 3 Abattoirs**
  Abattoirs with paper and Excel-based traceability systems
- **Type 4 Abattoirs**
  Abattoirs with highly sophisticated traceability systems, such as Abaserve, supported by Excel and paper records.

The processes within an abattoir are expected to remain the same regardless of the type of abattoir, since these processes are required by law for the slaughtering of animals (Figure 4.5). The differences between abattoirs of type 1, 2, 3 and 4 are mainly with regards to the information gathered and the way in which this is done, that is, the traceability system used.

Type 1 Abattoirs

Type 1 abattoirs are abattoirs that have no traceability system in place (8% - Figure 4.10). Animals enter the abattoir for slaughtering, go through the slaughter process and are sold to a customer without the abattoir tracking and tracing the animal or carcass at any point.

Type 2 Abattoirs

Type 2 abattoirs are typically abattoirs that only have a paper-based traceability system in place (26% - Figure 4.10). These abattoirs slaughter very few animals per day, usually not more than 1 or 2 units. They know exactly where every animal come from and since it is mostly one of a few animals slaughtered on a specific day they know exactly to which customer the carcass goes. This abattoir's traceability system

is very simple. For every animal that gets offloaded, the abattoir manager or an assistant writes the details of the farmer as well as the details pertaining to the animal in a book. The animal then goes through the slaughtering process shown in Figure 4.5, with the exception of scanning or typing the serial number into the computer system. Due to the low throughput, type 2 abattoirs do not use carcass stickers or tags, but normally use an ink pen to mark the carcass with a unique number before it is graded and classified. These type 2 abattoirs typically gather information regarding the farmer (name, surname, contact details, abattoir account number), the farm (name and location), the number of animals offloaded, the breed of animals and the gender and age of the animals, date of offloading, the date of slaughter, live weight and warm carcass weight, the classification and grade of the carcass, the selling date of the carcass and the customer.

Type 3 Abattoirs

Type 3 abattoirs are abattoirs that slaughter more animals than the type 2 abattoirs. A paper-based system is therefore not sufficient for them. These abattoirs usually combine paper and computers to create a unique Excel-based traceability system (13% - Figure 4.10). They have good traceability systems in place, but they do not see the need to invest in a more sophisticated, commercialised traceability system such as Abaserve, Meat Matrix or Beeftech. All animals that are off-loaded are kept in pens according to batches to keep track of the origin of the animals. Animals then go through the normal slaughtering process indicated in Figure 4.5. At the weighing and tagging stage, a sticker is applied to the carcass as well as the head of the animal; this is to have a cross reference in the case of a grading query. In some cases, this sticker only carries the abattoir's information and not the serial number of the animal. This may result in some of the abattoirs not knowing which carcass from which farmer went to which customer, but at least the abattoir can be contacted in case there is a problem at the wholesale, retail or butchery level. These Type 3 abattoirs typically gather information regarding the farmer (name, surname, contact details, abattoir account number), the farm (name and location), the number of animals offloaded, the breed of animals and the gender and age of the animals, date of offloading, date of slaughter, live weight, warm carcass weight, cold carcass

weight, the pH of the carcass, the classification and grade of the carcass, the selling date of the carcass and the customer.

Type 4 Abattoirs

Type 4 abattoirs are typically the high throughput abattoirs with highly sophisticated and commercialised traceability systems in place, such as Abaserve (35% - Figure 4.10), Meat Matrix (10% - Figure 4.10) or Beeftech (3% - Figure 4.10), which are only supported by Excel and paper-based records. Some of these high-tech traceability systems can be linked to Pastel or to the same traceability system used by other members in the supply chain. These traceability systems make use of serial numbers or in some cases barcodes that require scanners. This system requires a capital investment to get the Abaserve, Meat Matrix or Beeftech software in place, as well as the computers, scanners and trained staff to enable proper traceability. The Type 4 abattoirs generally gather the same information as the Type 3 abattoirs, with the difference that all the information gathered is uploaded onto the Abaserve, Meat Matrix or Beeftech system, either manually, by typing the information in, or by scanning the bar code at the classification, grading and weighing stage.

The participant abattoirs were asked to provide reasons why abattoirs would, in their opinion implement traceability systems as well as why they think abattoirs would not implement traceability systems. A common opinion amongst the abattoirs is that traceability systems are currently used for management purposes, especially the management of inventory, and not so much to guarantee certain quality claims or to ensure food safety. The responces obtained are summarised in Table 4.1.

Table 4.1: Reasons for having traceability systems in place

Reasons for having a traceability system in place	Reasons for not having a traceability system in place
• Creates trust between farmer and abattoir • Protects the abattoir's reputation and image • Double control system • Creates trust between the abattoir and the customer • Ensures food safety and quality • Reduces the presence of illegal substances	• Expensive to manage it properly • Overhead costs are expensive and a high capacity is needed to cover this • Abattoir might be too small to afford a system • The abattoir owner or manager feels that it is not needed • A traceability system expose all irregularities, some abattoir representatives or owners does not want it

Reasons for having a traceability system in place	Reasons for not having a traceability system in place
• Contaminated carcasses can be traced • Locate recalled carcass's origin • Provides control throughout the slaughtering process • Maintains consumer trust in the product • Assists with management in terms of inventory, admin and finance • Assists with production and supplier management • Prevents or at least limits theft both of carcasses and live animals • Increases consumer confidence in the product • Difficult to compete in the market without it – improves market access • Ensures the abattoir is not held liable in the case of a complaint • Required by the Consumer Protection Act • Origin of a product can be guaranteed • A group owned abattoir– head office requires and enforce the implementation	exposed • It is not demanded by customers • All market players does not insist on it yet • Unwillingness to implement the system and upkeep it • Oblivious to the benefits of such a system • Abattoir owners might be under the impression that it serves no purpose • Laziness on farmer's side to complete the forms and abattoir's side to implement the system • Does not want to take responsibility for the product • Having a system in place can be time consuming • Abattoirs that slaughter only for the informal sector does not need traceability systems

Of the participating abattoirs, 82 % were of the opinion that traceability systems will become an inevitable part of the sheep meat industry's future. The key drivers for implementation of traceability systems throughout the sheep meat supply chain, according to the participant abattoirs, are:

- Retailers are demanding traceability systems to be in place before an abattoir is considered as a supplier
- Consumers are becoming more educated and demanding a system to track and trace food back and forth in supply chains in case of a food safety scare
- The Consumer Protection Act demands traceability systems to protect supply chain members from being liable in the case of a food safety problem
- Government might enforce traceability systems due to pressure from concerned consumers

The following are some of the participant abattoirs' opinions about the future of traceabiltiy systems in the South African sheep meat industry:

> Food safety in terms of the Health Act and the Consumer Protection Act will be the main driver for the implementation of traceabiltiy systems, the demand for safe food products is increasing and therefore the demand for traceability. As the Consumer Protection Act has been implemented, traceability systems will become obligatory in order to provide the consumer with a certainty that the meat is safe and that there is a system to hold the provider responsible if there is something wrong with the product.

> With the existence of an informal sector, there is no way that a traceabiltiy system can be successfully implemented at all levels of the sheep meat supply chain. For a chain-wide traceabiltiy system to work, the informal sector needs to be cleaned up. However, in a multi-cultural and multi-religious country, this might be easier said than done. The South African government cannot implement this because they cannot control these informal slaughterings. South Africa might therefore not be ready to enforce traceabiltiy systems in the meat supply chains.

4.5.2 Hypothesis testing: Fisher's exact test

For quantitative analysis, the Fisher's exact test is used to test the five previously mentioned, formulated hypotheses. A summary of the hypotheses (as discussed in Chapter 1), the results obtained from running the Fisher's exact test in STATA as well as the rejection rules and conclusions are presented in the following sections.

Table 4.2 acts as a summary of the hypotheses, the Fisher's exact test, the rejection rule and the conclusion.

Table 4.2: Hypothesis test results, rejection rule and conclusion

Number	Hypotheses	Fisher's exact test (1 sided test)	Rejection rule (p-value > 0.05)	Conclusion
1	The proportion of abattoirs with traceability systems is independent of abattoir size	0.556	Hypothesis 1 cannot be rejected on a 5 % level of confidence	The size of the abattoir did not influence the presence of a traceability system
2	The proportion of abattoirs with traceability systems is independent of capital replacement value	0.320	Hypothesis 2 cannot be rejected on a 5 % level of confidence	The capital level of the abattoir did not influence the presence of a traceability system
3	The proportion of abattoirs with traceability systems is independent of whether they deliver to retailers	0.0000004	Hypothesis 4 can be rejected on a 5 % level of confidence	The fact that abattoirs deliver to retailers did influence the presence of a traceability system
4	The proportion of abattoirs with traceability systems is independent of whether there is a HAS system in place	0.284	Hypothesis 8 cannot be rejected on a 5 % level of confidence	The presence of HAS at the abattoir level did not influence the presence of a traceability system
5	The proportion of abattoirs with traceability systems is independent of whether the abattoir is vertically integrated	0.597	Hypothesis 8 cannot be rejected on a 5 % level of confidence	The level of integration in the supply chain did not influence the presence of a traceability system

The remainder of section 4.5 is dedicated to discuss the five hypotheses and their conclusions in as much detail as possible.

4.5.2.1 The effect of abattoir size on the presence of a traceability system

Initially it was expected that the size of the abattoir in terms of slaughtering capacity might influence the presence of a traceability system at the abattoir level. The results revealed the opposite.

Hypothesis 1:	The proportion of abattoirs with traceability systems is independent of size.
Fisher's exact test:	1 sided = 0.556
Rejection rule: (p-value > 0.05)	Hypothesis 1 cannot be rejected on a 5 % level of significance.
Conclusion:	The size of the abattoir did not influence the presence of a traceability system.

For hypothesis 1, the conclusion is drawn that the size of the abattoir did not affect the presence of a traceability system. A large abattoir that deals with around 3 000 animals per day needs a sophisticated traceability system. These systems are usually costly but even though the total variable cost of traceability increases with the

size of the abattoir, due to economies of scale, the average fixed cost for the implementation of traceability decreases with an increase in animals slaughtered. A very small abattoir with a capacity of 1 to 2 animals per day on the other hand, can easily implement a traceability system without increasing cost. This can be done by means of a paper trail for record keeping, where information about the animals entering the abattoir and information about the carcasses exiting the abattoir are recorded by hand. Therefore both small and large abattoirs have the means to implement traceability systems, regardless of their size.

4.5.2.2 The effect of abattoir capital replacement value on the presence of a traceability system

It was anticipated that the higher the capital replacement value of the abattoir the higher the chance that the particular abattoir will have a traceability system in place. According to the results discussed below, this was not the case.

Hypothesis 2:	The proportion of abattoirs with traceability systems is independent of capital replacement value.
Fisher's exact test:	1 sided = 0.320
Rejection rule: (p-value > 0.05)	Hypothesis 2 cannot be rejected on a 5 % level of significance.
Conclusion:	The capital replacement value of the abattoir did not influence the presence of a traceability system.

For hypothesis 2, the conclusion is drawn that the capital level did not affect the implementation of a traceability system. The capital intensity of an abattoir is linked to the slaughtering capacity – the higher the slaughtering capacity, the larger the abattoir and the higher the capital requirement. The conclusion drawn for hypothesis 1 is therefore also applicable to hypothesis 2.

4.5.2.3 The effect of the retail market outlets on the presence of a traceability system

It was initially thought that the fact that abattoirs delivered their product to retailers might influence the presence of a traceability system at the abattoir level. This idea was supported by the Fisher's exact test.

Hypothesis 3:	The proportion of abattoirs with traceability systems is independent of whether they deliver to retailers or not.
Fisher's exact test:	1 sided = 0.0000004
Rejection rule: (p-value > 0.05)	Hypothesis 3 can be rejected on a 5 % level of significance.
Conclusion:	The fact that abattoirs deliver to retailers did influence the presence of a traceability system.

For hypothesis 3, the conclusion is drawn that the fact that abattoirs slaughter carcasses for the retail market did impact the decision to implement a traceability system. The descriptive statistics act as further confirmation of this statement: 95 % of retail delivering abattoirs had traceability systems in place, the other 5 % of abattoirs were abattoirs situated in remote rural areas. Therefore, for abattoirs to be able to be considered as possible retailer suppliers, they need to have proper traceability systems in place. This contributes to competitiveness in the industry. Abattoirs will therefore decide to implement traceability systems based on the requirement by their retail outlet customers.

4.5.2.4 The effect of HAS, at the abattoir level, on the presence of a traceability system

Initially it was expected that abattoirs that have HAS in place have traceability systems in place. The results of the Fisher's exact test however indicated otherwise.

Hypothesis 4:	The proportion of abattoirs with traceability systems is independent of whether there is HAS in place.
Fisher's exact test:	1 sided = 0.284
Rejection rule: (p-value > 0.05)	Hypothesis 4 cannot be rejected on a 5 % level of significance.
Conclusion:	The presence of HAS at the abattoir level did not influence the presence of a traceability system.

For hypothesis 4, the conclusion is drawn that the presence of HAS in an abattoir did not impact on the decision of the abattoir to implement traceability systems. The owners and managers of these abattoirs admitted that it was unclear if traceability systems are a requirement of HAS and/or the Meat Safety Act (40 of 2000). Different results on the Fisher's test can therefore be expected if the implementation of traceability systems is indeed a requirement of HAS.

4.5.2.5 The effect of vertical integration in the sheep meat supply chain on the presence of a traceability system

It was anticipated that abattoirs that are vertically integrated, either upstream or downstream, tend to have traceability systems or better yet, chain-wide traceability systems in place, as they are the owners of the whole or most of the supply chain operations. This, however, was not the case.

Hypothesis 5:	The proportion of abattoirs with traceability systems is independent of whether the abattoir is vertically integrated.
Fisher's exact test:	1 sided = 0.597
Rejection rule: (p-value > 0.05)	Hypothesis 5 cannot be rejected on a 5 % level of significance.
Conclusion:	The level of vertical integration in the supply chain did not influence the presence of a traceability system.

For hypothesis 5, the fact that a supply chain is vertically integrated in some way, either by means of a production unit, or a wholesaler or butchery, or totally integrated by owning all these entities as part of their supply chain did not affect the presence of a traceability system at the abattoir level.

From the above discussion of the hypotheses, it can be concluded that, at this point, the only factor that might influence the decision of abattoir owners or managers to implement a traceability system is the fact that it is a requirement by retailers to their suppliers. This conclusion is based on the Fisher's exact test, and is further supported by descriptive statistics and the opinions of abattoir owners or managers. These indicate that 95 % of retail delivering abattoirs do have traceability systems in place, while the other 5 % of abattoirs are situated in remote rural areas and their retail customers have little choice other than to buy from them.

The owners or managers of the participant abattoirs indicated that, given the choice, they would not have traceability systems, because they carry all the costs of the implementation of a traceability system but receive very little benefit from it. The next section will consequently be dedicated to discussing the economics of traceability systems in meat supply chains. In this section, the costs and benefits according to the participant abattoirs will be discussed as well as the affected parties.

4.6 THE ECONOMICS OF TRACEABILITY SYSTEMS IN MEAT SUPPLY CHAINS

The study shows that 97 % of the abattoirs feel that they are the sole carriers of the cost of implementing a traceability system, whilst 75 % of the participant abattoirs feel that the benefits mostly fall to consumers (Figure 4.11). The question was then raised, "Why implement traceability systems when all the costs but very few of the benefits fall to you?" Their response was that it is a requirement from the retailers' side.

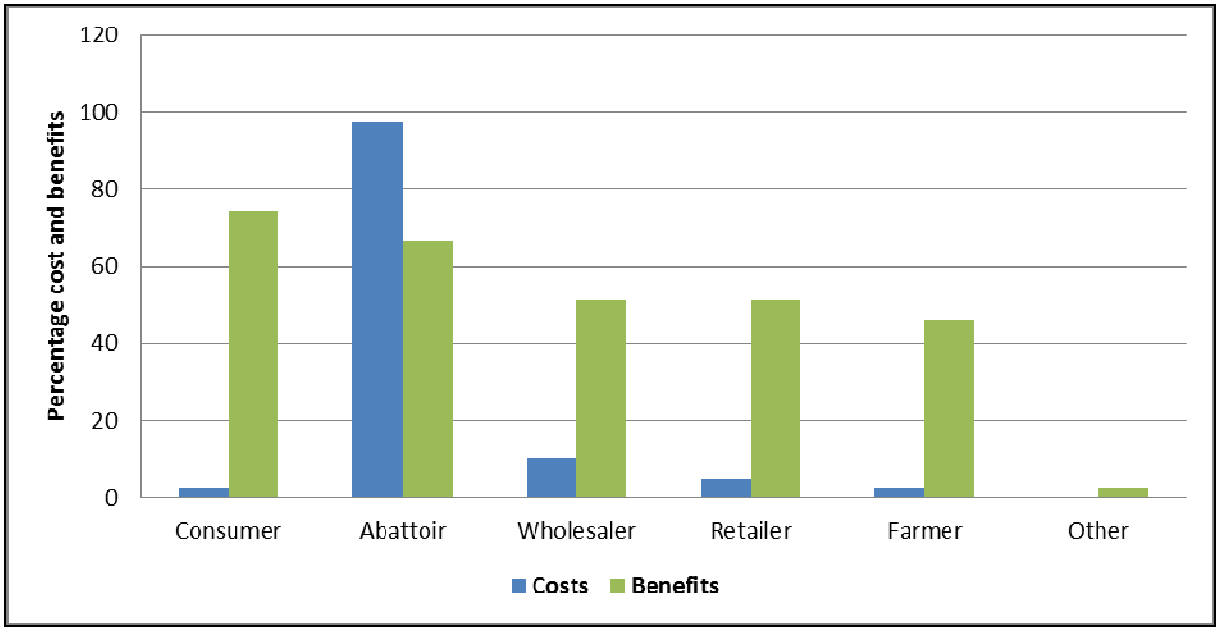


Figure 4.11: Who carries the costs and who gains the benefits?

Of the participant abattoirs, only 33 % knew exactly what their annual or monthly traceability costs were. This was alarming! It is impossible for these abattoirs to do a proper cost benefit analysis without knowing the costs behind such a system and it is again indicative that there is no pressing reason for the implementation of traceability systems. This confirmed the idea that there must be another prevailing reason for the implementation of these traceability systems.

The study found that a typical abattoir with a slaughtering capacity of 1 000 sheep per day, and that has a traceability system in place such as Abaserve, spends

approximately R70 000 in start-up fees and on hardware (scanners and computers) and software to get the system in place and thereafter R5 000 per annum on the licencing fees for the traceability system.

Table 4.3 summarises the costs and benefits of traceability systems highlighted by the abattoirs. The costs and benefits identified by the participant abattoirs are in line with the costs and benefits identified in the literature (Table 2.3).

Table 4.3: Costs and Benefits of traceability systems

Costs	Benefits
• Cost of hardware such as computers and scanners • Cost of software such as the Abaserve programme • Yearly licensing fees in the case where a system like Abaserve is used • Cost of labels and/or tags • Cost of Declaration of health and Livestock removal certificate books • Salary of employees (depending on the size of the abattoir) to tag the carcass and to scan or type in the carcass tag number	• Creates trust between the farmer and abattoir • Protects the abattoir's reputation and image • Double control; computers and scanners are more reliable than paper • Inventory control and management • Limits theft • Improves control regarding illegal substances (eg. hormones or growth stimulants) • Origin of carcasses can be determined and guaranteed • Ensures that the customer receives a product that they trust • Improves management and future occurances in the case of a recall • Better management of admin and finances • Creates market access • Opens up the retail market • Benefits consumers in terms of health and safety of a product

Abattoirs need traceability systems to be considered by retailers as a supplier. Of retail delivering abattoirs, 95% have traceability systems in place, and these abattoirs admitted that this is purely because it was a requirement to be able to sell their products to retailers. The general feeling among participant abattoirs was that retailers use the excuse of traceability systems as a market entry barrier. The participant abattoirs are of the opinion that retailers use the presence of a traceability system as assurance that all other quality and hygiene management systems are in place. This method used by retailers to select their supplying abattoirs eliminates all abattoirs that do not have traceability systems, even though they have quality and hygiene management systems in place. Abattoirs that are eliminated from the retailer's picking list are usually small ones that are not experienced enough or are

not financially capable of implementing traceability systems, due to high overhead costs and low slaughtering capacity.

It was noted, however, that certain retailers, especially those in remote areas where abattoirs are few and far between, do not follow this 'unwritten rule' as strictly as the retailers in the more urban areas. The 5 % of participant abattoirs that deliver to retailers without a traceability system in place are situated in remote rural areas. This might be as a result of the type of customer that the specific retailer caters for or it might be because retailers in rural areas have less bargaining power than retailers in urban areas and have no alternative other than to buy from the closest abattoir even though it does not have a traceability system in place.

The integrity of the role players in the Karoo sheep meat supply chain might be tested when Karoo sheep carcasses are moved outside the Karoo. In the case where Karoo and non-Karoo carcasses arrive at the same processing and/or deboning plant and there is not enough Karoo sheep meat cuts to fill a package, it might be tempting for the plant to add one or two non-Karoo sheep meat cuts to the package, hoping that the difference between the meat cuts will not be noted. For this reason, it might be better for the entire Karoo sheep meat supply chain to remain in the Karoo region. However, keeping the Karoo sheep meat supply chain in the Karoo brings about it's own set of challenges. The shelflife of meat cuts are limited and need to be transported to the market outlet fairly quickly provided a continuous cold chain to prevent spoilage. This creates logistical nightmares.

Furthermore, even though sheep are slaughtered, processed, packed and transported from the Karoo to the various market outlets, it is not always feasible for abattoirs in the Karoo to fill their slaughtering capacities or meet the customer demand with only Karoo sheep. During the recent Rift Valley fever crisis, abattoirs were forced to source sheep further than the normal boundaries, sometimes even as far as 400 km from the abattoir which may lie outside the Karoo region. These points highlight the importance of the integrity of the role players in the Karoo sheep meat supply chain to be able to guarantee the origin of a product like Karoo Lamb.

4.7 SUMMARY

To conclude, the analysis done in Chapter 4 proves that traceability systems are already in place at the abattoir level. Unlike the study done by Bulut and Lawrence on Iowa abattoirs (2008), it finds that South Africa's abattoirs are not the weak links in terms of traceability in the South African sheep meat supply chain.

The South African sheep meat industry and its abattoirs therefore have the ability to guarantee the origin of a meat product such as Karoo Lamb by means of their traceability systems. From the interviews and completed questionnaires, it was clear that the majority of abattoirs in South Africa have proper traceability systems in place, which makes it possible for these abattoirs at least to distinguish between batches from different farmers and therefore possibly different regions.

What is of concern is the fact that very few of the surveyed abattoirs know what the financial implications (costs and benefits) are for their business enterprise in implementing a traceability system. Based on this, a proper cost benefit analysis cannot be done to determine the real economic impact on the sheep meat industry if traceability systems were to become mandatory in future. Information and perhaps workshops for abattoirs to aid them in understanding the costs and benefits as well as the importance of the implementation of a traceability system are therefore recommended. Only when the abattoirs are aware of the financial implications can a proper cost benefit analysis be done.

In terms of the hypothesis test by means of the Fisher's exact test, four of the five hypotheses of independence could not be rejected on a 5 % level of significance. It can therefore be concluded that size, capital replacement value, implementation of HAS and/or vertical integration have no impact on the abattoirs' decision to implement a traceability system and it is possible that these independent variables are independent from the decision-making process.

However, hypothesis 3 could be rejected on a 5 % level of significance, indicating that the market offset point, specifically the retail market, does play an important role

in the decision to implement traceability systems. This, however, is not a decision made solely by the abattoir but is driven by the retailers' requirement for abattoirs to have traceability systems in place in order to gain retail market access.

It is clear that the downstream tiers play a vital part in the South African sheep meat industry in terms of traceability and transparency in order to guarantee the origin of a sheep meat product such as Karoo Lamb. Further research is therefore required to evaluate the other role players in the sheep meat industry for chain-wide traceabiltiy systems in order to test the readiness of this chain to guarantee the origin of a product like Karoo Meat of Origin.

Chapter 5 will consequently be dedicated to unpacking the supply chains that are able to guarantee the origin of a specific product. These supply chains and their traceability systems will then be used to compile a list of guidelines that can be used by various supply chains as a benchmarking tool for marketing origin guaranteed products.

CHAPTER 5

TRACEABILITY SYSTEMS TO GUARANTEE THE ORIGIN OF A FOOD PRODUCT

5.1 INTRODUCTION

Up to now, this study has proved that traceability, especially in the food and agricultural sector, is mainly used for three purposes:

- To keep track of the ingredients of a specific product
- To be able to ensure the health and safety of specific products for human and animal consumption
- To enable supply chain members to trace products back to the place or region of origin.

The systems that are currently used in supply chains for traceability purposes have not been intensively explored yet. This section focuses on the traceability systems in place in international supply chains to enable supply chain members to trace products back to the place or region of origin. To conceptualise this, traceability systems to ensure chain-wide traceability for four products with and without origin quality attributes, from various parts of the world, are discussed according to a common template.

The following four chains were identified:

- The VanDrie group veal supply chain in the Netherlands
- The beef supply chain in Ireland
- The Parma Ham supply chain in Italy
- The MeatCo beef chain in Namibia.

The common template, where information is available, covers:

- The structure of the products' supply chain
- The drivers for the implementation of the traceability system
- The workings of the traceability system
- Possible future plans for the system
- Key findings.

This common template supports the notion of highlighting similarities and differences between the products to create a better understanding of traceability systems implemented in international supply chains.

5.2 TRACEABILITY SYSTEMS IN INTERNATIONAL CHAINS

5.2.1 The VanDrie Group veal chain – the Netherlands

The VanDrie group started in the early 1960s when Jan Van Drie, founder of the group, bought his first new-born calf for fattening. Today the VanDrie group is the largest privately owned agro company in the Netherlands (VanDrie, 2012a).

5.2.1.1 The structure of the veal supply chain

The VanDrie group veal supply chain consists of members participating in the entire supply chain: in dairy products, calf milk production, calf husbandry, slaughterhouse, calf skin processing, marketing and consumers (Figure 5.1). These seven supply chain members encompass more than twenty companies, making it the largest integrated veal producer in the world, annually rearing and processing almost 1.4 million calves (VanDrie, 2012b).

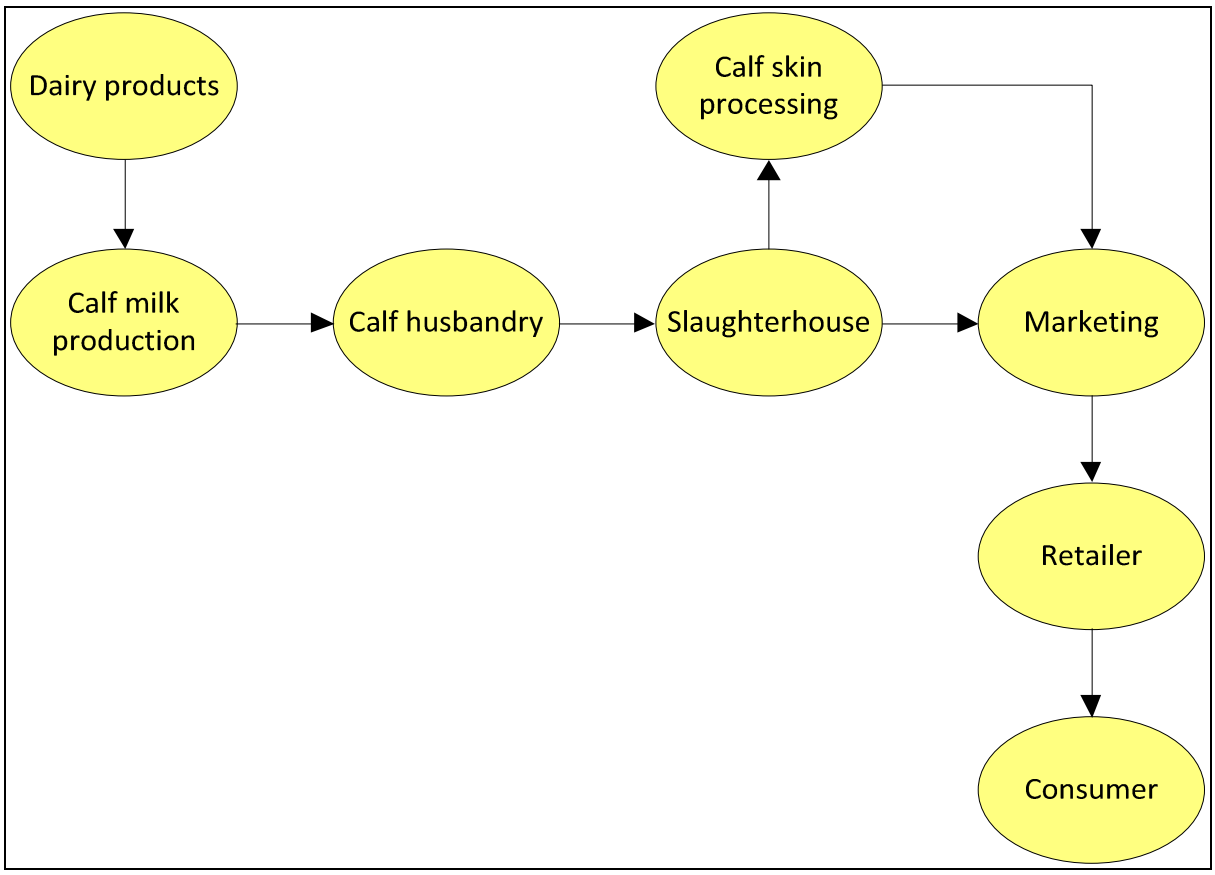


Figure 5.1: VanDrie group veal supply chain
Source: VanDrie (2012b)

5.2.1.2 The drivers for the implementation of the traceability system

The main driver for the implementation of traceability systems in the VanDrie group's veal supply chain is the integrated nature of the supply chain. To successfully manage twenty interlinked companies, a proper chain-wide traceability system is inevitable (VanDrie, 2012b).

Another driver is the tailor-made products for specific clients by the VanDrie group. Veal slaughtered by the different slaughtering companies is tailor-made for clients in terms of origin, weight, colour, packaging and labelling. To be able to tailor-make products according to clients' specifications a chain-wide traceability system is needed to ensure that each member of the VanDrie group's supply chain works toward satisfying each client's specific requirements (VanDrie, 2012c).

5.2.1.3 The workings of the traceability system

The VanDrie group uses Safety Guard, a quality and checking system, as their traceability system. This system ensures that all existing quality systems within the twenty companies, such as HACCP, GMP and ISO quality management systems are linked, to ensure food safety (VanDrie, 2012d). The traceability system within each sector of the integrated VanDrie group veal supply chain is as follows:

Traceability at the dairy product and calf milk production level

Liquid dairy products as well as all other raw ingredients get tested at the calf milk production stage before the raw materials to be used in powdered milk production are unloaded. All ingredients get sampled, checked and approved and only then are they released for production. These results are then recorded to ensure chain-wide tracking and tracing. Companies involved at the dairy product stage are Eurolat and Melkweg, while companies involved at the calf milk production stage include Tentego, Navobi, Schils, Zoogamma, Kalmi Italia and Vals (VanDrie, 2012b; VanDrie, 2012e).

Traceability at the calf husbandry level

Calves are reared in herds by means of group housing on more than a thousand controlled farms, in spacious, well ventilated and well lit sheds. These farms are managed by means of modern management systems and undergo constant research to improve production. Companies that are involved at this stage are Van Drie, VanDrie Kalverhouderij, Sobeval, Schils France, Vals, Naturalys and VanDrie Deutschland (VanDrie, 2012b; VanDrie, 2012e).

On the controlled farms, each calf receives a unique identification number, printed on an ear tag, at birth. The complete history of the calf, including what it has been fed, is then linked to this number. This allows the VanDrie group to trace meat cuts from the supermarket to the individual animal (Swinkels, 2008:20).

Traceability at the slaughterhouse

Since the VanDrie group offers tailor-made products to clients, a proper traceability system is crucial. Clients have specific requirements regarding carcass conformation, weight and colour as well as requirements regarding packaging and labelling. Companies that are involved at the slaughterhouse stage include KSA, T. Boer & zn., Ekro, Sobeval and VanDrie België (VanDrie, 2012b; VanDrie, 2012c).

As soon as the calf is slaughtered, the identification number on the ear tag is scanned. This means that the history of the calf is now on the system. Data such as weight, colour, grade and fat covering will be uploaded onto the system as soon as the slaughtering process is completed. When the carcass undergoes processing all the cuts from a specific carcass will go into one crate, all the data gathered from the farm to this point will then be transferred to a transponder in the specific crate. During the packaging process, the label with the relevant data of the veal in the specific crate, including the unique identification number, is printed out and fixed to the packaged veal product. This makes traceability from the point of sale back to the individual calf possible (VanDrie, 2012e).

Traceability at the marketing level

The VanDrie group has a transparent tracking and tracing system. Any consumer that has access to the Internet can go to www.vealvision.com, enter the unique identification code found on the veal product package and have a digital introduction to the calf as well as where the calf grew up. This makes the VanDrie group veal chain one of the few meat supply chains with chain-wide traceability of this detail in place.

5.2.1.4 Possible future plans for the system

The VanDrie group's future plans include the acceptance of the ISO22000 quality management system throughout the production system, including retail organisations as well as regulatory bodies (Swinkels, 2008:21-22).

From the research done, no definite plans to improve the VanDrie group's existing transparent chain-wide traceability system could be found.

5.2.1.5 Key findings

From the aforementioned, the VanDrie group's chain-wide transparent traceability system has brought about the following benefits:

- The transparent chain-wide traceability system has made it possible for consumers to trace the veal product back to the individual calf of origin
- Consumer trust in the product is strengthened
- The system also supports the tailor-made marketing process
- This traceability system has strengthened the VanDrie group's market position by strengthening the links between the members of the integrated supply chain.

5.2.2 Beef supply chain – Ireland

"A contaminated meat scare has spread from pork to beef after tests found illegally high levels of chemicals [Polychlorinated Biphenyls] in cattle…" as reported by Sky News on 9 December 2008 caused major uproars in the Irish meat industry. Even though the public was told not to be worried, the beef industry, Ireland's most important and largest farming sector, suffered. This Irish food scare illustrates the importance of traceability systems that need to be in place at each link in the supply chain but more so illustrates the tremendous importance of chain-wide traceability systems not only to protect the public but also to protect supply chain members. Since 2008 the Irish beef industry has upped their game in terms of traceability systems.

5.2.2.1 The structure of the beef supply chain

The Irish beef supply chain consists of feed and medicinal companies that supply the farm rearing stations with inputs, as well as abattoirs and boning halls supplying to

both processors and butcheries, which take final products to the market either as pre-packed meats or as a serve order (Figure 5.2).

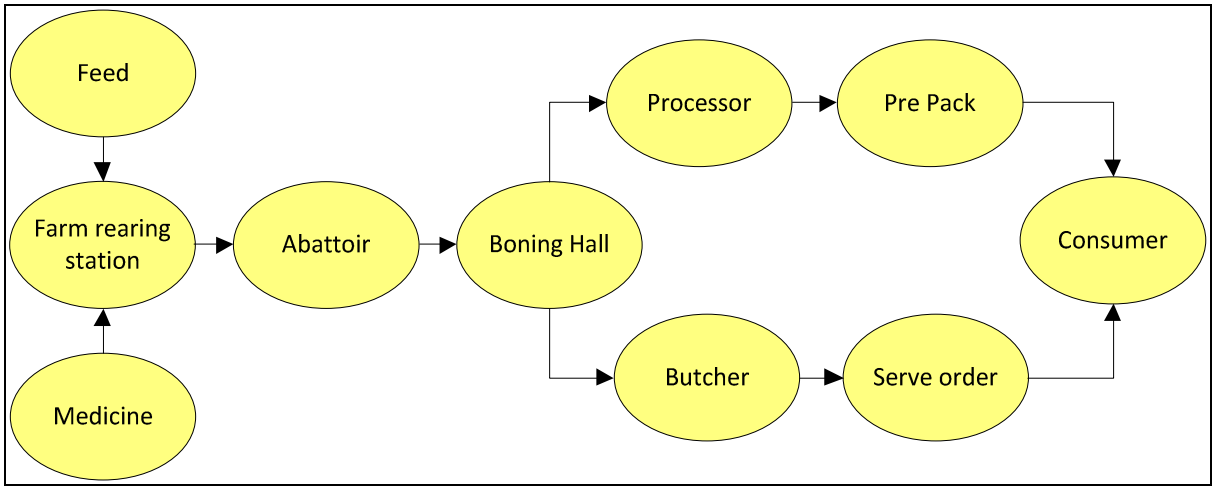


Figure 5.2: Ireland beef supply chain
Source: GS1 Ireland (2005:11)

5.2.2.2 The drivers for the implementation of the traceability system

The beef traceability case study done by the GS1 Ireland in February 2005 stated that the BSE crisis in Europe was one of the major drivers for the implementation of traceability systems. This crisis caused a decrease of approximately 16 % in beef consumption from 1999 to 2001 and a much lower market price for beef, since consumers refused to purchase beef of unidentified origin. This crisis led to governments and trade associations rapidly introducing codes of practice, schemes and systems to reassure the consumer about the safety of beef products. Producers and retailers that introduced traceability systems had a much slower and lower decrease in beef sales than the national average. Their beef sales also recovered much quicker and to a higher level compared to producers and retailers that had no traceability or food initiatives in place (GS1 Ireland, 2005:7).

A second driver for the implementation of traceability systems was the regulations introduced by the European Commission (EC) that would ensure the traceability of beef back to the origin of the product through labelling. The first of these regulations was the beef labelling regulation 1760/2000, introduced on July 17th 2000. This regulation completely revoked the existing EC 820/97 legislation. The beef labelling regulation 1760/2000 requires that all beef retailers and producers should place

information regarding the origin of the beef product on the label and since January 1st 2002 it has been compulsory to specify the cattle's complete origin on the label. This legislation puts forward the principles needed in order to establish a system to enable supply chain members to identify and register bovine animals and lays down the labelling procedures for beef and beef products. The second regulation introduced by the EC was the food safety regulation 178/2002, effective from January 1st 2005. This regulation aimed to increase consumers' confidence in the safety of all foods and to ensure that all supply chain members involved in any process within any food product supply chain have a reliable traceability system in place. This system should provide details in terms of who the focal firm received the product from and who they are supplying (the principle of 'one-up one-down') to ensure a chain-wide traceability system (GS1 Ireland, 2005:5).

The main principles of the legislation are (GS1 Ireland, 2005:7):

- All food and feed companies must be able to identify any company from whom they received raw ingredients and/or products and to whom they supplied food, feed, a food producing animal or an ingredient used in a feed or food product
- This regulation applies to every member in the supply chain either production, processing and distribution of the food and feed, or a combination of the three
- All supply chain members should have procedures and systems in place to offer authorities easy access to information
- To facilitate traceability all food and feed should be adequately identified and labelled
- Measures and penalties applicable to infringements of the food law will be laid down by authorities and these penalties will be effective, proportionate and dissuasive
- Any solution designed to fulfil the requirements of 1760/2000 must now also be capable of the fulfilling the requirements under 178/2002.

Both the food safety legislation 178/2002 and the beef labelling regulation 1760/200 are based on the principles of traceability with the purpose of guaranteeing a

connection between every section of the supply chain, be it processing or distribution (GS1 Ireland, 2005:6-7).

A third driver, specifically in Ireland, was the additional national regulations that required labelling of products with certain compulsory traceability information by all chain members involved in marketing and production of veal or beef. These mentioned regulations were the European Communities (Labelling of Beef & Beef Products) Regulations 2000 (S.I No 435 of 2000) and the EC Amendment Regulations 2002 (S.I No 485 of 2002). The regulations furthermore allowed for additional voluntary labelling subject to approval (GS1 Ireland, 2005:6-7). Both the compulsory beef labelling and voluntary beef labelling regulations are shown in Table 5.1.

Table 5.1: Beef labelling regulations as set out under 1760/2000

Beef labelling regulations as set out under 1760/2000	**Compulsory Labelling**	• The reference number or code of the animal or group of animals from which beef was derived • The country of slaughterhouse and approval number: 'Slaughtered in (name of country) (approval number)' • The country of the de-boning hall and approval number: 'Cutting in (name of country) (approval number)' • Country of birth • All countries where fattening took place • The country where slaughter took place • The only exception to the compulsory beef labelling system is for minced meat
	Voluntary Labelling	• Operators wishing to place additional information on the label must first submit an application for approval to the competent authority • In Ireland it is the responsibility of the Department of Agriculture and Food • Voluntary information can include the animal identification number, gender and breed of the animal
	Serve Over Beef Labelling	• In the case of serve over beef, similar traceability information must be made available to the consumer at the point of sale • This is usually provided through a whiteboard

Source: GS1 Ireland (2005:5-6)

5.2.2.3 The workings of the traceability system

In the following subsections, the traceability systems of the Irish beef supply chain are discussed in as much detail as possible. The supply chain members to be discussed are the abattoir, the processing plant and the distribution level.

Traceability at the abattoir level

On arrival at the abattoir (in this case Kepak), the animal's identity and history are captured on the abattoir's database. The animal then proceeds to slaughter, followed by hide removal and quartering (hind and forequarters). A carcass label is then attached to each quarter providing information such as the farmer's name and address date of the animal's birth, country of origin, ear tag number, carcass number, factory of slaughter and date of slaughter, grade, sex and the cold weight of the carcass; this information is also scanned onto the abattoir's database (GS1 Ireland, 2005:10).

Traceability at the processing plant

As soon as the animal is quartered, it moves to the deboning hall. Here the hind and forequarters are deboned and made into primal cuts. These cuts are then weighed, vacuum packed and labelled with the EAN128 barcode. The EAN128 label contains the batch and product codes, the country of origin and slaughter, the factory of slaughter and cutting as well as the slaughtering, packing, cutting and use-by dates. This barcode label ensures that the primal cuts can be traced back to a group of animals slaughtered. After labelling, these cuts scanned and moved to the freezer or chiller of the abattoir where they are kept prior to marketing. By using scanners and scanning the EAN128 barcodes, a full traceability record of each product is maintained of exactly when the product entered the cold storage facilities and when it was dispatched to the retailers (GS1 Ireland, 2005:10-11).

Traceability at distribution level

A specific retailer (in this case Musgrave SuperValu-Centra) places a daily order for beef, and the abattoir (Kepak) collects the product from the cold storage facility. Quality control and the distribution process are much more effective and efficient when products are tracked during cold storage. The ordered products are selected and scanned out of storage before transported to the retailer. These primal cuts are then directly transported to the retail store where they are processed, either for serve-over products or for in-store pre-packed products (GS1 Ireland, 2005:11).

Traceability at the retail store level

At the retailers' butchery departments (SuperValu and Centra outlets), the EAN128 labels of the primal cuts are scanned to confirm receipt of the beef products. The scanning process transfers all the traceability information of the primal cuts to the database of the retailer. The primal cuts are scanned as they go into storage and are ready to be scanned out when they are needed for cutting and packing. This enables the retailer to keep records of when the beef was delivered and processed, ensuring a link between the primal cut and the animal batch from which it originated. Once the primal cuts are cut and packed, the traceability information contained in the EAN128 label is transferred by means of the FoodTrace system via the retailers' scales onto labels of the pre packed products. Printed on every piece of pre-packed or serve-over beef is a FoodTrace number, also called the daily lot number. This number serves as a unique reference number that enables the retailer to retrieve traceability information such as the processing factory or even the batch of animals from which the product originated in the case of a consumer query.

In October 2004, Kepak and Musgrave SuperValu-Centra modified their system to accommodate the name and the address of the farmer on the FoodTrace label. The label on the pre-packed product now contains not only a unique FoodTrace number but also the farmer's name and the farm address. The FoodTrace system works on the basis of the EAN identification numbers and aids in converting EAN numbers into consumer friendly information such as farmer, batch, date and primal cut. This system furthermore facilitates immediate product recall (GS1 Ireland, 2005:12).

Where serve-over products are concerned, the information contained in the EAN128 label is transferred onto the back office computer once the label is scanned. A lot number is then allocated to the primal cuts used for serve-over within a given time. As soon as a product is selected from the batch, the traceability information is printed on the price label during the weighing process, providing the consumer with a traceability report. Copies of the labels used in serve-over transactions are printed and stuck in a manual log book as a record of all the batches used. A 'whiteboard' sheet is used for in-store display of the traceability information, which replaces the whiteboard initially used (GS1 Ireland, 2005:12).

5.2.2.4 Possible future plans for improving the traceability system

Kepak and Musgrave SuperValu-Centra's future plans for improving their traceability system, FoodTrace, are to modify the system in such a way that beef products are not only traceable to the batch of animals slaughtered on a particular date, originating from a particular farm, but to be able to trace the beef product back to the individual animal (GS1 Ireland, 2005:14).

5.2.2.5 Key findings

The implementation of a chain-wide traceability system in the Irish beef industry, particularly within the Kepak and Musgrave SuperValu-Centra chain, has brought about the following benefits (GS1 Ireland, 2005:14-15):

- Positive reactions from consumers, and increasing consumer confidence since consumers are now reassured that SuperValu and Centra outlet beef are fully traceable to a group of animals as well as the farmer and farm of origin
- The increase in consumer confidence has positively influenced sales
- Immediate product recalls are facilitated, since SuperValu and Centra have accurate information on where the primal cuts were delivered to
- Electronic databases have increased the speed at which information is stored and made available, which has saved in store labour hours and also improved some of the stores' financial positions
- The use of the EAN.UCC system of bar-coding and scanning has reduced the occurrence of errors relating to batch numbers or production dates since information is captured automatically in the EAN128 label
- The EAN.UCC system reduces the likelihood of false traceability data
- Whiteboard information regarding beef being served on a specific day is more accurate since it is done automatically and not manually
- The FoodTrace system is suitable for a variety of food products and other suppliers, as it is not system dependant and does not need prior configuration.

5.2.3 Prosciutto di Parma (Parma Ham) supply chain – Italy

The production of Italy's Prosciutto di Parma has a tradition of excellence. The region of Parma in Italy, a region defined by the hills around it, with its dry, uniquely sweet, aromatic breezes from the Apennine Mountains, creates the perfect environmental conditions for the natural drying process of the hams. And it is indeed in this region where experts have patiently salted and cured hams for centuries. The characteristics of the Parma Ham as a result of the region are what justified Parma's protected origin status. This means that only hams originating from the Parma region are allowed to become Parma Hams (Prosciutto di Parma, 2007a).

5.2.3.1 The structure of the Parma Ham supply chain

Due to the protected origin status of Parma Ham, all producers of Parma Ham should be situated within the geographical boundaries of the Parma production area in Italy, Figure 5.3 clearly illustrates the dimensions of the Parma Ham supply chain.

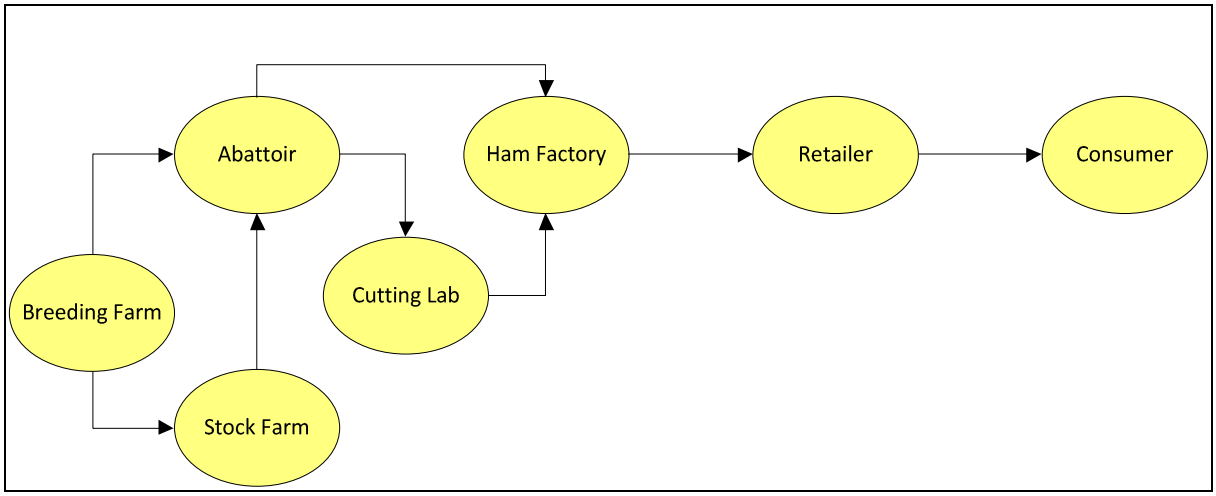


Figure 5.3: Italy's Parma Ham supply chain
Source: Arfini, Giacomini and Mancini (2003)

Pigs that are to become Parma Hams are carefully selected and should be from the Landrace, Duroc or Large White breeds. After the birth of the piglets on the pig breeding farms, pigs are either reared on the breeding farm or sold to a stock farm for rearing. When the pigs reach their ideal weight of 140 kg at no less than 9 months, they are transported to the abattoir for slaughter (Prosciutto Di Parma, 2007b). Following slaughter, the pig legs, which weigh around 15 kg (Prosciutto Di Parma,

2007c), are removed from the carcasses and transported from the abattoir to the cutting laboratories and then the ham factories or directly to the ham factories for curing. At the ham factories, the pig legs are salted, rested, washed and dried, cured, greased and cured again (Prosciutto di Parma, 2007c). The only ingredients allowed by the Parma Ham Consortium (the Consortium) (Consorzio del Prosciutto di Parma) for the curing process are Italian pigs, salt, air and time. No additional preservatives are added, making Parma Ham an all-natural product (Prosciutto di Parma, 2007d). This process will take at least one year from the date of the first salting before it is sent to various off set points, either whole or sliced into pieces of varying shapes and weights (Prosciutto di Parma, 2007c; Arfini *et al.,* 2003:9-11).

5.2.3.2 The drivers for the implementation of the traceability system

According to Arfini *et al.* (2003:3, 15), the most important driver for the implementation of a traceability system in the Parma Ham supply chain is the consumers. It is important to have systems in place to reassure consumers specifically about the credence attributes of a product since these attributes can only be partially detected during consumption. These credence attributes can be guaranteed either by the brand of the manufacturing company or by quality seals in the form of collective or certification marks affixed by a government approved independent third party. However, to effectively safeguard the interest of consumers, a traceability system across the entire supply chain needs to be implemented. This requires the cooperation of all members involved in the supply chain (Arfini *et al.,* 2003:3, 15).

The second driver for the implementation of traceability systems is the council regulation (EEC) 2081/92 that aims to reduce asymmetrical information in the supply chain. This regulation lays down rules to protect geographical indications (GIs) as well as designations of origin for agricultural products and foodstuffs. By incorporating these rules, the community legislator provides the consumer with a guarantee of the origin of the product. The guarantee can be validated through a transparent system that is mediated by a third party. These GIs and designation of origin quality marks are periodically checked by independent bodies and guarantees that the quality standards set down in the Code of Practice have been met. The

system activated by the council regulation (EEC) 2081/92 narrows the information gap between producers and consumers and helps to transfer wealth within the supply chain to the producers involved (Arfini *et al.*, 2003:3).

5.2.3.3 The workings of the traceability system

The Italian consortium, Protection Consortia (Consorzi di Tutela), was established to inform consumers and safeguard producers before European Union regulations were adopted. The task of the Protection Consortia was to guarantee that members of the supply chain followed the rules as set out in the Code of Practice and also to verify the quality of products before they are sold on the market. In Italy, an intermediary institution, the Consortium established in 1970, has been instrumental in putting products with a geographical indication or designation of origin on the market by guaranteeing their origin, production techniques and quality to the consumer thereby improving consumer confidence in the particular product and safeguarding the interests of the consumer. The Consortium has adopted a traceability system, for the meat of Parma Ham since its establishment in 1970, to be able to verify the origin and compliance with production and product specifications (Arfini *et al.*, 2003:4-5, 7).

The production regulations of Parma ham pigs as set out by the Consortium are (Arfini *et al.*, 2003:7):

- No animal fats are allowed in pig feeds
- Pigs should originate exclusively from Italian pig farms
- Farmers are required to brand piglets 30 days after birth.

In January 1998, the supervising activity that ensures that all members of the supply chain comply with specification regulations was granted to the independent body, Istituto Parma Qualità. The functions of marketing and developing Parma Ham in Italy and abroad were retained by the Consortium (Arfini *et al.*, 2003:7).

The Consortium then, and today the Istituto Parma Qualità, adopted a system of applying marks and the registering of various passages to verify compliance with the above regulations. This system encompassed the essential characteristics of a

system, today called a traceability system. The traceability procedure takes place through various consecutive phases, such as: (i) affixing identification marks (stamps and seals) on pork legs by farmers, slaughterhouses, producers and the Istituto Parma Qualità and (ii) completing a set of documents to move with the pork legs throughout the entire supply chain (Table 5.2) (Arfini *et al.*, 2003:7-8).

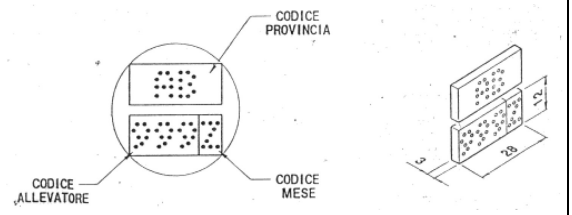
Table 5.2: Actions and procedures to ensure Parma Ham traceability

Phase	Actions	Procedures
1	Approval of all stock farms, slaughterhouses, ham factories of the PDO circuit and assignment of regular identification code	Companies' data. Identification codes.
2	Birth of pigs on rearing farms	Inedible tattoo on rear legs within 30 days from birth
3	Pigs transferred to different stock farm	Intermediate Certification issued
4	Pigs sent to slaughterhouse	Unified Conformity Certificate issued for each shipment to slaughterhouse made by farm of origin
5	Inspection of lots of pigs arriving at slaughterhouse	Check Unified Conformity Certificate and compliance with specification requirements Branding of approved pork legs with hot iron by slaughterer
6	Pork legs sent to cutting laboratory (optional) or directly to the ham factory	Cumulative Slaughter Declaration issued by slaughterer
7	Cutting laboratory approved by inspection authority	Stamping and completing Cumulative Slaughter Declaration prepared by slaughterer
8	Pork legs transferred to ham factories	Check Cumulative Slaughter Declaration and compliance with specification requirements
9	Processing started	Seal applied before salting and (Homologation document issued
10	Processing completed	Brand applied by Istituto Parma Qualità and certificate of conformity issued
11	Sale of ham pieces	Brand applied on each piece at authorised ham factories
12	Sale of pre-packaged slices	Brand applied to each package
13	Approval and identification of slicing and pre-packaging laboratories	Identification code assigned List of slicing and pre-packaging laboratories
14	Manufacturers of packaging materials	Contract for use of brand signed with Istituto Parma Qualità

Source: Arfini *et al.* (2003:9)

Table 5.3 shows all the stamps, seals and marks used by Consortium to support the traceability system and to guarantee high quality, true to origin Parma Hams.

Table 5.3: Stamps, seals and marks used by the Consortium to aid with traceability

Description	Stamps, seals and marks
Inedible stamp Identifying breeder Stamped upon each pig	
Hot iron brand Identifying slaughter Branded on each pork leg	P P SLAUGHTER-HOUSE'S IDENTIFICATION CODE
Seal applied to each pork leg before processing is started The relief seals shows the CPP initials and the date processing was started (month and year)	 MONTH AND YEAR OF BEGINNING OF
Brand to be applied to each pork leg at the end of processing It represents a five-pointed coronet Contains the company identification code.	 PRODUCER'S IDENTIFICATION CODE

Source: Arfini *et al.* (2003:8)

From the research done, it seems as if Parma Ham does not have future plans for improvements in the chain-wide traceability system.

5.2.3.4 Key findings

The Parma Ham label carries the message of quality Parma Ham from Italy produced by using traditional production methods. The intensive chain-wide traceability system present in the Parma Ham supply chain guarantees the quality, origin and traditional production methods of Parma Ham.

This brings about the following benefits for farmers, producers and consumers (Serra, 2007:10-11):

- Farmers and producers gain a price advantage if the origin and quality of Parma Ham can be guaranteed through a traceability system, to be sold at a higher price in the market
- The products produced by farmers and producers are protected from exploitation by Parma Ham imitations through the presence of proper chain-wide traceability systems and labelling
- The guarantee of the origin of Parma Ham contributes to sustainable rural development by safeguarding natural resources and traditional skills for generations to come
- Due to Parma Ham's quality, labels offer a unique marketing message about high value-added products, and consumers are not exploited by imitations when buying Parma Ham products.

5.2.4 The MeatCo beef chain – Namibia

Namibia is Africa's leading exporter of prime natural beef to supply markets around the world. Namibian farmers manage extensive natural farming systems that are in harmony with the natural environment. The free range cattle herds feed on sweet grasses and nutritious leaves, giving the meat a distinct flavour and dark colour (MeatCo corporate video, 2008).

The Meat Corporation of Namibia (MeatCo) purchases mainly free range cattle, free from antibiotics and growth hormones, from local farmers, to ensure a 100 % natural product. The MeatCo abattoirs are HACCP and ISO quality management system approved. MeatCo benchmarks its processes against the world leaders and is capable of delivering meat anywhere in the world (MeatCo, 2012a).

MeatCo has been the cornerstone of the Namibian Meat Industry for over 20 years. Since then it has developed world-class slaughtering facilities that deliver products of a consistently high quality to both local and international customers. Figure 5.4 illustrates the dimensions of the MeatCo organisational structure.

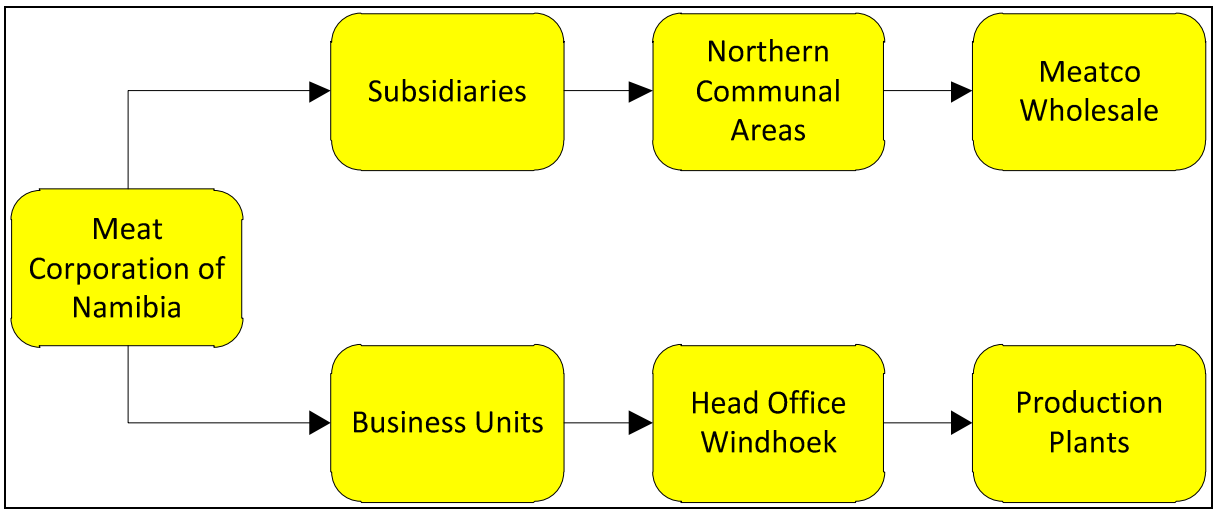


Figure 5.4: The organisational structure of MeatCo
Source: MeatCo (2012b)

5.2.4.1 The structure of the MeatCo beef supply chain

The key word in the Namibian beef supply chain is teamwork. The Namibian beef supply chain consists of supply chain members that are experts in their field with a passion for their product (MeatCo corporate video, 2008). This supply chain is laid out in Figure 5.5.

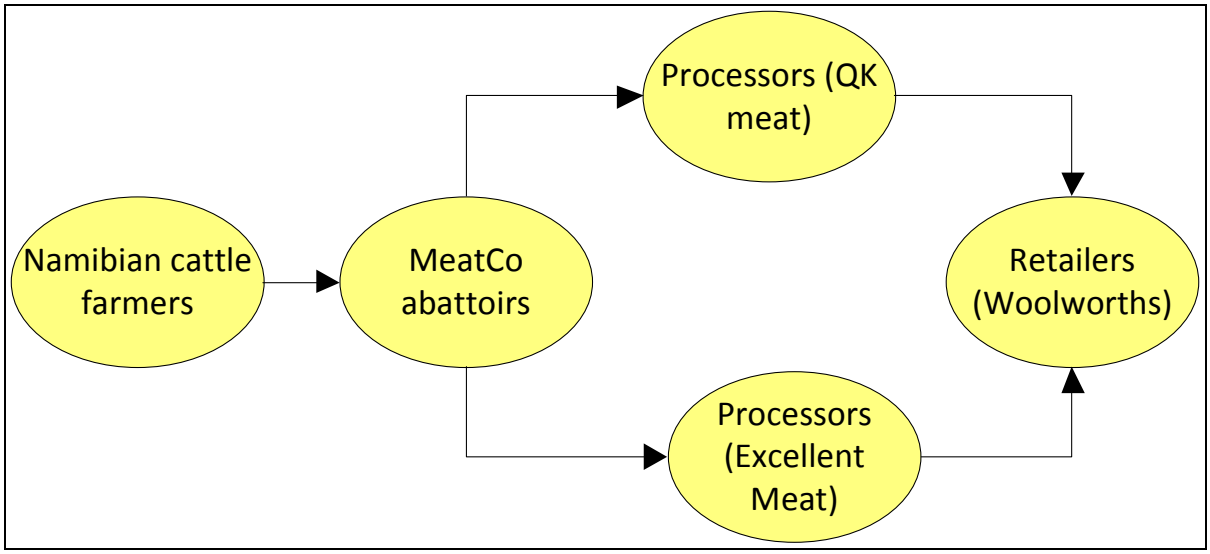


Figure 5.5: Namibia's farm assured beef supply chain (SA customer)
Source: MeatCo corporate video (2008)

5.2.4.2 The drivers for the implementation of the traceability system

Traceability is the backbone of the company and their strongest selling point. The chain-wide traceability system in the MeatCo supply chain is supported by the Farm Assured Namibian (FAN) meat scheme administered by the Meat Board of Namibia (MeatCo, 2010:4). The FANmeat scheme is a total meat quality assurance scheme focused on the consumer. Meat quality assurance is obtained through a process of inspections, monitors and record keeping certifying Namibian meat for the export market (Potgieter, 2012:7).

The main driver for the implementation of traceability systems in the Namibian beef supply chain is the requirements set by their European outlet markets as well as requirements set out by Woolworths, their South African outlet market. Traceability is extremely important to stay competitive in a highly competitive international market (MeatCo corporate video, 2008).

5.2.4.3 The workings of the traceability system

The Farm Assured Namibian meat scheme (FANmeat) is a world-class tracking system that provides traceability from farm to fork and aims to guarantee safe, healthy and quality products from the producer to the consumer. The farm to fork traceability system enables consumers to trace beef products back to the farm of origin (MeatCo corporate video, 2008).

Each farmer is required to use both ear tags and RFID tags as animal identification (Meat Chronicle, 2010:2). The farmer is furthermore required to register their cattle at the nearest Veterinary Service Officer by handing in an Animal Registration Card to register the cattle on the NamLITS (Namibian Livestock Identification and Traceability System) database. This should be done within 14 days of tagging. The ear tag number is also recorded in the farmer's documentation system. When the animal is ready to be marketed the animal's unique identification number is used by the abattoir when the animal is slaughtered. This unique number is used for the individual animal as it goes through the slaughtering and processing stages. This number can

then be used by consumers to track products back to the animal and farm of origin (MeatCo corporate video, 2008).

5.2.4.4 Possible future plans for the system

One of the mentioned future plans for the Namibian beef supply chain is investment in the expansion of personnel skills and knowledge to create a better more efficient supply chain (MeatCo corporate video, 2008). In terms of improving the traceability system FANmeat would like to incorporate the use of RFID tags for all animals and they want to extend the traceability system country wide (Toto, 2010:14).

5.2.4.5 Key findings

The benefits from the implementation of a proper chain-wide traceability system in the Namibian beef supply chain are (Toto, 2010:11-12):

- The industry's collective interests have been enhanced – traceability has led to access to European markets
- The Namibian cattle industry has gained a competitive edge – the unique traceability system and farming methods are what sets them apart from other beef producers, both in Africa and globally
- Protection of public interest such as animal health, public health and crisis management
- The farmers' access to finance has increased since they can put identified animals up as collateral
- On par census of animals enhances rangeland management
- Stock theft has decreased
- Market transactions have been facilitated and the purchasing and slaughtering processes have become more streamlined.

5.2.5 International supply chain summary

This review of international supply chains with seemingly good chain-wide traceability systems in place highlights the economic success of such operations.

There are certain strong similarities between the different supply chains:

- All products have some unique characteristics, be it the origin or production method
- Traceability systems are in place to protect either the origin or geographic indication of a product and/or the method of production
- By having chain-wide traceability systems in place, these supply chains gain a competitive edge in the local and international market
- Traceability systems therefore lead to value creation throughout the supply chain but it is not yet proven if they lead to value distribution.

It is evident from the discussion of preceding supply chains that transparent chain-wide traceability systems are present. This is not only possible but is a necessity to differentiate between supply chains in the same industry and to gain a competitive edge. The importance of having a transparent, chain-wide traceability system in place is even higher when it comes to marketing products with an origin guarantee.

Based on the supply chains discussed above that can successfully guarantee the origin of a food product by means of a traceability system and the Food Safety Authority of Ireland (2010), the following serves as a guideline for supply chains that need to guarantee the origin of a food product but do not have established transparency and traceability measures and systems in place.

5.3 GUIDELINES FOR THE IMPLEMENTATION OF A TRACEABILITY SYSTEM

All supply chain members must have horizontal and vertical traceability systems in place to achieve chain-wide traceability. Each member can decide on the process to follow to obtain horizontal traceability as long as they are able to collect, record and share the necessary information with upstream and downstream members. For successful supply chain traceability it is important to determine the scope of the traceability system in a specific supply chain, to identify the members involved in the supply chain and to clearly identify the boundaries of the traceability system. It is also important to map the physical flow of products between the different supply chain

members and describe their logistical hierarchy. This aids in identifying the physical locations, inputs, internal processes and outputs.

Figure 5.6 serves as a diagrammatic representation of guidelines for an organisation or supply chain to implement a traceability system and hence become transparent. This follows from the discussion of international supply chains that are able to successfully guarantee the origin of a food product by means of a traceability system and the Food Safety Authority of Ireland's Guidance Note on Traceability (2010).

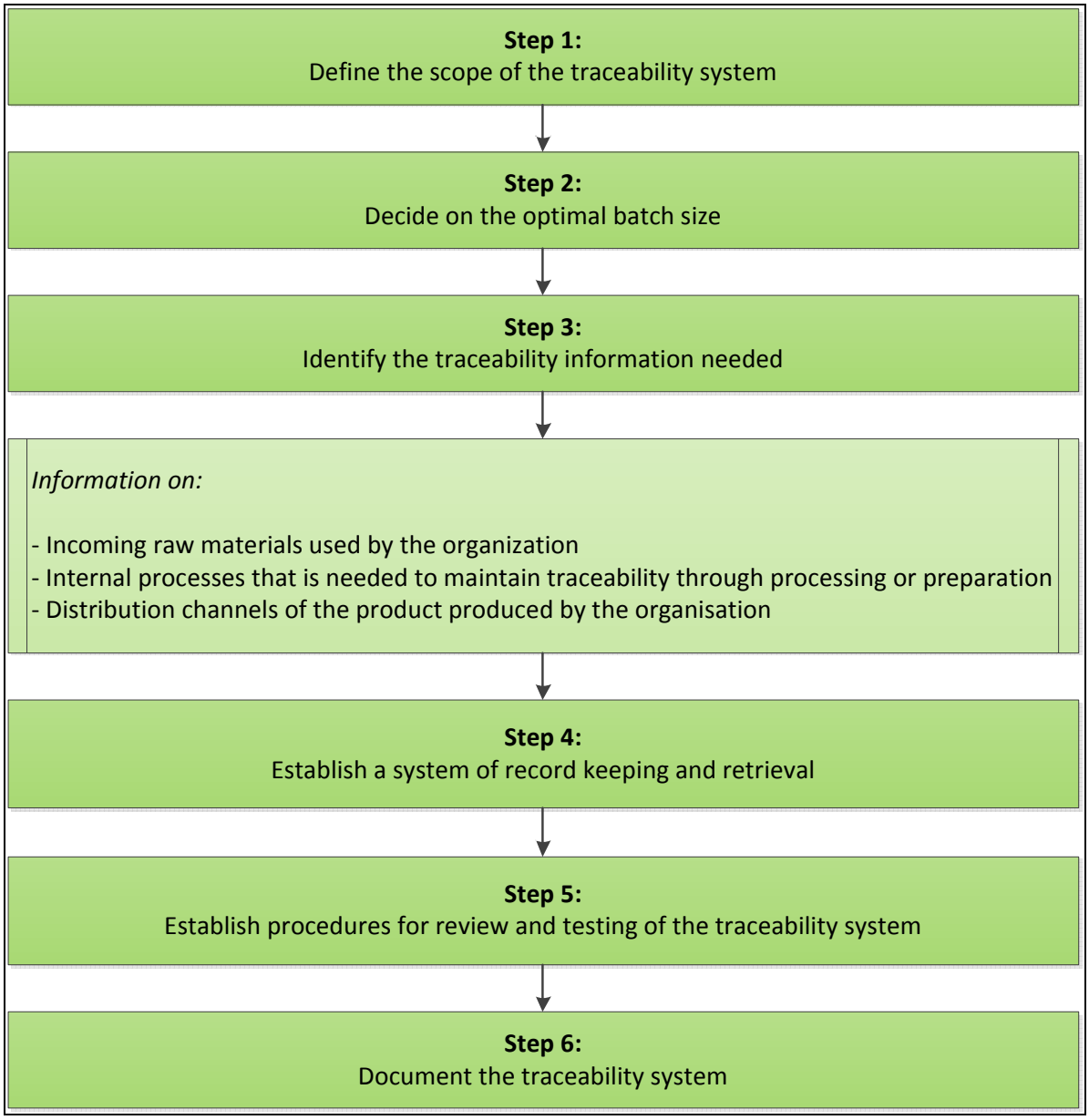


Figure 5.6: Guidelines for the implementation of a traceability system
Source: Food Safety Authority of Ireland, 2010

The subsections to follow will include a detailed discussion of Figure 5.6.

5.3.1.1 Define the scope of the traceability system

Organisations should plan, organise and define the scope of a traceability system before developing the traceability system. This includes determining how to assign, collect, share and keep traceability data, for example, paper-based, computer-based, web-based or a combination. This process should also determine how to manage connections between inputs, internal processes and outputs.

Depending on the nature of the organisation, the traceability system can either include or exclude the following elements:

- Supplier traceability, where information on the supplier of specific products should be captured as well as details pertaining to the production process of the supplied products
- Traceability of products and production processes within the organisation
- Customer traceability, where products should be traceable from the producing organisation to the immediate customer.

For a continuous traceability system, attention should be given to information sharing between the linkages of the three elements.

5.3.1.2 Decide on the optimal batch size

For good traceability, it is essential to establish batches of products and to be able to track these batches through the production stage to the immediate customer. The size selection of the batch is up to the organisation and is correlated with the risk profile of the organisation; the larger the batch, the higher the financial risk and the larger the exposure to reputational damage in the case of a recall or withdrawal. Care must therefore be taken not to include too many products in the batch as all those products will be recalled or withdrawn in the case of a food safety incident. It is therefore important to find a balance between the feasibility of the batch size and the

complexity of the specific traceability system used, given the organisation's risk profile.

5.3.1.3 Identify the traceability information needed

The organisations should establish what information is needed for the traceability system to function optimally. This should include information regarding inputs used in production, internal process information to maintain traceability throughout the production process and information regarding the distribution process. This information will depend, however, on the elements (supplier, process and/or customer traceability information) included in the scope of the traceability system.

Supplier traceability information

The following information should be captured with regards to suppliers of raw materials:

- Supplier name, address and contact details
- Nature and description of the food supplied
- Any supplier batch numbers
- Delivery date
- Confirmation of acceptance
- Number of packs in the case
- Weight of the packs if applicable
- Number of cases in delivery
- Lot number assigned to the delivery
- Details of the haulier and vehicle
- Cross reference to any in-house quality control records associated with the food or packaging supplied to the food business operator.

In turn, these suppliers should keep the following records and these should be available to the organisation on request:

- The name of the supplier
- The address of the supplier
- Nature of products supplied
- The date of each transaction or delivery.

Each incoming shipment of raw materials should carry an identification code, for example, a batch number, as a means of tracing it to the source of supply. If there is no batch number, the organisation should apply its own identification code as soon as the product is received.

Process traceability information

Each member of the supply chain should ensure that the ingredients and primary packaging used on the premises are traceable back to their suppliers.

At the processing stage, the following information should be captured:

- Each and every product in the product batch, unless the product is too small to attach an identification code
- The identification code on the outer case of the batch
- Internal process documentation associated with the product batch
- Records of the traceability codes of raw materials and packaging used in the production process of the product batch
- Records of production and quality and all the information regarding raw materials, packaging and process times to allow traceability to the finished product
- Examples of process traceability information are:

  – Product name
  – Product batch number
  – Date of production

  - Time of start and end of production
  - Time of start and end of production
  - Saleable unit size
  - Number of packs per cases
  - Number of cases
  - A means of linking the product batch number to raw material batches used in its manufacture.

More specific information can be found regarding the type of information gathered when the supplier is a sheep farmer or when the processor is an abattoir, and this is discussed in detail in section 3.3.2.

Wholesalers and central distribution centres are not involved in the manufacturing or preparation of food but they may be involved in the splitting of batches of products received into new product deliveries, which often involves mixed batches of products. In cases where batches are split and products of different sources end up in the same batch, it is important to keep the batch number with the specific product to ensure that traceability information is maintained throughout the supply chain.

Customer traceability information

Records of the dispatched food from the organisation to their destination should be captured. The following applies:

- Records of production and quality and all the information regarding raw materials
- The name, address and contact details of the immediate customer
- The name, address and contact details of the transport firm
- Container code
- Date of delivery or transaction
- Nature of products supplied
- A comprehensive inventory of the products being delivered:

  - Product name, nature and description

- Product batch numbers
- Number of cases
- Number of packs per case
- Supplier detail where necessary.

5.3.1.4 Establish a system of record keeping and retrieval

After the scope of traceability, the batch size and the point of information gathering is identified the organisation should determine what type of traceability system is to be used. The type of traceability system depends very much on the financial position of the organisation, the capacity of the production process, the skill level of the employees and the level of detail of information to be gathered.

As discussed earlier in this study, there are three general types of traceability system, namely:

- Paper-based traceability systems
- Excel-based traceability systems
- Sophisticated computer-based traceability systems.

As soon as a traceability system is chosen that will satisfy the needs of the organisation, the management team can then venture into the workings of the specific traceability system to start the implementation process.

The information mentioned in this section should be made available on demand to all members in the supply chain as well as to the competent authorities for a transparent, traceable supply chain. It is crucial that these traceability records are readily available and it should generally not take more than one business day to pull all the traceability records on a specific product. According to the Food Safety Authority of Ireland (2010), the speed at which an organisation should be able to pull traceability records depends on the risk posed by the product that is on the market, in the case of a food safety incident.

These traceability records should be maintained, depending on the perishability and the shelf life of the product. The longer the shelf life, the longer the traceability records should be maintained. In the case of meat products or products of animal origin, the Food Safety Authority of Ireland (2010) recommends maintaining the traceability records for at least three years.

5.3.1.5 Establish procedures for review and testing of the traceability system

A traceability system should be reviewed at least on an annual basis to ensure that it is delivering the required level of traceability. It should also be tested if accurate traceability records can be produced in a relatively short amount of time.

The traceability system should also be audited by means of a horizontal and vertical check and areas for improvement should be addressed. The horizontal assessment should consist of an audit of several batches at the same point in the process to ensure that all identification marks, codes and documentation are correct. The vertical check should follow several batches from the customer back to the supplier to ensure that the product can be traced back and that all identification marks, codes and documents are in order. These checks are more commonly known as ‘mock forward’ and ‘mock backwards’ traceability checks.

5.3.1.6 Document the traceability system

Proof that the traceability system has been maintained should also be kept on record. This should include the scope of the traceability system, the batch size, the information to be gathered, the type of traceability system used, the review and verification process, the upkeep and maintenance of the system as well as the staff and their roles and responsibilities in the traceability process. Proof of the traceability system is important for auditing purposes as well as staff training and traceability system upgrades.

5.4 SUMMARY

The main purpose of Chapter 5 is to discuss in detail the types of international supply chains’ traceability systems that can successfully guarantee the origin of a product.

By using the traceability systems that these international supply chains have in place as a norm, a set of guidelines are identified.

Chapter 6 is therefore dedicated to explaining the Karoo Meat of Origin Certification scheme in detail as well as the relevant specific supply chains and traceability systems in place. Furthermore, this particular certification scheme and its supply chains will be contrasted with the discussed international supply chains and their traceability systems.

CHAPTER 6

THE KAROO MEAT OF ORIGIN CERTIFICATION SCHEME

6.1 INTRODUCTION

In 2011, a system of auditing and certification was launched in an attempt to prevent exploitation of the Karoo as a concept and to be able to guarantee the credence attributes, such as origin of a product. The Karoo Development Foundation, a trust registered in early 2009, registered the Karoo Meat of Origin certification mark at the South African Companies and Intellectual Property Commission and at the DAFF under the Agricultural Products Standards Act (Act 119 of 1990). The certification scheme also complies with the Consumer Protection Act (Act 68 of 2008). The Karoo Meat of Origin mark qualifies as an approved protocol under the new labelling regulations that came into operation on 1 March 2012. These aim to prevent the use of “misleading descriptions” on product labels and require that quality descriptions, such as Karoo Lamb be used only in terms of DAFF approved protocol. The Karoo Development Foundation’s main aim through the registering of the Karoo Meat of Origin certification scheme is to protect and promote the Karoo region by acting as a custodian of the intellectual property rights that rest in the name Karoo (Kirsten, 2011:40).

6.2 THE STRUCTURE OF THE KAROO MEAT OF ORIGIN SUPPLY CHAIN

The major driver for the implementation of chain-wide traceability systems in the Karoo meat of origin certification scheme is to protect the image of the Karoo from members of society exploiting the marketing potential linked to the Karoo name. The implementation of traceability systems within the Karoo sheep meat supply chain ensure that consumers are guaranteed that sheep meat labelled as Karoo Lamb actually originates from the Karoo. By implementing a proper traceability system, all members of the supply chain benefit.

Farmers, abattoirs, processing plants, wholesalers, retailers, butcheries, delis and restaurants can apply to become certified members of the Karoo Meat of Origin scheme. After the application form and application fee are received by the governing body, the Karoo Development Foundation, the applicant is audited by an independent authority, the SAMIC. In this context, an audit is defined by Ramphal (2009:4) from the Red Meat Abattoir Association as "a systematic, independent and documented process of obtaining audit evidence and evaluating it objectively to determine the extent to which the audit criteria are fulfilled". Every farm, abattoir, value adding meat plant, butchery, wholesaler and retailer or restaurant should adhere to the following standards and requirements in order to pass the audit, as set out on the Karoo Meat of Origin website (2012a).

Farmers:

- At least two of the six Karoo shrub species mentioned earlier should be present on at least 60 % of the farm area used for grazing
- Pastures should be well managed to prevent over grazing and camps should be fenced with gates to control the movement of sheep
- Adherence to the Code of Practice of Good Stockmanship, Animal Welfare Practice and the Animal Protection Act (Act 71 of 1962)
- Sheep should feed freely from indigenous veld, and roam freely in sizable camps representative of the identified typical Karoo vegetation, and have access to clean, cold and fresh water
- The occasional use of supplementary feed (free from animal products or by-products) is allowed within reasonable measure
- When sheep are transported, trucks should not be overloaded and should be free from any hazards that may harm the animals
- Records of animals moved to abattoirs or between farms should be recorded
- Sheep carcasses classified into age classes: A, AB, B and C, fat classes 1 to 6 and carcass conformation 3 to 5 qualify for certification as Karoo Meat of Origin.

Abattoirs:

- Should be a sheep slaughtering abattoir in the Karoo
- Should be registered with the South African Red Meat Abattoir Association
- Traceability systems should be in place that are able to trace the carcass back to the farm of origin
- Carcasses should be safe, of consistent high quality and should meet all legal requirements as set out by South African law.

Value adding meat plant, butchery, wholesaler and retailer:

- Not limited to the Karoo region
- Should comply with the Food Premises Regulation
- Products should be safe, hygienically processed, of consistent high quality and should meet all legal requirements as set out by South African law
- Traceability systems should be in place that are able to trace the carcass back to the slaughtering abattoir and processing plant as well as the farm of origin
- The registered Karoo Meat of Origin label should be accurately applied to the packaging.

Restaurants:

- Not limited to the Karoo region
- Traceability systems should be in place that are able to trace the carcass back to the slaughtering abattoir, processing plant, wholesaler and retailer as well as the farm of origin
- Meat should be prepared hygienically in a clean environment to prevent contamination
- The registered Karoo Meat of Origin logo should be accurately represented on the menu.

Once the applicant has passed the audit, based on the above criteria, the Karoo Development Foundation awards a certificate stating the successful application of either farms or facilities. The applicant is thereby a proud member of the Karoo Meat

of Origin consortium, enabling them to use the Karoo Meat of Origin mark within the regulations of the Karoo Development Foundation.

The Karoo Meat of Origin certification scheme, under the governing body of the Karoo Development Trust, allows applicants the use of the certification mark only after they have been audited and certified. Trust, transparency, traceability and efficient coordination between farmers, abattoirs, transport contractors as well as wholesalers, retailers, butcheries, delis and restaurants are the pillars on which this certification scheme is built. In order to guarantee the integrity of the scheme, it is extremely important that certified members comply with the rules and regulation as set out by the Karoo Development Trust. The certification mark and the traceability systems that are in place guarantee the origin of Karoo meat and eliminate any doubt in terms of the credibility of the certification mark (Karoo Meat of Origin, 2012c). It is therefore obvious that traceability can be an important tool to help to establish the authenticity of food and to check that claims made by producers are true (Van Rijswijk *et al*., 2008:453).

6.3 CERTIFICATION POINTS IN THE KAROO MEAT OF ORIGIN SUPPLY CHAINS

The following section confers the three supply chains that currently exist in the Karoo Meat of Origin Certification scheme by means of process maps.

Figure 6.1, Figure 6.2 and Figure 6.3 illustrate the Karoo Meat of Origin supply chain, which includes sheep farmers, abattoirs, meat packers, retailers and consumers. With these process maps, different points of certification are identified and indicated by the Certified Karoo Meat of Origin logo. These points can also be referred to as critical control points in the traceability system, since these points indicate entities or processes where information flow can easily be disrupted or discontinued, but where information gathering and sharing and therefore traceability are of the utmost importance. This logo merely indicates that this particular supply chain member has had to apply, be audited and certified as a Karoo Meat of Origin member to be part of this prestigious supply chain. These process maps furthermore indicate the processes such as rearing, slaughtering, processing and packing as well as the

information that is gathered at each enterprise in the supply chain. The processes within and between the enterprises are independently governed by the Karoo Development Foundation, which oversees all the activities of the Karoo Meat of Origin scheme.

Figure 6.1 illustrates the Karoo Meat of Origin supply chain with the following certification points:

- Karoo sheep farmers
- Karoo sheep abattoirs
- Karoo sheep meat packers.

Figure 6.2 illustrates the Karoo Meat of Origin supply chain with the following certification points:

- Karoo sheep farmers
- Karoo sheep abattoirs with packing facilities.

Figure 6.3 illustrate the Karoo Meat of Origin supply chain with the following certification points:

- Karoo sheep farmers
- Karoo sheep abattoirs
- Retailers or butchers.

To summarise, this means that Karoo sheep farmers, Karoo sheep abattoirs, Karoo sheep meat packers or abattoirs with a packing facility as well as the retailer or butcher should be audited and certified to become a member of the Certified Karoo Meat of Origin supply chain.

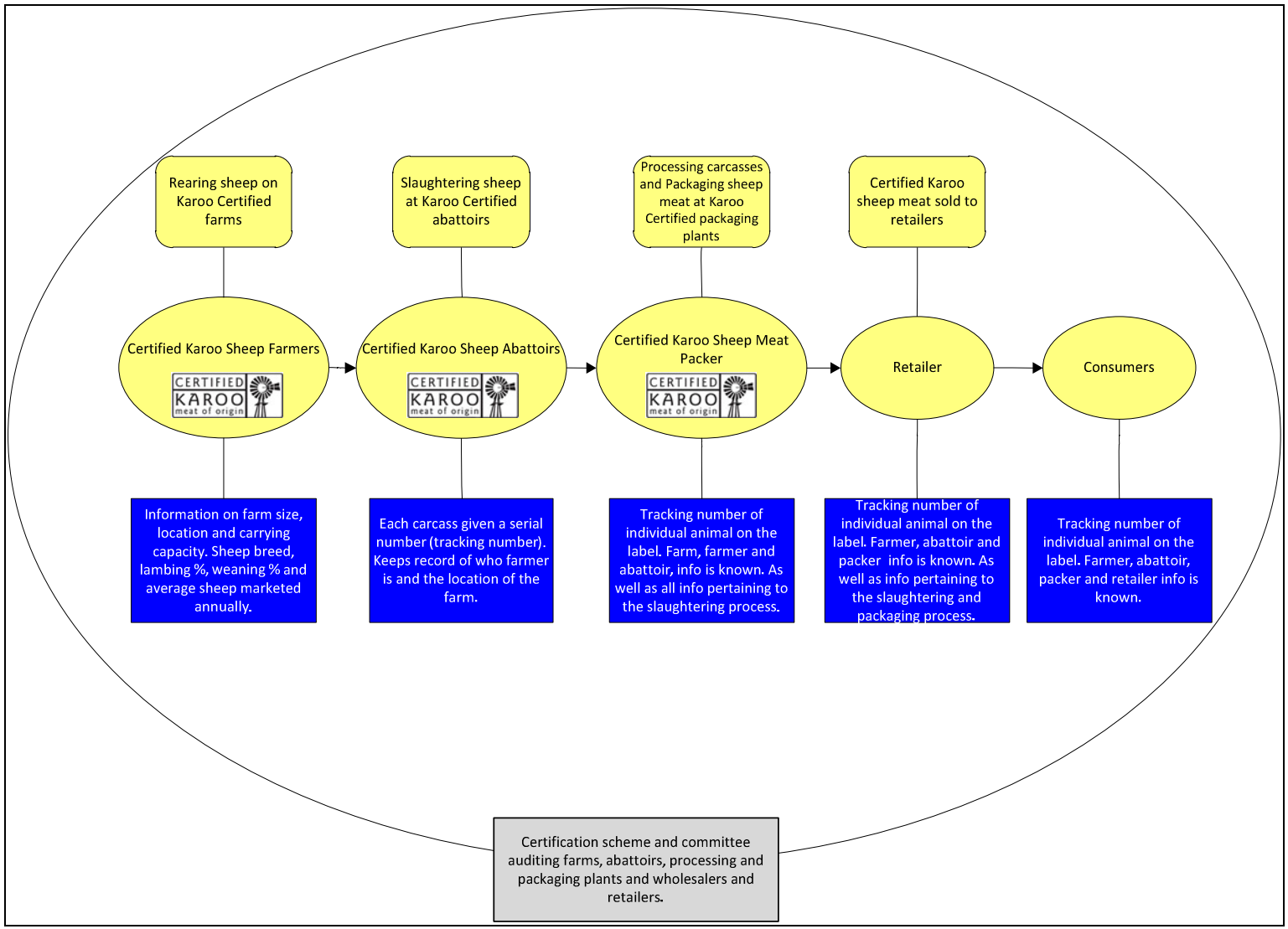


Figure 6.1: Three certification points: Farmer, abattoir and meat packer

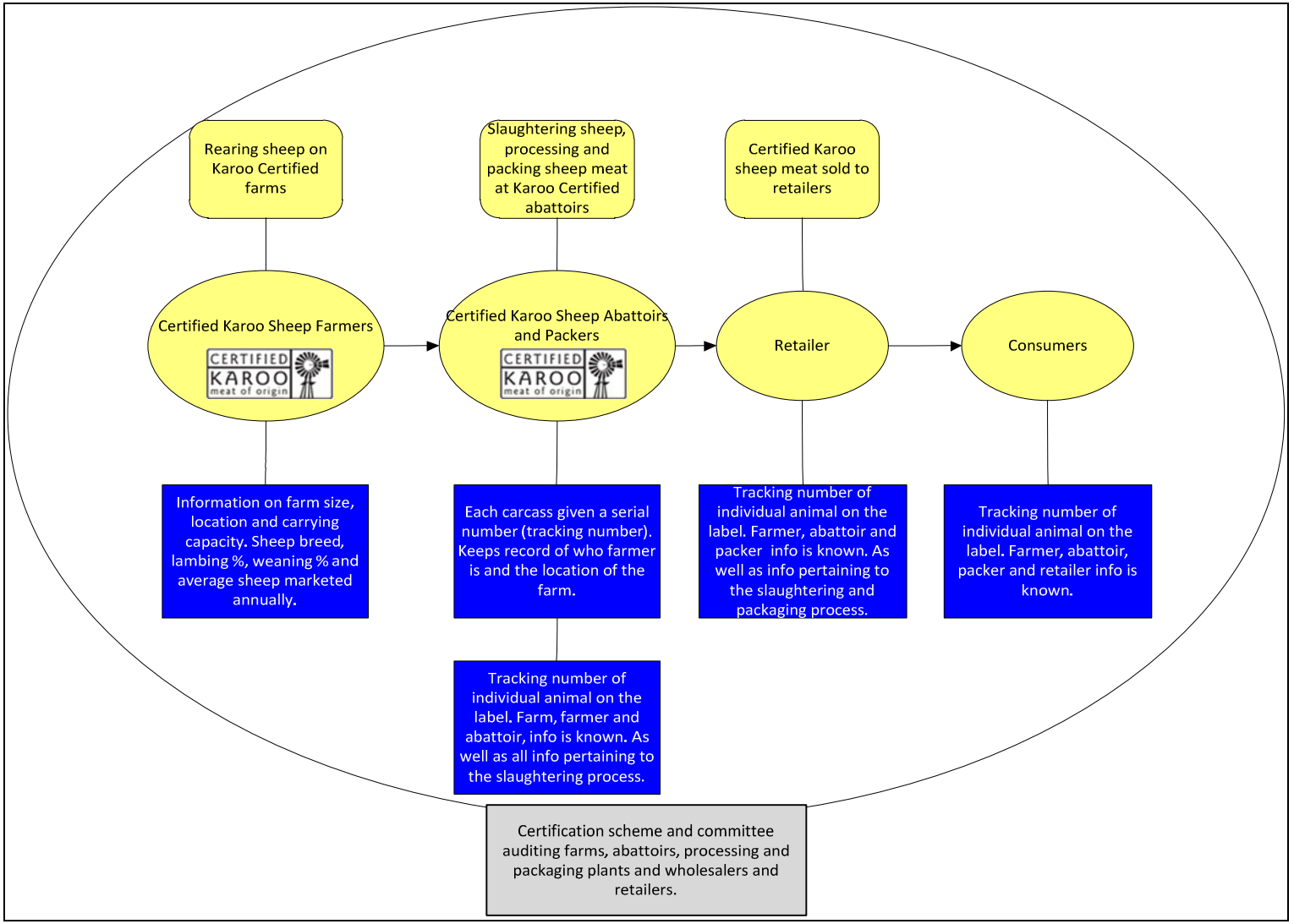


Figure 6.2: Two certification points: Farmers and abattoir with packing facility

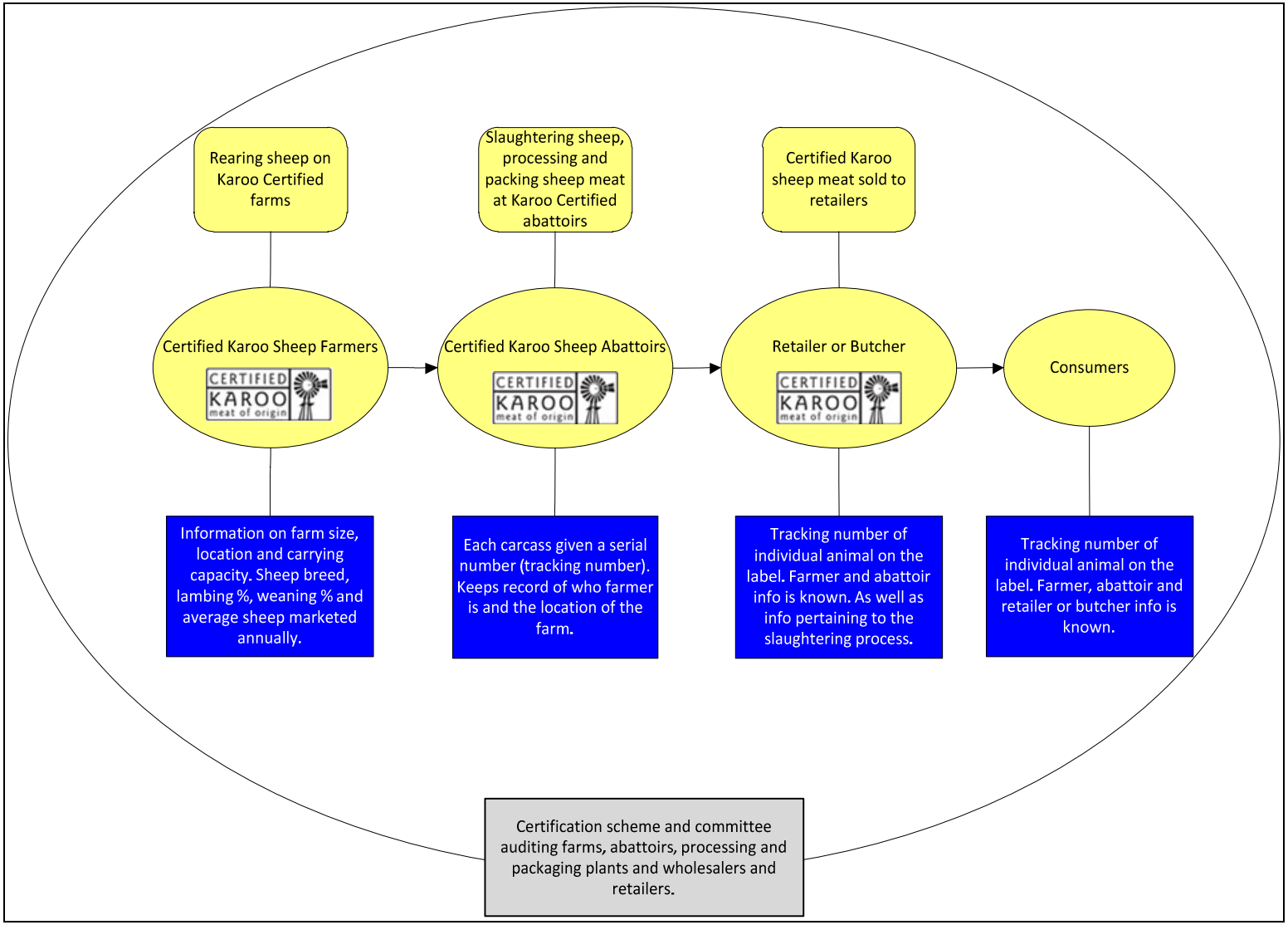


Figure 6.3: Three certification points: Farmers, abattoirs and retailer or butcher

To date (December 2012), 82 farmers, 163 farms, 2 abattoirs, 3 meat packers or processors and 13 restaurants and pre-packed product stores have been audited by SAMIC and certified by the Karoo Development Foundation and are proud members of the Karoo Meat of Origin family (Karoo Meat of Origin, 2012f).

6.4 THE WORKINGS OF THE KAROO TRACEABILITY SYSTEM

Sheep are offloaded at the abattoir into specific pens to separate batches of different farmers. Sheep that are offloaded at the abattoir should be accompanied by livestock removal and declaration of health certificates. By law (Animal Identification Act No 6 of 2002), all the animals should have an ear tag or a tattoo with an identification number and each farmer should have a completed livestock removal certificate to accompany the animals. The number of animals, age, gender and breed will then be noted by a member of the abattoir staff and a receipt note will be issued to the farmer or truck driver. This is to guarantee that the number of sheep loaded onto the truck on the farm was indeed offloaded at the abattoir and that sheep were not stolen along the way.

The batch of sheep received from the specific farmer will then be split into age, gender and breed categories, if they arrived in a mixed batch. These batches will then receive batch numbers. The animals should be well rested before slaughter and clean water should be provided in the pens. Each animal will be checked by a veterinarian for illnesses or medical conditions to make sure only healthy animals are slaughtered. In the case of a sick animal, an emergency slaughtering will be scheduled by the veterinarian. If a sheep arrives dead at the abattoir, a post-mortem check will be performed to identify the cause of death and to isolate all other sheep from possible illness.

From the pens, the sheep move to the abattoir for slaughtering and go through the slaughtering process, which includes (Refer to Figure 4.5 the abattoir process map):

- Stunning
- Killing
- Removal of the head

- Hide removal
- Evisceration
- Trimming and washing
- Carcass inspection
- Grading, classification, weighing and tagging
- Cooling of carcass

The sheep are kept in specific batches during the slaughtering process to keep the traceability system reliable. The batches are kept separate by hanging tags between batches. At the grading, classification, weighing and tagging stages, the carcass are tagged with a serial number. This includes the batch number, the number of the animal in the batch, a specific code assigned to the particular abattoir, the year, the week of the year, and the day of the week. For example: 2829115 (batch number); 2 (code for the specific abattoir), 8 (the year 2008), 29 (the 29th week of the year), 1 (Monday) and 15 (the specific sheep in the batch).

This serial number differs for most abattoirs. Some abattoirs have a batch traceability system where they use the same number for all sheep in a specific batch and others have a specific number to identify individual animals in a specific batch. Some abattoirs do not indicate the year, week and day and only use the batch numbers while others prefer as much detail in their serial number as possible.

The carcass tag with the serial number or batch number, abattoir name, abattoir telephone numbers and barcode is then affixed to the Achilles tendon. In the case of the Certified Karoo Meat of Origin abattoirs, a tag with the Certified Karoo Meat of Origin logo is also affixed to the same Achilles tendon (Figure 6.5) and a stamp is applied to the same leg where the carcass tag is affixed (Figure 6.4).

Figure 6.4: Karoo meat of origin stamp
Source: Kirsten (2012)

Figure 6.5: Karoo meat of origin carcass tags
Source: Kirsten (2012)

After the grading, classification, weighing and tagging processes, a slaughter list is compiled. This includes the slaughter date and in some cases the slaughtering time and the batch number, which indicates the farm and farmer of origin of every carcass as well as the number of sheep in every batch. Other information includes the agents

that bought the sheep, classification and grading information as well as the carcass weight. According to the participant abattoirs, the slaughter list comes in handy when farmers have queries in terms of carcass weights or grades of sheep slaughtered.

From the grading, classification, weighing and tagging stages, the carcasses are transferred to the chillers for cooling. Carcasses will be selected from the chillers, based on the FIFO method and sold to wholesalers, retailers or butcheries.

A total of 76% of the participant abattoirs have a forward traceability system in place. This system captures information regarding the carcass market outlet destinations (processing and packaging plants, wholesalers, retailers and butcheries) and the selling date of the carcass to the market outlet destinations.

On arrival at the processing and packaging plant, retailer butcher or butchery, the carcasses are again kept in batches to ensure a traceable system and to ensure that carcasses from the Karoo region are kept together during processing. When the meat is packed, the processing and packaging plant, retailer butcher or butchery affixes a label with the Certified Karoo Meat of Origin logo as well as a label with a barcode and information regarding the meat cut, and the price and weight of the packaged meat (Figure 6.6).

Figure 6.6: Karoo meat of origin product label
Source: Kirsten (2012)

Figure 6.6 and Figure 6.7 illustrate the label used for the Food Lovers' Market Karoo sheep meat products, which has the logo for the Certified Karoo Meat of Origin scheme on it.

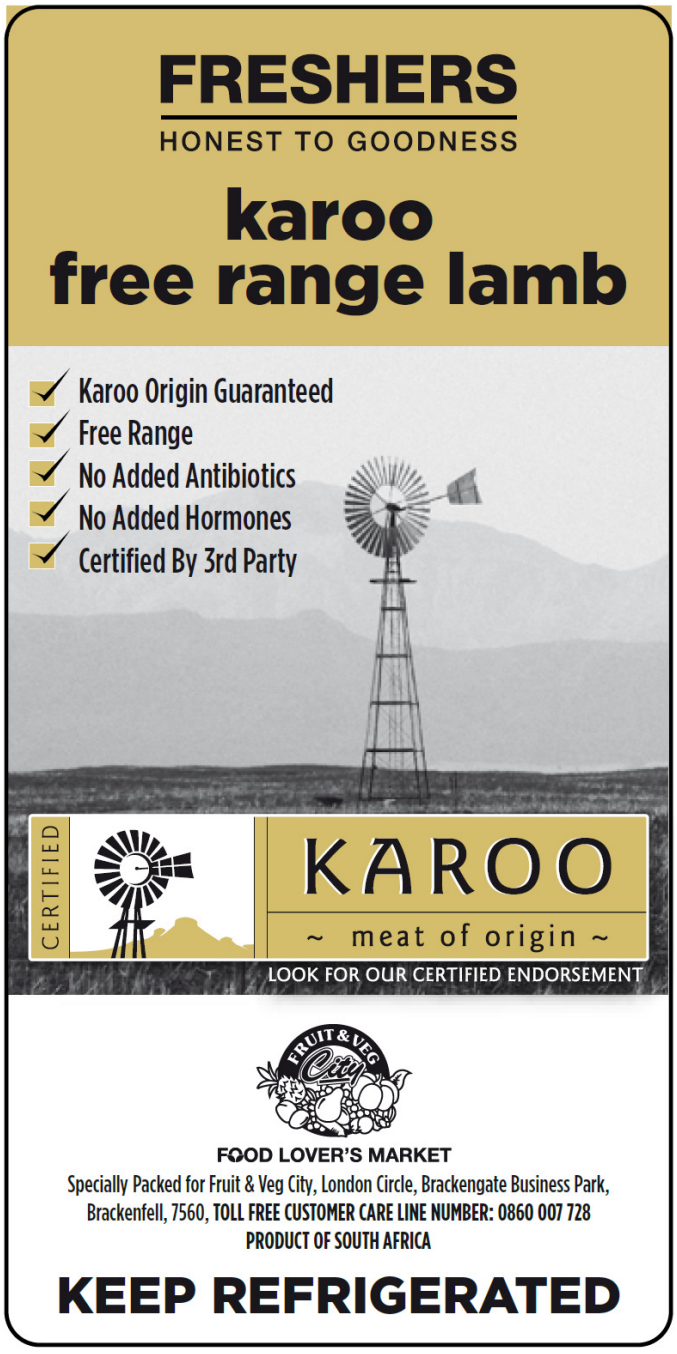


Figure 6.7: Food Lovers Market label
Source: Kirsten (2012)

This logo guarantees the following:

- The sheep meat originates form the Karoo region
- The sheep was reared as free range
- There are no added antibiotics or hormones.

These mentioned guarantees are certified by an independent third party: SAMIC.

Figure 6.8 illustrates the Certified Karoo Meat of Origin tracking and certification number label. This label is to be affixed to the product package. This label also includes information such as the type of sheep meat product, the price per kilogram, the sell-by date, the mass, the price, a barcode, a Quick Response (QR) code that will take you to the Karoo Meat of Origin Website, as well as information on how to use the tracking and certification numbers.

Figure 6.8: Tracking and certification number label
Source: Kirsten (2012)

The Karoo Meat of Origin scheme is in the process of establishing a transparent, web-based, chain-wide traceability system like that of the VanDrie veal group. With such a system, any consumer with access to the internet can go to www.karoomeatoforigin.com (Figure 6.9), enter the unique certification or tracking number found on a Karoo sheep meat product package and have a digital introduction to the farm of origin, the abattoir, packer or processor.

Figure 6.9 illustrates the Certified Karoo Meat of Origin website that can be used by consumers to trace their Karoo sheep meat product back to the farm of origin or the abattoir, processor or packer. The circled section of the webpage is a space where the tracking or tracing number on the pack of Karoo Lamb meat cuts (Figure 6.10) can be typed in.

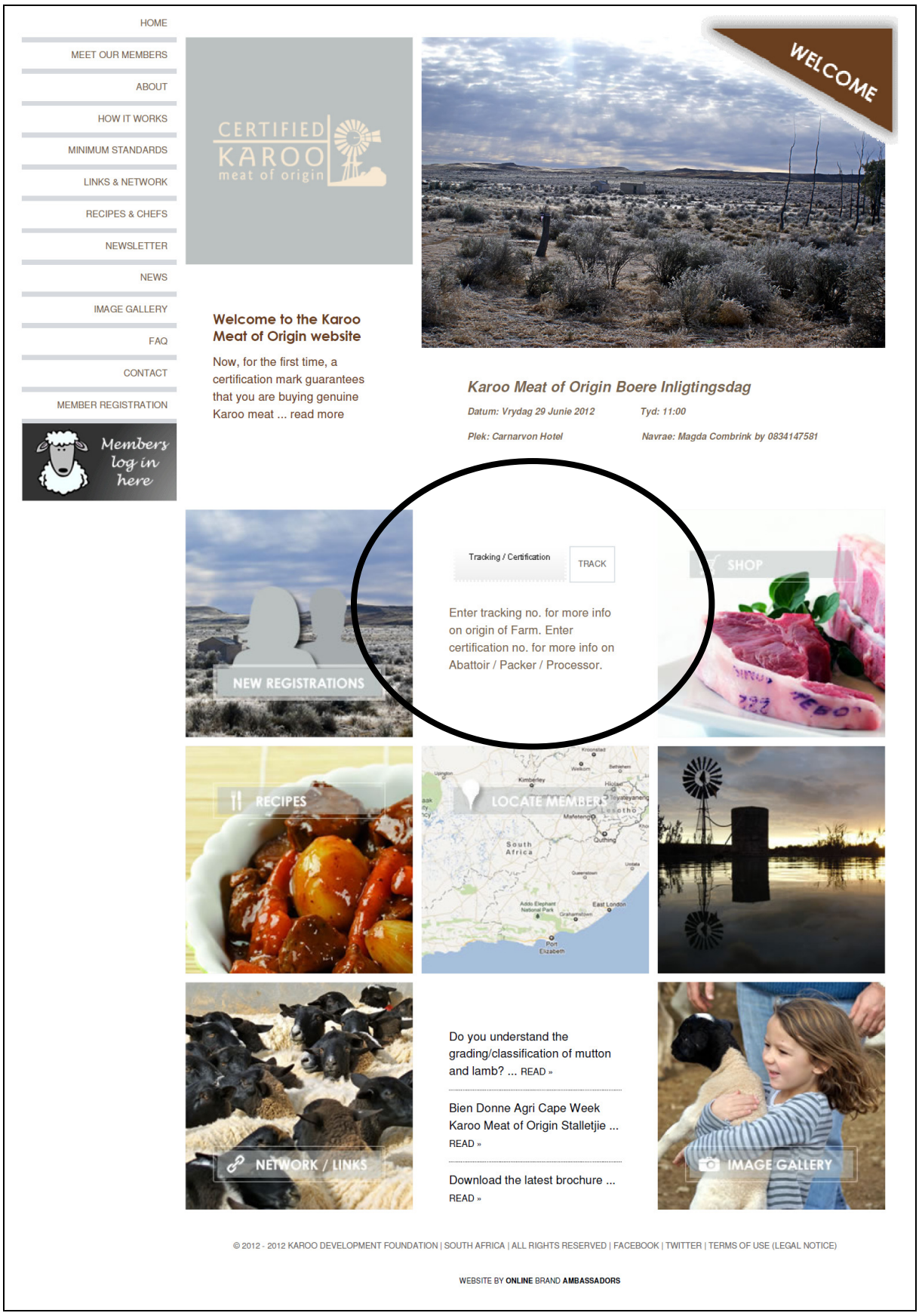


Figure 6.9: Karoo Meat of Origin website homepage
Source: Karoo Meat of Origin (2012d)

This specific pack of Karoo Lamb meat cuts (Figure 6.6) can be tracked back to the abattoir or processing and packaging plant by using the certification number or tracked back to the specific farm where the animal was reared by using the tracking number. (In Figure 6.10 the tracking and certification numbers are encircled).

Figure 6.10: Karoo Lamb label with tracking and certification number

Source: Kirsten (2012)

During the tracking process, information about the abattoir, processor or meat packer such as location, history, slaughtering process and standards that are in place at the abattoir and photos can be viewed by using the certification number on the label. By using the tracking number, information on the farm, such as the location, history of the farm and farmer, sheep rearing process, sheep breed as well as photos of the farm and operations can be viewed.

6.5 FUTURE PLANS FOR THE KAROO TRACEABILITY SYSTEM

December 2012, it has been just more than a year ago since the first certified Karoo Lamb carcasses were sold and from July 2012 certified Karoo Lamb was available on the shelves of the Food Lovers Market outlets in the Western Cape. To date, October 2012, 1 430 Karoo lambs (the A2 (63.4%) and A3 (35.9%) grade) were sold under the Karoo Meat of Origin certification mark. Farmers who sold their lambs under this certification mark got a R2 premium on the normal per kilogram producer price. These premium prices ranged between R43.00 and R47.50 averaging at R44.95 per kilogram (October 2011 – October 2012).

It is expected that 84 farmers, 165 farms and more than 700 000 ha of Karoo land will be part of the Karoo Meat of Origin certification family by the end of December 2012 (Table 6.1).

Table 6.1: Karoo Meat of Origin membership status

	Members	Applied – Not yet audited	Total
Producers	82	2	84
Farms	163	2	165
Abattoirs	2	2	4
Packers	3	2	5
Restaurants and retailers (selling pre-packed lamb)	13	-	-
Total certified members	**87**	**Potential 6**	**93**
Total members	**100**	**Potential 6**	**106**

Source: Karoo Meat of Origin, 2012f

In the near future Karoo Meat of Origin would like to have all Karoo lamb farmers, abattoirs slaughtering Karoo sheep, as well as delis, restaurants, hotels, butcheries, wholesalers and retailers, selling Karoo Lamb, as certified members of the Karoo Meat of Origin certification scheme.

Karoo Meat of Origin plans to sell their product not only in the already registered restaurants and pre-packed product stores but also at the major retailers across South Africa. To date (December 2012) GWK De Aar abattoir supplies certified Karoo Lamb to Food Lovers Market outlets in the Western Cape and Kings Meat Deli in Gauteng. Plans are underway to make Karoo Lamb available at the Food Lovers Market branches in the rest of South Africa.

Section 6.6 will be dedicated to comparing the guidelines based on the international supply chains in section 5.3 with the Karoo Lamb supply chain.

6.6 COMPARING GUIDELINES

The guidelines identified in section 5.3 are summarised as six steps in Figure 5.6. The steps include defining the scope of the traceability system, deciding on the optimal batch size, identifying the traceability information needed, establishing a system of record keeping and retrieval, establishing procedures for review and testing of the traceability system and documenting the traceability system. The research described in Chapter 6 shows that these steps are indeed followed by the Karoo Lamb supply chain. It is therefore concluded that the Karoo Lamb supply chain is on par with the traceability systems to guarantee origin-based products in the international supply chains discussed in Chapter 5.

6.7 SUMMARY

Even though the Karoo Meat of Origin certification scheme still has a long way to go compared to the established traceability systems implemented by the VanDrie group veal supply chain in the Netherlands, the beef supply chain in Ireland, the Parma Ham supply chain in Italy and the MeatCo beef chain in Namibia, it remains one of the few chain-wide traceability systems implemented in the South African meat industry. The Karoo Meat of Origin certification scheme's main goal is in direct relation to the objectives of this study, to protect, manage and govern the food of origin attributes of Karoo sheep meat, and this is exactly what the traceability system that they have in place guarantees.

Chapter 7 follows, with concluding remarks and recommendations for future studies.

CHAPTER 7

CONCLUSIONS AND RECOMMENDATIONS

7.1 INTRODUCTION

In a consumer driven world consumers want to feel a connection between the product that they are consuming and the origin of that product. This connection requires traceability systems. These traceability systems ensure a guarantee of the product's origin attribute. The main purpose of this study is to assess current traceability systems implemented in the South African sheep abattoirs thereby establishing their ability to guarantee the origin of a carcass. Research indicated that the South African sheep abattoirs have traceability systems in place and can guarantee the origin of a meat product. The descriptive analysis and hypothesis tests identified the tipping factor for the implementation of a traceability system as the retail markets to which abattoirs deliver their product. However, traceability systems at all levels of the sheep meat supply chain should be evaluated to test the readiness of the industry to guarantee the origin of a meat product.

7.2 REVISITING THE RESEARCH OBJECTIVES

Proper traceability and certification systems need to be in place to try to prevent the exploitation of the Karoo concept and to be able to guarantee the credence attributes, such as origin of a product. These traceability systems should at least be able to capture information regarding the origin, the producer, the sheep rearing process, the slaughtering process in the abattoir, the procedures and processes during cutting and deboning at the processing plants and the packaging and labelling of sheep meat cuts as well as information regarding the movement of the product along the supply chain, to guarantee a traceable high quality product and ensure consumer confidence in the product. Traceability is therefore basically a proactive approach to origin guarantees, food safety and quality management as it requires pre-incident investment in the form of auditing.

Traceability is often lacking at various stages in the sheep meat supply chains in South Africa, this hampers the quality guarantee and maintenance of chain wide traceability systems from the sheep production farm to the sheep meat consumer. The weak links (supposedly abattoirs and meat processing plants) in terms of traceability in the sheep meat supply chain are mainly due to the role players' strategies to minimise costs and to maximise profits. In doing this, important measures to ensure the basic value, quality of sheep meat products and credence attributes are generally bypassed to cut seemingly unnecessary costs.

The study had the following overall objectives:

- To assess current traceability systems in the red meat industry and to establish their ability to guarantee the origin of a carcass
- To develop a model and subsequent recommendations towards establishing an effective traceability system within the Karoo sheep meat supply chains in South Africa, that will protect, manage and govern the food of origin attributes of Karoo sheep meat.

The following specific research objectives were investigated:

- To create a high-level process map with information flows of the current South African sheep meat supply chain, specifically the Karoo sheep meat supply chain
- Within this high-level process map, the flow and destination of Karoo sheep meat products is identified
- The process map also shows the information flow within the Karoo sheep meat supply chain
- To develop a detailed description of current and potential traceability systems applied to Karoo sheep meat supply chains, with specific reference to the level, breadth and depth of these traceability systems
- To establish whether the Karoo sheep meat supply chain's traceability systems are in line with best practices
- To identify critical control points within existing and potential Karoo sheep meat supply chains to maintain the integrity of the product

- To investigate the factors that might influence the decisions and ability of Karoo sheep abattoirs and processing plants to implement improved traceability systems
- To develop recommendations towards establishing an effective traceability system in the Karoo sheep meat supply chains in South Africa that protects, manages and governs the 'food of origin' attributes of Karoo sheep meat
- To test the role-players within the Karoo sheep meat supply chain's opinions and/or perceptions towards these recommendations to establish an effective traceability system.

During the study the following hypotheses was used to test, by means of the Fisher's exact test, the variables that would possibly influence the implementation decision of traceability systems. The hypotheses, independent variables, description of the hypotheses as well as the expected outcome and conclusions are summarised in Table 7.1.

Table 7.1: Independent variables, expectations and hypotheses

Nr	Independent Variable	H_0: $\theta = 1$ (Independence)	Expectation	H_a: $\theta > 1$ (Positive Association)
1	Size	The presence of a traceability system is independent of the size of the abattoir.	Larger abattoirs are more likely to have traceability systems in place.	The proportion of abattoirs with traceability systems is higher among large abattoirs.
2	Capital level	The presence of a traceability system is independent of the capital of the abattoir.	More capital intensive abattoirs are more likely to have traceability systems in place.	The proportion of abattoirs with traceability systems is higher among capital intensive abattoirs.
3	Market outlets	The presence of a traceability system is independent of the market outlet of the abattoir.	Abattoirs that deliver their product to retailers are more likely to have traceability systems in place.	The proportion of abattoirs with traceability systems is higher among abattoirs delivering to retailers.
4	Presence of HAS	The presence of a traceability system is independent of the presence of a HACCP system at the abattoir.	Abattoirs that have HACCP systems in place are more likely to have a traceability system in place.	The proportion of abattoirs with traceability systems is higher among abattoirs that have HACCP in place.
5	Vertical integration	The presence of a traceability system is independent of vertical integration up and down from the abattoir.	Abattoirs that are vertically integrated up or down in the supply chain are more likely to have traceability systems in place.	The proportion of abattoirs with traceability systems is higher among abattoirs that are vertically integrated.

7.3 CONCLUSION

From the aforementioned it is clear that traceability systems play an integral part to guarantee the origin as well as the safety of a food product. The South African sheep meat industry's abattoirs have the ability to guarantee the origin of a meat product such as Karoo Lamb by means of their traceability systems. From the interviews and completed questionnaires, it was clear that most (92%) of the participant abattoirs in South Africa and possibly abattoirs in general have proper traceability systems in place. This makes it possible for them to at least distinguish between batches from different farmers and therefore possibly from different regions.

The research however showed that the participant abattoirs were unsure if traceability systems are indeed a requirement by government. Only one participant abattoir mentioned that the requirement for traceability systems was indeed indicated in the Meat Safety Act of 2000. This comment could as of yet not be supported by other participant abattoirs. It is therefore important that the vagueness of this point is stated more clearly in the Meat Safety Act of 2000.

When comparing the Karoo Meat of Origin supply chain to the international supply chains and their traceability systems, the Karoo Meat of Origin supply chain stood its ground and compared well with the web-based system of the VanDrie veal group in the Netherlands. During the research, it was found that the Karoo Meat of Origin supply chain is indeed able to market and deliver products with an origin guarantee.

A chain-wide traceability system is considered a competitive factor, as it provides consumers with information about the production process of a specific product. It also connects the consumer with the region of origin of that product. These systems therefore improve the reputation of the company and supply chain as well as the products they supply. What is worrying is the fact that very few of the surveyed abattoirs are aware of the financial implications (costs and benefits) for their business enterprise when implementing a traceability system.

Other economic benefits such as a reduction in transaction costs, an increase in trust up and down in the supply chain and contract facilitation (Table 2.3) were not even

mentioned by the participant abattoirs. It is for this reason that a proper cost benefit analysis cannot be done to determine the real economic impact on the sheep meat industry if traceability systems were to become mandatory in future. Information and perhaps workshops for abattoirs to aid them in understanding the costs and benefits as well as the importance of the implementation of a traceability system are therefore long overdue. Only when the abattoirs are aware of the financial implications can a proper cost benefit analysis be done and can added value gained from the implementation of a proper traceability system be distributed fairly throughout the specific supply chain.

The fact that 92 % of the participant abattoirs had traceability systems in place, even though they were uncertain about the economic implications of these systems was interesting. Research showed that only 33 % of abattoirs knew their exact costs. In total, 97 % of abattoirs were certain that they carried all the costs of implementing a traceability system, while 75 % of the participant abattoirs were convinced that all the benefits of a chain-wide traceability system fall to the consumer. This did not make sense from an economic viewpoint. Why would an abattoir carry the cost of implementing a traceability system if most of the benefits fall to the consumer?

The main reason why abattoirs had traceability systems in place soon came to light: retailers require traceability systems before an abattoir is even considered as a supplier to a retailer. Consequently, 95 % of retail delivering abattoirs had a traceability system in place. This statement is supported by applying Fisher's exact test to the study's findings. This test concluded that hypothesis 3 (that the proportion of abattoirs with traceability systems is independent of the outlet market) can be rejected at a 5 % level of significance. This means that the fact that an abattoir delivers to a retailer significantly affects its traceability system implementation decision. This also shows the tremendous power that retailers have in the sheep meat supply chain. The 2 (5 %) retail delivering abattoirs with no traceability systems in place were both situated in remote rural areas. Retailers in these regions had little choice other than to buy from these abattoirs, as the next best abattoir might be several hundred kilometres away.

At the abattoir level, the traceability systems are quite easily implemented; it is much easier to trace a single carcass in an abattoir than to trace different pieces of one carcass in the processing plant. Since this study did not include the downstream tiers, meat processors, packers, wholesalers and retailers, it is not possible to conclude that the entire South African sheep meat supply chain can guarantee a product's origin in the case of Karoo Lamb. The integrity of these role players will play a tremendous role in the Karoo sheep meat supply chain's ability to guarantee the origin of a sheep meat product, especially when sheep carcasses are moved outside the Karoo boundaries for processing.

In the case where Karoo and non-Karoo carcasses arrive at the same processing and/or deboning plant and there are not enough Karoo Lamb cuts to fill a package, it might be tempting for the plant to add one or two non-Karoo Lamb cuts to the package, hoping that the difference between the meat cuts will not be noticed. For this reason, it might be better for the entire Karoo sheep meat supply chain to remain in the Karoo region. However, keeping the Karoo sheep meat supply chain in the Karoo brings about its own set of challenges. The shelf-life of meat cuts is limited and creates logistical difficulties, especially when these fresh meat cuts travel beyond Karoo boundaries. Furthermore, even though sheep are slaughtered, processed and packed and transported from the Karoo to the various offset points, it is not always feasible for abattoirs in the Karoo to fill their slaughtering capacities or meet customer demand only with certified Karoo sheep. During the recent Rift Valley fever crisis, abattoirs were forced to source sheep further than the normal Karoo boundaries, sometimes even as far as 400 km from the abattoir, which in some instances fell beyond the Karoo boundaries. It is therefore clear that the downstream tiers play a vital part in the South African sheep meat industry in terms of traceability and transparency in order to guarantee the origin of a sheep meat product such as Karoo Lamb.

7.4 RECOMMENDATIONS

When doing survey research with categorical data, it is recommended that the population be thoroughly evaluated before the research process is underway. Only after the random sample was drawn it was noted that, based on the list from the

RMAA, some of the abattoirs listed as in the population did not exist anymore. Of a possible 55 participant abattoirs drawn, only 39 responded positively; 12 of the 16 that did not respond did not exist anymore and 4 of the 16 were unwilling to participate. This created problems during the statistical analysis. It is therefore important to first establish whether every possible participant in the population is still in operation before the sample is drawn. It is also important to look into the tests that are considered for hypothesis testing before the questionnaire is set up or the interview process begins. This will ensure smooth sailing in terms of doing the statistical analysis.

In the study by Bulut and Lawrence (2007), a logistic regression model, an ordered logit equation for binary response variables, was used to determine what characteristics of an abattoir were the drivers for the traceability system implementation decision. This method was considered for this study but due to the relatively small sample, there was not enough variation in the data and the logit model could not be used to statistically test the hypotheses. Due to financial and time limitations, it was not possible to expand the sample to provide for enough variation to use the logit model.

During the study, quite a few statistical methods were considered for hypothesis testing. Initially, based on previous studies on similar subjects (survey research with categorical data), the Chi-squared tests were considered to determine possible relationships between the dependent variable and the independent variables. However, after further research it came to light that one of the assumptions for using Chi-squared tests is that the expected frequency for each cell should be larger than 5. In a case where this assumption is violated, it is recommended that the Fisher's exact test is used as the results are more accurate. With this study, most of the cell frequencies are between 1 and 5 due to the small sample. Statistical analysis therefore required the Fisher's exact test. The Fisher's exact test is consequently recommended for small sample survey research with categorical data, especially when cell frequencies are less than 5.

As mentioned earlier, a proper cost benefit analysis is long overdue. However, during the study it was discovered that abattoirs need to be educated first in terms of the

costs and benefits of the implementation of a traceability system before a cost benefit analysis can be done. A proper cost benefit analysis will enable abattoirs as well as other members in the supply chain to understand the real cost implications, but also to understand the benefits and possibly position themselves to take advantage of the competitive edge gained by the implementation of proper chain-wide traceability systems. By understanding the economics of traceability systems, abattoirs can possibly develop strategies to spread costs throughout the entire supply chain to reduce cost pressures on their already vulnerable profit margins. Traceability systems can furthermore enhance competition levelling the playing field between different supply chains in the sheep meat industry.

Even though some of the downstream role players in some of the sheep meat industry's supply chains were analysed to some extent, this study was based intensively on the sheep slaughtering abattoirs in the sheep meat supply chain. It is the responsibility of the entire supply chain to commit to delivering safe meat products and in some cases origin guaranteed products. However, traceability downstream in this particular supply chain should also be studied in detail to gain a comprehensive understanding of the ability of the entire supply sheep meat supply chain to guarantee safe or origin-based meat products. It is therefore proposed that a similar study be conducted, especially at the wholesale, meat processing and retail tiers downstream in the supply chain to determine the readiness of the chain to guarantee the origin of a product like Karoo Meat of Origin and to convey a specific message to the consumer, in order to gain real competitive advantage.

For reasons stated in this study it is recommended that:

- Government update the list of existing abattoirs in South Africa
- Government update the Meat Safety Act of 2000 to clarify if having a traceability systems is a requirement of the Act or not and to ensure the Act ís enforced
- A responsible party is appointed to educate supply chain members in terms of the importance of traceability systems especially in terms of economic costs and benefits

- A governing body is appointed to monitor and regulate the sheep meat supply chains for compliance with traceability systems to ensure origin guaranteed and safe products to the consumer

The South African sheep meat industry and its abattoirs have the ability to guarantee the origin of a meat product such as Karoo Lamb by means of their traceability systems. There is however, aside from the Karoo Meat of Origin certification scheme, no governing body to monitor and regulate the implementation of traceability systems in the sheep meat supply chains. This result in an uneven playing field and abattoirs that have traceability systems in place, that has lower profit margins because of this, fights a losing battle competing against abattoirs with no traceability systems in place.

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APPENDIX

DATE	2	0	1					

Participant's number					
For office use only	V1	1	2	3	4

SURVEY – Traceability in sheep meat supply chains

Dear participant

Thank you for your willingness to complete this survey. The purpose of the survey is to gain a better understanding of the current and potential traceability systems applied to sheep meat supply chains in South Africa. The survey should not take more than 60 minutes to complete. This is a confidential survey and the answers you provide will be used for research purposes only. Data analysis will be based on pooled results from the total sample.

Please answer <u>all</u> questions. There are no right or wrong answers. The researcher are interested in understanding the detail surrounding sheep meat supply chains, where the supply chain in this case, consists of the sheep producing farms, the abattoirs and/or processing plants, the wholesalers and the retailers.

The questionnaire will be referring to 'level', 'breadth' and 'depth' of sheep meat supply chains, which can be defined as:

- ***Level*** of traceability refers to the way in which a product can be traced back or forward within a supply chain. Three levels exist: genetic, farm to retail and batch traceability. Genetic traceability refers to taking DNA samples from carcasses to locate the records of the animal. Farm to retail traceability refers to the ability of the system to track the identity of all cuts from a farm through the processing and distribution channels. Batch traceability is the traceability from farm up to carcasses without further tracking on the cutting floor – the identities of the source are maintained at the batch level.
- ***Breadth*** of traceability refers to the amount of information the traceability system record, for example the attributes (contact or production information such as free range, organic, Karoo certified, grain fed etc.) that are recorded for each product.
- ***Depth*** of traceability refers to how far back or forward the traceability system is able to trace or track an item for example from the abattoir to auction, feedlot or sheep farm.

Where the supply chain starts at the production farm level and ends at the consumer or retail level.

<u>PARTICIPANT INFORMATION</u>:

Company:	
Participant's title, name, surname:	
Position in company:	
Phone number:	
Email address:	

Q1 What is the ownership structure of the abattoir or processing plant? For example, independent ownership or group (corporate) ownership?

Q2 Is the abattoir vertically and/or horizontally integrated and to what extent? For example, does the abattoir owner(s) also own sheep farms and or wholesalers? OR is the abattoir part of a group of abattoirs?

Q3 Please indicate the abattoir or processing plant activities **(You can select more than one option)**.

Slaughtering (only slaughtering)	Processing (Cutting and all other forms of processing)	Distribution (Transport from the abattoir to the next supply chain member)	Other: Please specify ....

Q4 Please indicate the share of the different meat types in the abattoir or processing plant's total annual production processes as a percentage of total meat slaughtered.

Meat type:	**Share**	**%**
Sheep		**%**
Beef		**%**
Pork		**%**
Other		**%**
TOTAL	**100**	**%**

Q5 Please indicate the number of employees working in the abattoir or processing plant.

Q6 For how many years has the abattoir or processing plant been operating?

Q7 What is the capacity (animals per day slaughtered) of the abattoir or processing plant?

Meat type:	**Number of Animals slaughtered per day**
Sheep	
Beef	
Pork	
Other	
TOTAL	

Q8 What is the capital replacement value of the abattoir or processing plant? In other words, what would the current capital investment be for establishing a similar abattoir or processing plant?

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Q9 Please indicate the sales distribution of sheep meat. Identify the main outlets as well as the share of sheep meat going to each of the main outlets as a percentage of the total sheep meat slaughtered and distributed.

Distribution channel	**Share**	**%**
Wholesalers		%
Exporters		%
Retailers		%
Butcheries		%
Restaurants		%
Hotels		%
Other:		%
TOTAL	**100**	%

Q10 Please indicate from which provinces the sheep entering the abattoir originates (prior to arrival at the abattoir) as a percentage of the total sheep meat slaughtered and distributed.

Province	**Share**	**%**
Northern Cape		%
Eastern Cape		%
Western Cape		%
Gauteng		%
Mpumalanga		%
Limpopo		%
KwaZulu-Natal		%

Province	Share	%
North West		%
Free State		%
TOTAL	**100**	%

Q11 Please indicate the share of sheep coming from the veld and the share of sheep coming from a feedlot.

Origin	Share	%
Veld		%
Feedlot		%
Unknown		%
TOTAL	**100**	%

Q12 Please indicate the abattoir or processing plant's sheep meat products with credence attributes and their share within the abattoir or processing plant's total annual sales as a percentage of total annual sales. Credence attributes refer to characteristics of a product that cannot be measured on the products. These attributes include measures like organic, free range, fair trade production and food of origin.

Sheep meat product with credence attribute	Share	%
1.		%
2.		%
3.		%
4.		%
5.		%
TOTAL	**100**	%

Q13 Please indicate the branded products (such as products with a certification mark, products carrying the abattoir brand name or supermarket brand name) and their share within the abattoir or processing plant's total annual sales as a percentage of total annual sales.

Branded product:	Share	
1.		%
2.		%
3.		%
4.		%
5.		%
TOTAL	**100**	%

Q14 Please indicate the share of LIVE SHEEP procured using the following arrangements, as a percentage of total volumes and values.

Procurement method:	**Volume share:**	**Value share:**
Cash market transactions (7 day payment)		
Contract transactions (Contract farmers producing a specific quantity of sheep at a predetermined price)		

Q15.1	Does the abattoir or processing plant engage in product testing in terms of the requirements in order to adhere to government food safety requirements (Eg. HACCP, HAS, ISO9000 etc.).	Yes	No

If YES please specify.

Q15.2	Does the abattoir or processing plant engage in product testing **over and above** the requirements in order to adhere to government food safety requirements (Eg. HACCP, HAS, ISO9000 etc.).	Yes	No

If YES please specify.

Q16.1	Does the abattoir or processing plant engage in testing of the environmental cleanliness (in terms of chemical, physical and microbial contaminants) in the processing area (the area where sheep are slaughtered and carcasses are cleaned and/or cut and/or deboned) in terms of the requirements in order to adhere to government requirements (Eg. HACCP, HAS, ISO9000 etc.).	Yes	No

Q16.2	Does the abattoir or processing plant engage in testing of the environmental cleanliness in the production area **over and above** the requirements in order to adhere to government requirements (Eg. HACCP, HAS, ISO9000 etc.).	Yes	No

Q17 What is the composition and share of the products leaving the abattoir or processing plant as a percentage of total products leaving the abattoir or processing plant?

Product composition	**Share**	**%**
1. Carcass form		**%**
2. Fresh meat products		**%**
3. Processed meat products		**%**
TOTAL	**100**	**%**

Q18	Does the abattoir or processing plant provide incentives, for example, premiums based on certain quality attributes, to its suppliers?	Yes	No

If YES, elaborate in terms of which quality attributes and also provide more detail on the incentives.

Q19 Which quality assurance system(s) does the abattoir or processing plant have in place? (Eg. ISO9000)?

Q20 Please describe the abattoir or processing plant's suppliers' (farmers, feedlots or auctions) quality assurance system(s).

Q21 Please describe the food safety and quality demands to the suppliers of live animals of the abattoir or processing plant.

Q22 Please describe the food safety and quality demands to the suppliers of fresh meat to the abattoir or processing plant.

Q23 Please describe the food safety and quality demands of the abattoir or processing plant's customers.

Q24	Does the abattoir or processing plant have any form of traceability system in place?	Yes	No

IF YES PLEASE ANSWER THE FOLLOWING QUESTIONS ON THE TRACEABILITY SYSTEM OF THE ABATTOIR OR PROCESSING PLANT.

Q25 Describe the FORWARD traceability system (tracing the flow of products from the abattoir or processing plant to the wholesalers or retailers) that is in place in the business in terms of:

Batch traceability systems (the tracking of meat products in batches or lots, meat cuts are not tracked individually but in batches)
Level:
Breadth:
Depth:
On what standard or other traceability system is the traceability system based and with which requirements does the traceability system comply?

Other traceability systems (For example, traceability systems based on DNA sampling of sheep carcasses.)
Level:
Breadth:
Depth:
On what standard or other traceability system is the traceability system based and with which requirements does the traceability system comply?

Q26 Describe the BACKWARD traceability system (tracking the flow of products from the abattoir or processing plant back to the auction, the feedlot or the farm of origin) that is in place in the business in terms of:

Batch traceability systems (The tracking of meat products in batches or lots, meat cuts are not tracked individually but in batches.)
Level:
Breadth:
Depth:

Other traceability systems (For example, traceability systems based on DNA sampling of sheep carcasses.)
Level:
Breadth:
Depth:
On what standard or other traceability system is the traceability system based on and with which requirements does the traceability system comply?

Q27 How does the abattoir or processing plant keep track of its business operations and transactions (computer based or paper based)? Please specify what computer system is used. **(You can select more than one option)**.

Computer based	Paper based	Other, please specify: ....
Excel		

Q28.1 What percentage of total animals entering the abattoir has identification in the form of ear tags attached by the farmer?

On farm identification:	**Share**	**%**
1. Ear tags and/or other identification marks		**%**
2. Unidentified		**%**
TOTAL	**100**	**%**

Q28.2	Does the abattoir or processing plant make use of the farmer's animal identification number on the ear tag in any way?	Yes	No

Q28.3 **If NO please specify why not?**

Q29.1a	Does the abattoir or processing plant engage in MOCK FORWARD traceability trials? In other words do you engage in 'spot checks'? Ensuring that the traceability system in place is indeed functioning correctly, especially regarding sheep coming into the abattoir, during the slaughtering process and distributed to offset points such as wholesalers (Forward).			Yes	No
Q29.1b	If YES, how often?	Routinely > twice a year	Routinely twice a year	Routinely once a year	Occasionally

Q29.1c If YES please specify if this was voluntary, for auditing purposes or other purposes?

Voluntary	Internal Audit	Other: Please specify
	External Audit	……..

Q29.2a	Does the abattoir or processing plant engage in MOCK BACKWARD traceability trials? In other words do you engage in 'spot checks'? Ensuring that the traceability system in place is indeed functioning correctly, especially regarding the origin of sheep coming into the abattoir (Backward).			Yes	No
Q29.2b	If YES, how often?	Routinely > twice a year	Routinely twice a year	Routinely once a year	Occasionally

Q29.2c If YES please specify if this was voluntary, for auditing purposes or other purposes?

Voluntary	Internal Audit	Other: Please specify …… ……..
	External Audit	

Q30.1a	Does the abattoir or processing plant have plans to improve FORWARD traceability?	Yes	No

Q30.1b If YES please specify the type of improvements and why?

Q30.1c	If YES please indicate when (within how many years) the abattoir or processing plant expects to begin using the practice.	1	2	3	4	5

Q30.2a	Does the abattoir or processing plant have plans to improve BACKWARD traceability?	Yes	No

Q30.2b If YES please specify the type of improvements and why?

Q30.2c	If YES please indicate when (within how many years) the abattoir or processing plant expects to begin using the practice.	1	2	3	4	5

Q31	Does the traceability system within the abattoir provide for recall if a complaint is not received from the buyer of the product? In other words, can the abattoir indicate to which clients which batch went to?	Yes	No

Q32	Does the abattoir or processing plant carry insurance against product recalls and or claims?	Claims		Recalls	
		Yes	No	Yes	No

Q33	Has the abattoir or processing plant ever been subjected to a product recall due to food safety problems in the last three years?	Yes	No

If YES, please explain in terms of what was the food safety problem and how was it handled.

Q34	Has the abattoir or processing plant ever been subjected to a product recall due to other (non-food safety related) problems in the last three years?	Yes	No

If YES, please explain in terms of what was the other (non-food safety) problem and how was it handled.

Q35 Please provide your opinion in terms of possible implementation and adaptability of the following traceability systems:

A documentation system is used where every producer or batch has a physical document, where the documentation of the animal is kept up to date throughout the animal's production and processing.
An IT system where documents and barcodes accompany the animal, carcass and meat cuts throughout production and processing. These documents and barcodes are linked to an IT system.
A web-based system where information on products and product flows are captured by means of bar-coding and physical entry. This web-based system can be accessed by all members of the supply chain to track and trace the movement of any animal, carcass or meat cut within the supply chain.

Q36 Could you please give some indication of the nature of your traceability system? Is the documentation trail paper of computer based? For example, all sheep coming into the abattoir are documented (computer based) from there on each individual sheep receives a barcode (computer based) as it moves through slaughter and cleaning (computer based) until where the specific sheep carcass is transported to the next role player in the chain.

Q37 Who, in your opinion, carries the cost of implementing a traceability system?

Farmers	Abattoirs	Wholesalers	Retailers	Consumer

Q38 What do you think is the COST of implementing traceability systems, in terms of overhead cost? Can this be a reason why abattoirs do not implement these traceability systems?

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Yes	No

Q39 What do you think are the perceived BENEFITS to the implementation of traceability systems?

Q40 Who in your opinion are the beneficiaries of the implementation of such traceability systems?

Farmers	Abattoirs	Wholesalers	Retailers	Consumers

Q41 In your opinion, what do you think are the reasons for having or for not having traceability systems in place?

For having: **For not having:**

Q42 In the case where traceability systems become a prerequisite for slaughtering and selling carcasses, how ready would you say your abattoir is? Where 1 is not ready at all and 5 is extremely ready?

1	2	3	4	5

Q43 What do you perceive will be the future of traceability systems within the sheep industry?

Q44

Do you think traceability systems will become an inevitable part of the future of abattoirs in the sheep industry?	Yes	No

If YES, who in your opinion will be the drivers for the implementation of traceability systems?

******* Thank you for your participation *******