Exploring food loss and waste along the biltong value chain in the Western Cape, South Africa.

by

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DECLARATION

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ABSTRACT

Despite South Africa being a biltong producing country, little research has been published on this popular commodity. Biltong is not only a popular food product in South Africa but also popular worldwide-wide. In South Africa, biltong sales constituted more than R2.5 billion (€143 million) in 2015. It will be important for the country's biltong processors to capture the potential of new and emerging markets to sustain the biltong industry in the future and to grow domestic demand. In recent years, large-scale biltong processors have emerged. Due to the size of this segment it is important to understand the science behind producing at such a large scale (30 tonnes of dry products per month), but the science of producing large quantities of biltong is not well understood or documented, even though value chain analysis provides a methodological tool to do so. The sector under investigation concentrates on the production of biltong products which included snapsticks and nuggets with the additional production of dry sausage (droëwors). For the thesis, "biltong" includes large cuts pieces, plain cut pieces, chilli biltong products and snap sticks. To provide a better understanding of the sector, a biltong study funded by CIRAD was completed in May 2016. The study conducted a food loss analysis of biltong in the Western Cape of South Africa. The study mapped the value chain and showed that there are few processing losses from the start of process to retailer stores. Therefore, the purpose of this research was to further explore food loss and waste along the biltong chain of South Africa.

The study adopted a case study approach. This entailed collecting qualitative and quantitative data in the form of questionnaires and follow-up questionnaires from secondary processors (biltong processors) and retail stores along the value chain. Data included losses, prices and value added time. A total of fourteen biltong processors and three retailers participated in the study for losses.

This thesis highlights the benefits of value chain analysis as a useful tool in understanding sector performance. The results of this study have confirmed low processing losses for all the biltong and dry sausage products. Processing losses include pre-process, process and post-process loss. All three processing losses along the secondary and retailer point of biltong products and dry sausage supply chains for both beef and game are insignificant. Total pre-process loss is 3% weight-loss for one specific raw meat cut, which include sinew and blood loss. Cuts only included silverside and topside. Process loss is 0.01% . Process loss is the lowest loss of all three processing losses. This includes percentage of total product loss through the spicing and drying stage per month, which are unfit for sale to retailers. The highest loss identified is secondary producer and retailer post-process losses recorded at 0.01% to 0.05% of total monthly produce. One retailer's post-process loss was recorded at 4%. The post process loss is the total

amount of dry products return per month from retailers to secondary processors. The most common post-process loss recorded from secondary processors and retailers is mould.

The main reason for low process losses is due to the nature of short-term sales as identified when analysing value added time. The value added time indicated that the lead-time (the time that must be allowed for the completion of a process) for biltong is only around five days. This includes cutting raw meat, spicing and drying. Therefore, the product moves fast through the processing stage to the retail point.

OPSOMMING

Ten spyte van Suid-Afrika wat bekend is vir biltong, is daar vandag min gepubliseerde navorsing oor die gewilde produk. In Suid-Afrika, was totale biltong verkope in 2015 meer as R2,5 miljard. Dit sal belangrik wees vir biltong verwerkers in Suid-Afrika om potensiële marke raak te sien in die bedryf, veral vir die binnelandse mark. Onlangse, het groot skaal biltong verwerkers meer bekend geword. As gevolg van die groote van hierdie segment (30 ton droë produk per maand) is dit belangrik om die wetenskap te verstaan agter die verwerking. Die sektor wat ondersoek was, fokus hoofsaaklik op die produksie van biltong en droëwors. Die studie verduidelik die waardeketting en indetifiseer 'n paar verwerkings verliese aan die begin van die maak van biltong tot op die winkel se rakke. Daarom was die doel van hierdie navorsing om te kyk hoeveel biltonggaan verlore in die biltong ketting van Suid-Afrika.

Die studie het 'n beskrywings studie benadering. Dit behels die versameling van kwalitatiewe en kwantitatiewe data in die vorm van vraelyste en opvolg vraelyste van sekondêre verwerkers (biltong makers) en winkels in die waardeketting. Die inligting sluit in pryse en hoeveel tyd voeg waarde by, die maak van biltong. 'n Totaal van veertien biltong verwerkers en drie winkels het aan die studie deel geneem.

Hierdie studie beklemtoon die voordele van die waardeketting analise as 'n nuttige hulpmiddel om 'n produk in 'n seckor te verstaan. Die resultate van hierdie studie het lae verwerkings verliese bevestig. Verwerkings verliese sluit verlies voor verwerking, verwerking self en na verwerkings verliese. Al drie verwerking verliese gedurende die verwerking en die handelaar punte van biltong en droëwors is min. Totale voor verwerkings is 3% vir die rou vleissnitte, wat sening en bloedverlies insluit. Verwerkings verlies is 0,01%; Dit sluit in totale droë produkte wat nie geskik is vir verkoop aan kleinhandelaars nie per maand.

Die naverwerkings verlies is die grootste ekonomiese verlies. Die naverwerkings verlies is aangeteken teen 0,01% tot 0,05% van die totale maandelikse droë produksie. Een handelaar se naverwerkings verlies is aangeteken teen 4%. Die mees algemene rede vir die verlies is muf op die droë produkte.

Die hoofrede vir lae verliese is die aard van die kort termyn verkope soos geïdentifiseer tydens die analise van toegevoegde waarde aan tyd. Die tyd aan toegevoegde waarde word aangedui deur die tyd wat toegelaat word van die maak van biltong tot op die winkels se rakke. Die tyd is slegs sowat vyf dae. Dit sluit in sny van rou vleis en droogmaak verwerking van biltong en droëwors. Daarom beweeg die produk vinnig deur die verwerkings stadium na die kleinhandelspunte.

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TERMINOLOGY

Biltong: Dried and spiced meat from domestic or game animals. Biltong looks like North America 'jerky'. 'Jerky' can be seen as a substitution for biltong, however the drying process and spicing is different with jerky undergoing an additional heat (cooking) phase (Lewis, Masterton & Ward, 1957). Biltong is derived from the Dutch word "bil" meaning buttock or meat and "tong" meaning tongue or strip. Biltong was originally prepared in France during the middle Ages (476 to 1453) and then made its way to South Africa via Dutch settlers. African herders called "voortrekkers", trekked across the continent drying their meat strips, sometimes travellers even placed it under their saddles on horseback to dry on the move.

Heart biltong: Biltong made from the heart of an animal. This product is popular in the informal market.

Biltong Powder: A very dry fine product made by homogenising biltong pieces. This product is mainly used as an ingredient and flavouring for breads, salads and pizza.

Chips: Thin meat slices (2-3 mm thick)

Nuggets/ bites: Biltong nuggets made from game or domestic meat. The meat is cut into small blocks and dried out.

Chilli bites: Biltong spiced with chilli, commonly thin sticks containing high levels of collagen (sinew) making chewing difficult.

Snap sticks: Thin strips of meat that are easier to chew. This is also one of the driest and most expensive products (15% moisture content).

Baby biltong: Made from beef or game. The biltong is cut into smaller sizes and lightly spiced with only one spice (usually salt) to keep the biltong flavour plain. This biltong is considered a great remedy for baby teething problems.

Dry sausage: Dry sausage called "droëwors" in Afrikaans. It is made from domestic or game meat, mutton fat and spices. This is also a popular South African snack food, based traditionally on coriander spiced boerewors sausage. Dry sausage is unusual among dried meat in being dried in a short period of time in warm, dry conditions with a minimum if any, fermentation, unlike traditional Italian cured salami, which is dried slowly in relatively cold and humid conditions.

Dry sausage Wheels: Consists of a mixture of lean beef, a few well-chosen cuts of lamb, minced and flavoured with a melody of mixed spices. The shape of the meat piece is circular and thin.

Game: In this study, "game" refers to commonly hunted species for game meat Although game meat is often referred to as venison, the two terms should be differentiated. Venison refers to meat originating from farmed animals, such as deer in New Zealand and Europe, while game meat in South Africa originates from wild, free-roaming animals (Bekker, Hoffman & Jooste, 2011). In this thesis, the term game meat is

used for meat taken from wild ungulate species (e.g. springbok, kudu, eland, blesbok, wildebeest species, zebra species, etc.). Ostrich is not included in this definition of game meat, although it is commonly used to make any of the above mentioned products.

Game Harvest: refers to commercial shooting of large numbers of game animals in a short period of time; mostly done by professional hunters. For a full explanation of the process, see (Van Schalkwyk & Hoffman, 2016).

Professional hunting: A commercial hunt for game meat for the export and domestic market. Typically, large quantities of game animals are shot within a short period of time, usually at night. It differs from biltong hunting which is not so strictly regulated to. Professional hunting is regulated (van Schalkwyk & Hoffman, 2016) and supplies game meat for the formal market.

Professional hunter: Professional hunters (PHs) are registered with the Professional Hunters Association of South Africa (PHASA) after the completion of a comprehensive training course at a professional hunting school. Companies employ PHs to hunt game and sell the meat in large quantities for the international market or domestic market. Professional hunters also works as guide for trophy hunters or biltong hunters.

Biltong Hunter: A South African or permanent resident who regularly hunts as a hobby, sport, own consumption or for additional source of income. He/she is not a professional hunter as hunting is not his/her main occupation. However the biltong hunter may be involved into professional hunting activities from time to time. Typically, provincial regulations are applicable as well as the landowner's permission. It is estimated that over one million game animals are hunted per annum in South Africa.

Biltong Hunting: An activity where game animals are hunted with a rifle or any weapon for their meat. This meat can be processed as biltong and droëwors (Van der Merwe & Saayman, 2008). In this study, biltong hunting is seen as a recreational activity, a sport, hobby, secondary or minor income. Even though the boundary between biltong hunting and professional hunting is unclear, especially if biltong hunters take part in commercial harvesting activities or if it is their primary source of income.

Trophy Animal: A trophy animal is an animal that is hunted for its desired appearance (e.g. size, length of horns). They are mostly male animals.

Trophy Hunter: Person hunting trophy animal for recreational purposes.

Trophy Hunting: A recreational activity, whereby trophy animals are hunted. Trophy hunting is done by both South Africa residents as well as tourists. Game meat is usually a by-product of trophy hunting.

Food loss (FL): Is the decrease in food quantity or quality (FAO, 2016).

Quantitative food loss: When food mass decreases (FAO, 2016).

Qualitative food loss: When food quality attributes decrease (FAO, 2016).

Processing losses: All Losses that occur at the processing step along the supply Chain. These losses are sub-divided into three losses. They include pre-process loss, process loss and post-process loss.

Pre-process loss: When raw meat enters the secondary processors. The raw meat is trimmed and prepared. These losses are associated with the quality of the meat bought from primary processors. This includes losses due to meat quality, blood loss and sinew. It includes all that is purchased by the processor that will not be transformed into biltong.

Process loss: Product discarded after drying and packaging. These products are unfit for selling.

Post-Process loss: When the quality of the product decreases after it has been sold. Refers to spoilage (mould) and degradation (rancid).

Mould: Develops on the surface of unpacked products and products packed with oxygen (not vacuum packaged, nor back flushed with nitrogen), the product (i.e. packaged in a jar, or non-vacuumed bulk pack). Mould requires oxygen and moisture to develop.

Rancid: A degradation/deterioration loss. A major cause of meat product deterioration is oxidative rancidity. Rancidity is the development of unpleasant smells or taste in fats of a product. That is why fat on biltong strips are frequently cut off to avoid rancidity (Burfoot *et al.,* 2010). Oxidation of lipids in meat and meat products is responsible for changes in its nutritional quality, loss of vitamins and essential amino acids, colour, odour and texture. This is more common in droëwors than biltong.

Retailing points: Place where final consumers can purchase meat or processed meat (biltong, droëwors) from wild or domestic animals. Retailing points can be in supermarkets, butcheries, biltong shops, restaurants (including hotels) and food markets (Bekker, Hoffman & Jooste, 2011)**.**

Industrial Abattoir: A public slaughterhouse for cattle, sheep, and other domesticated animals. The activities include the killing, dressing, and cooling of carcasses, could also include the deboning, mass meat packing, exports of frozen and chilled meat. It includes well-organized and intensive teamwork through which the animal passes rapidly from the slaughtering pen to the cooling room as a finished dressed carcass. An Industrial Abattoir is a slaughter facility which has been approved, graded and registered in terms of the Meat Safety Act, 2000 (Act 40 of 2000). The approval, registration, monitoring and control of Industrial Abattoirs are the responsibility of the veterinary public health units of provincial government in their respective areas of control (Bekker, Hoffman & Jooste, 2011).

Primary processors: Primary processors are abattoirs and wholesalers. The activities that occur at this stage is slaughtering and raw meat packaging. Inputs are animals and outputs are raw meat cuts.

Secondary Processor: Secondary processors are biltong processors and wholesalers. The activities include cutting, mixing, spicing and drying. Inputs are raw meat cuts and outputs are dry products.

Critical loss point (CLP): The points in the food supply chain where food losses have the highest impact on food security and economic loss.

Formal market: Part of an economy that is included into any Gross Products (gross domestic product (GDP), and gross national product (GNP).

Informal market: Sector in the economy where the products are not taxed, not monitored by the government nor included in any GDP or GNP calculation. The informal sector in South Africa does not adhere to legal requirements, standards and procedures. Informal activities are viewed as 'small enterprises'. The former definition includes informal producers and traders. The first category, 'informal producers', includes small enterprises producing goods and services that compete with the formal sector producing similar products such as food. Informal traders differ from informal producers because they do not produce a product and they do not compete directly with the formal sector over price. Rather, they purchase formal sector goods, which they sell on to consumers with a fixed margin (Davies & Thurlow, 2010).

CHAPTER 1: INTRODUCTION AND PROBLEM STATEMENT

1.1. Background

Biltong and droëwors are traditional popular high-value snacks in southern Africa. Initially, biltong was mainly prepared from springbok meat. Today many species are used: beef, springbok, kudu, wildebeest, impala, ostrich, chicken and even pork (Strydom & Zondagh, 2014). The most popular species used for biltong today is beef. Biltong process is simple and is produced at a variety of levels; from large scale for industries to small-scale family businesses as well as at home for self-consumption (Strydom & Zondagh, 2014). This results in a mixed market of branded and unbranded products (D'Amato et al., 2013). The industrial market and small-scale family businesses differ in quantity produced and type of technology used. Companies at industrial level produce an estimated thirty tonnes of dry product per month and normally use specially designed chambers for drying. Small-scale family businesses produce around one tonne of dry products per month and typically use fans for drying.

Biltong and dry sausage are sold everywhere in South Africa and can be bought packaged or unpackaged from upscale supermarkets, specialised biltong shops, butcheries, pharmacies and even hardware stores. A paper from North-West University reported that biltong sales constituted more than R2.5 billion (€143 million) in 2015. Game biltong sales constituted R237 million, while beef biltong constituted R2.4 billion (Saayman, 2015). Unfortunately, neither the source of the data nor the methods used to estimate the figures were provided. The most salient price drivers for biltong include the cost of the animal, the cost of processing and the popularity of the meat used (Petit et al., 2014).

The demand for all meat types is predicted to increase in the near future. Economic and population growth to 2050 will lead to a proximate 21% increase in per capita meat consumption (Revell, 2015). The reasons for this include population increase, urbanisation, changes in lifestyle, and consumer preferences. All of these reasons are associated with an increase in disposable income of the middle-class population (Delgado, 2003; Taljaard, Jooste & Asfaha, 2006). If meat producers are to deliver safe and quality products to consumers in the near future, efficiency in the different value chains need to be analysed.

The South African meat industry has undergone several crisis and changes in recent years. One such crisis is the 2011 foot-and-mouth disease outbreak in Kwazulu-Natal. This disease had a huge economic impact on South Africa, for example the restriction of meat export after the outbreak; most of the meat exported from South Africa is derived from game. This then meant that "new" markets

had to be found for this meat, typically most of the meat went via the biltong market, although there was also an increase in the selling of game meat in restaurants as well as supermarkets. However, this change in market has not been quantifies. Another ongoing crisis is that the concentration of market power lies in the hands of multiple retailers in the developing countries. This has major consequences for the farmers and processors in the value chain. One such consequence of market power is the decrease in price transparency when setting the price in the market (Vink & Sandrey, 2007).

Moreover, livestock systems are characterised by long marketing chains featuring great distances, numerous phases of weight gain and feeding regimes, many levels of traders and transactions, a multitude of steps and stages of processing, and a variety of employment-creating services and inputs (Rich et al., 2011). For these livestock systems to supply customers with quality products and remain competitive, an analysis to increase efficiency is required. This applies to the entire chain; therefore a holistic approach is regularly used for this type of analysis (Desmarchelier et al., 2007). One such method of analysis is 'value chain' analyses. The concept of value chains is key in understanding how inputs and services are brought together and then used to grow, transform, or manufacture a product; how the product then moves physically from the producer to the customer, and how value increases along the way.

1.2. Problem Statement

1.2.1. Introduction

Biltong is a traditional South African snack. Many species can be used for biltong, namely beef, game, ostrich, pork and chicken. The word "Biltong" is derived from Dutch the word *bil* meaning buttock or meat, and *tong* meaning tongue or strip. Biltong made its way to South Africa via Dutch settlers. *Voortrekkers* trekked across the continent drying their meat strips, sometimes even placing it under their saddles on horseback to dry on the move.

The value chain analysis strives to achieve economic, environmental and social sustainability. Sustainability occurs when economic, environmental and social aspects are all taken into account equally (Van der Vorst, Tromp & Van der Zee, 2009). This challenge is complex for CEOs, governments and organisations, and few are successful. The main principle in value chains are to extend the line of sight to achieve a sustainable competitive advantage; that is, to move towards a more holistic approach. Individuals within the organisation need to work collectively to succeed in making the process work efficiently. As a result, cross-functional and multi-disciplinary teams are required to identify their specific task to achieve a specific objective throughout the chain. To do this, problems hindering the performance of the chain need to be identified for chain managers and government officials.

1.2.2. Estimated food loss in South Africa

The following statements show a preliminary assessment of food loss generated in South Africa. Data from South Africa Waste Information System (SAWIS) can be regarded as disappointing, as only four locations showed data on food loss. The reason for this lack of data is that reporting to SAWIS is optional. Some studies have been undertaken in South Africa; including Johannesburg, Bloemfontein, the Western Cape and Limpopo. These studies focused mainly on consumer loss (Oelofse & Nahman 2012).

Inedible food loss value is measured by the forgone value of not receiving the waste for use in downstream activities. Downstream activities include energy generation or composting, as well as costs associated with disposal to landfills. From an economic perspective, the costs of food waste tends to be under-valued (and therefore ignored by policy-makers), particularly in developed countries, where food represents only a small proportion of consumers' total budgets (Parfitt, Barthel & MacNaughton, 2010). However, even in developing countries the cost of food waste can be significant. The opportunity costs are estimated to be R6.4 billion per year in South Africa. If edible food loss is added to non-edible food loss, estimates come to R71.4 billion. Thereafter, when the estimates of the costs associated with disposal of this food waste to landfill, including both financial costs and externalities (social and environmental costs) are taken into account, these costs amount to R255 per tonne, giving rise to a total cost of food waste in South Africa of R75 billion per annum (de Lange & Nahman, 2015). Most of the economic loss occurs at the processing and distribution stages of the vegetable chain, as well as the processing and distribution stage of the meat chain (Nahman, 2013).

1.2.2.1. Food loss by mass

Table 1.1 shows proportion (by mass) of food entering each stage of the chain that is lost (Gustavsson et al., 2011a). As mentioned, this thesis focuses on the meat chain in South Africa. Table 1.1 shows a reliable indication of meat losses along the chain; the highest percentage of loss is at the agriculture production and distribution phase, closely followed by the processing and packaging phase.

Table 1.1: Proportion (% of mass) of food loss entering each stage of the value chain (Gustavsson et al., 2011a)

Commodity group	Harvest (%)	Post-harvest (%)	Processing (%)	Distribution (%)	Consumer (%)
Cereals	6.0	8.0	3.5	2.0	1.0
Roots and tubers	14.0	18.0	15.0	5.0	2.0
Oil seeds and pulses	12.0	8.0	8.0	2.0	1.0
Fruits and	10.0	9.0	25.0	17.0	5.0

3

vegetables

Meat	15.0	0.7	5.0	7.0	2.0
Fish and seafood	5.7	6.0	9.0	15.0	2.0
Milk	6.0	11.0	0.1	10.0	0.1

The total mass of food waste for each commodity in South Africa is shown in Figures 1.1 and 1.2. Vegetables and fruit constitute the largest portion of all food waste (Mena, Adenso-Diaz & Yurt, 2011). This is closely followed by cereals. In terms of the different stages in the value chain, the stages contributing most to food loss have a close spread ranging between 20% - 26% of overall food loss produced. The stage with the least amount of food waste is post-consumer, which contributes only 5%.

1.2.2.2. Food loss in value

Value is added along all stages in the food value chain. Food loss in value can differ, a 5% loss in agrifood is not equivalent to 5% distribution loss due to economic loss. This is due to different pricing and processing value-adding activities. For example, a tonne of meat loss is more problematic from an economic perspective compared to a tonne of fruit; the latter is cheaper per kilogram compared to meat. Meat also includes higher value-adding processes compared to fruit. For example, beef is slaughtered and cut into different meat cuts, each with its own value, while a specific meat cut can be further processed and packaged.

Figure 1.1 shows that meat, fish and seafood constitute only 9% of total food loss in mass (Gustasson, 2011). The higher market price of these commodities show the change in total economic loss in the total food loss in South Africa. The economic contribution of meat, seafood and fish is currently 24%, as depicted in Figure 1.3. Contribution of the different stages in the value chain have also shifted when comparing the value (Figure 1.3 and 1.4) to mass (Figure 1.1 and 1.2) of each commodity, distribution and processing phases contribute a larger piece of the pie. Further, the distribution stage is shown at 20 - 32%, where processing remains at 25%. Therefore, Figures 1.3 and 1.4 provide a more accurate reflection of the cost of food losses along the South African commodity value chains.
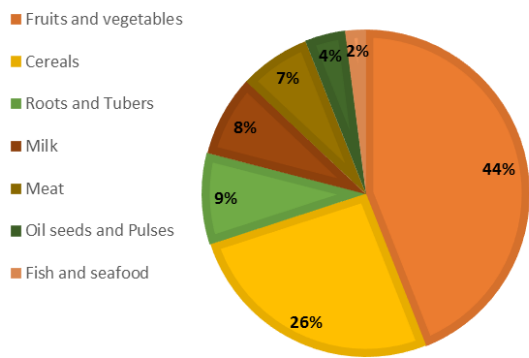
Figure 1.1: Relative contribution of food loss (% by mass) in each commodity group to the total food loss in South Africa. Adapted from Gustavsson (2011).
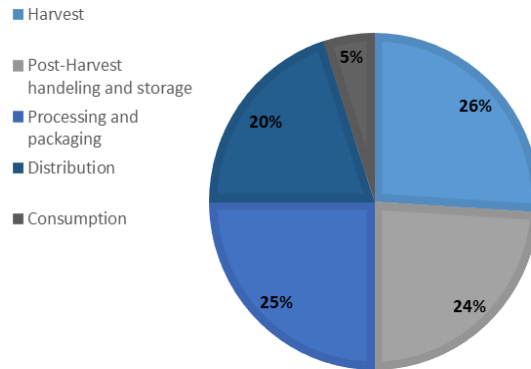
Figure 1.2: Relative contribution of food loss (% by mass) in each stage of the value chain in South Africa. Adapted from Gustavsson (2011).
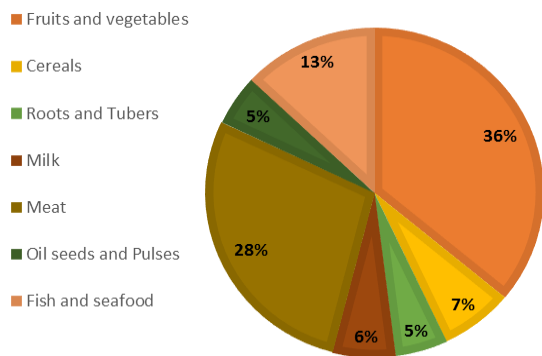
Figure 1.3: Relative contribution of food loss (% by value) in each commodity group to the total food loss in South Africa. Adapted from Gustavsson (2011).
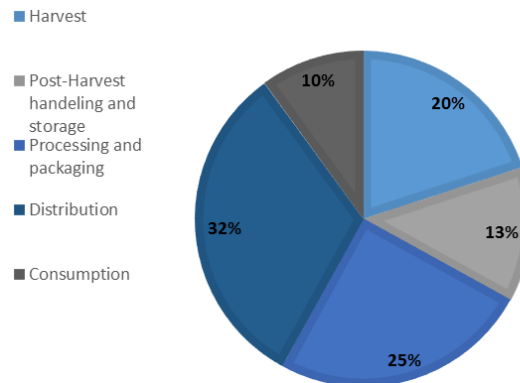
Figure 1.4: Relative contribution of food loss (% by value) in each stage of the value chain in South Africa. Adapted from Gustavsson (2011).

The distribution waste and consumption waste are considerably lower for processed food in comparison to fresh products, a phenomenon mainly due to the longer preservation time of the former (Gustavsson et al., 2011a). Distribution in developed countries is not the largest contributor to food loss along the chain; in the German food chain estimates of loss are at 3%, and at 3.8% in the Swedish value chain (Eriksson et al., 2014). However, in developing countries food losses are high at the distribution phase as well as the processing phase. Food loss is an economic, environment and social problem. Governments have focused on diverting loss from landfills through regulations, taxation and public awareness. South Africa's Draft Waste Classification and Management Regulations of 2010 promotes composting of organic waste and aims to ban the landfilling of organic waste by setting criteria for the progressive restriction on waste disposal mechanisms (FAO, 2013).

Given the significance of the problem, this thesis addresses the problem by identifying the main causes of food loss at specific stages in the South African biltong value chain, even though efforts to understand how food losses occurred are limited.

The red meat industry has four unique characteristics. They include:

- *Product disassembly:* An animal carcass as a whole unit is split into a variety of finished products, each with its own demand and price (Cox & Chicksand, 2005).
- *Carcass imbalance:* This is due to a rare balance of specific meat cuts, resulting in an unsustainable and unpredictable supply downstream.
- *Long animal production lead times*: A lead time is the time it takes for a specific activity to start and finish within the value chain. Animal production is much longer than most other food industries. For example, the period from insemination to slaughter of a cow is typically 14 months. Corn, for example, can only take from 2 to 4 months to reach harvest.
- *The dominant position of the South African supermarket within the chain:* The extent to which supermarkets' power is used to decrease prices for processors and farmers is an influential factor in the South African red meat industry.

The value chain in the South African beef industry lacks a set of linked actions for production, marketing, distribution and storage (Labuschagne, Louw & Ndanga, 2011). Consequently, high-cost promotional activities are needed to boost sales. Actions in the value chain are strictly regulated. The beef industry is more transparent than the game meat industry. However, not much is known about product types, prices and locations for beef products; this thesis will also address prices and lead time along the value chain of biltong.

The mapping and quantification of value chains in South Africa has been the subject of several studies. However, to date losses and prices have not been applied to the meat industry in South Africa. That said, there are some papers that have analysed the beef meat chain in developing countries, which can prove helpful in a context such as South Africa (Labuschagne, Louw & Ndanga, 2011).

Therefore, the following research question is set:

What are the implications of food loss in the biltong value chain in South Africa?

1.3. Objectives of the study

The objective of this thesis is to develop a framework for understanding the South African biltong and droëwors value chain. It focuses specifically on the implications of food loss. This thesis addresses the following primary objectives:

- Describe the structure of the biltong value chain, with specific focus on secondary processors and biltong retailers in the Western Cape,
- Identify and Quantify food loss along the biltong chain at critical loss points,
- Identify and compare prices along the value chain for both beef and game biltong.

In an extension of these primary research objectives, the following secondary research objectives are also included:

- Identify the key problems and destinations of food losses.
- Estimate the short-term marketing margins from the beginning of the biltong process to retail point.

1.4. Proposed method of the study

Two methods from value chain literature were used:

1. Value stream management (VSM): Mapping the entire chain (Figure 1.5). This is an important element in value chains research (Fitter & Kaplinksy, 2001).

2. The case study research: The case study method is the most widely used data collection method in the value chain, combining qualitative and quantitative data. Findings were based on a specific group of companies in a specific value chain.

Step 1
Selection of a specific group of companies in a specific value chain

Step 2
Development of a casual chain map of the specific agrifood value chain

Step 3
Develop a new chain map with research results identified
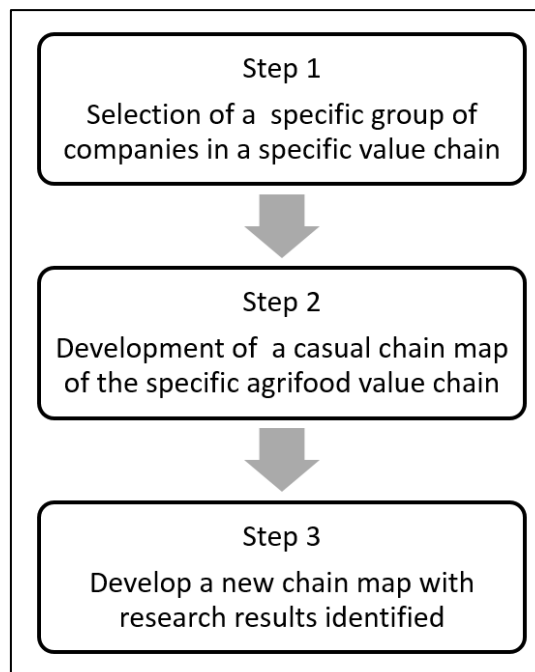
Figure 1.5: An approach for Value Stream Mapping (VSM) for determining 'waste' in the agri-food supply chain. (Adapted from Folinas et al., 2013).

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The data was collected by using a combination of quantitative and qualitative interviews. The surveys were included to ask questions that could not be found in a secondary source. To increase the number of different viewpoints in the interviews, at least five respondents per stage analysed in the value chain are required (FAO, 2007).

The research tools for value addition have been adopted from a cotton value chain analysis (Rieple & Singh, 2010).

1.5. Outline of this Study

From here on, the outline of this thesis will be as follows: Chapter 2 will provide an extensive literature review on key concepts. Value added will be analysed by discussing Porter's value chain in detail in section 1. Section 2 focuses on food losses as well as describing and defining the concept. Chapter 3 discusses the research design and methodology. Chapter 4 contains the results and provides an extensive overview and discussion of the results. Finally, chapter 5 presents the conclusions and recommendations based on the results. Furthermore, the limitations of the study will be discussed and some guidelines for further research will be provided.

CHAPTER 2: LITERATURE REVIEW

SECTION 1: VALUE CHAIN ANALYSIS THEORY

2.1.1. Introduction

Every business today competes in two worlds. Firstly, a physical world of resources such as raw materials that stakeholders can touch, smell, move and see. These resources are normally manufactured, and aid in daily business activities. Secondly, a world of technical resources such as stakeholders exchanging information and online marketing. Technological resources are becoming increasingly important to businesses. This is because it supports business needs in terms of connectivity, and advertisement. Creating value in these two worlds is equal. Stakeholders who excel in both worlds can create and extract value in the most efficient and effective ways (Rayport & Sviokla, 1995). Over the past twenty years, the value chain (VC) model has established itself as one of the main models utilised in product and service industries. Today, the VC model can assist practitioners and policy-makers in participating more efficiently and effectively in value chain analysis. With an increase in effectiveness, local companies' ability to compete in the global market progresses (Schmitz, 2005). There are a number of different approaches and theoretical backgrounds that are drawn on for this model due to the rapid increases in the literature regarding all facets of VCs (Lazzarini, Chaddad & Cook, 2001; Feller, Shunk & Callarman, 2006). As a result, VC becomes difficult to define due to varying literature containing an array of definitions.

2.1.1.1. Definitions and terminology

One well known definition for a value chain defined by Kaplinsky and Morris (2001), is the full set of activities required to bring a product or service from raw material through the different phases of production, transformation and delivery to the consumer, as well as the disposal after us. An expansion of Kaplinsky's definition appeared in 2014 regarding sustainable food chains. This expansion described value chains as follows: "The full range of farms and firms and their coordination in value-adding activities that produce particular raw agriculture materials and transform them into particular food products that are sold to a final consumer and the disposal after use, in a manner that is profitable throughout". Further, Kaplinsky adds that value chains have a wide range of societal benefits and that they are environmentally sustainable (FAO, 2014a). The "full range of farms and firms" here refers to stakeholders in the chain such as processors, wholesalers, and retailers who have a direct influence on the product. The value chain as a concept has existed for many years but was famously introduced by Porter (1985a). Porter focused on manufactured products at firm level. Interestingly, Kaplinsky did not mention Porter's value chain analysis in his paper, where value chain analysis was applied to whole industries (Kaplinsky, 2004).

Often, the terms 'value chain' and 'supply chain' are used interchangeably. Generally, supply chains focus more on goods to customer, whereas value chains flow in the opposite direction. The customer is the source of value, and value flows from the customer, in the form of demand, to the supplier (Feller, Shunk & Callarman*.,* 2006). In this way, value chains can also be called 'demand chains' (Walters & Rainbird, 2004). For the purpose of this study, the term value chain rather than supply or demand chain will be favoured. This is because the term value chain is more widely used in literature that uses similar theories as will be explained later. In summary, the term value chain is used to characterise a system composed of different stakeholders, activities, and institutions, all functionally interdependently.

Literature in environmental economics, production economics and ecological studies perceives a value chain to be equal to the sum of its parts. This means the literature focuses on each individual activity along the chain rather than looking at the chain as a whole. However, in logistics, supply chain management and engineering literature, value chains are approached differently. In this approach, the VC refers to the individual activities that affect the whole value chain. Therefore, the activities that affect the whole are greater than the sum of the individual activities. This approach adds additional supporting theories, which are integrated throughout the chain. One of these supporting theories is the lean approach. This popular principle eliminates non-value adding activities along the value chain, called waste or muda (Hollingworth, 2002; Droste, 2007). Lean thinkers go back to core issues, by focusing on what the customer really perceives as value. The theoretical background of lean thinking is based on the history of Japanese manufacturing techniques which have now been applied to industries world-wide (Abdulmalek & Rajgopal 2007; Wee & Wu, 2009).

 It becomes clear that the VC is an accommodating model, leading to many definitions and different tools of analysis (Womack & Jones, 1996). In addition, this model can be applied at sector level, industry level or through a holistic approach.

There are many historical concepts related to the VC, five of which will be discussed. They are subsector analysis (commodity systems approach), *filière*, Porter's value chain, supply chain management, and global commodity chain. Although these terms are often used interchangeably, they represent different ideas which need to be understood. These concepts have been developed over time to address the limitations of older concepts, thus increasing efficiency. The large volume of literature on VCs and the many variations of definitions and frameworks have often made it difficult to understand the concept fully (Feller, Shunk & Callarman*.,* 2006). Researchers looking for guidance in value chain methodologies often fail to dedicate time to discuss these conceptual issues. Therefore, VC theoretical principles can be of use for researchers.

This chapter presents a theoretical framework based on the literature where value added and losses along the value chain are highlighted. Section 1 provides a short overview of the above mentioned

value chain concepts as well as value added along the chain. Section 2 will follow, where food losses in South Africa will be analysed, particularly at processing and distribution stage.

2.1.2. The value chain concept

2.1.2.1. The period: 1950s - 1980s

The value chain concept evolved from economics engineering, management sciences and operational research. Historically, industrial organisations offered the theoretical and analytical backbone for earlier work done on value chains in the 1950s.

Later, the Commodity System Approach (CSA), also referred to as subsector analysis, was introduced. This approach evolved in the 1970s with the development of mapping. Mapping is a descriptive process that shows the flow, of a particular raw commodity, through many different stakeholders and a range of consumer markets. Benefitting from the expanding literature in agricultural marketing, transaction costs economics, and recent work on rapid appraisal, the methods from this literature were applied to the sector approach. CSA approach aims to identify the drivers that influence the competitive position of a sector within a single product group (Boomgard et al*.,* 1992).

The next concept, which appeared into the agriculture food sector in the 1970s, is *filière*, or the commodity chain. This concept originated at the *Institut National de la Recherche Agronomique* (INRA) and the *Centre de Coopération Internationale en Recherche Agronomique pour le Développement* (CIRAD). This approach focused on physical product flows and related to large-sale processing of commodities. It focuses mostly on export crops such as cocoa (Raikes, Friis Jensen & Ponte, 2000). *Filière* means 'industry' in the fields of economics, but focuses more on agriculture industries, especially in developing countries. The *filière* approach covers many schools of thought, where each school has its own theoretical baseline and research questions. *Filière* borrowed theory and methodologies from system analysis as well as old and new institutional economics.

In the mid-1980s the term "value chain analysis" was first used and popularized by Porter in his book "Competitive Advantage: Creating and Sustaining Superior Performance" (Porter, 1985b). In this book, Porter reflected on the value adding character within a firm border. Many researchers have expanded upon Porter's framework to explain how value chain analysis can be an important managerial tool (Kaplinsky & Morris, 2001; Chang & Hwang, 2002). This will be elaborated on further in the next few sections as many of Porter's value chain concepts are still found in business management disciplines to this day.

2.1.2.2. The period: 1981 - 2000

 Another important concept in value chain analysis is Supply Chain Management (SCM). Keith Oliver coined this term in 1982 (Cox, 1999; Ganeshan & Harrison, 1995). The term originated in operational

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research focusing on logistics. A number of definitions of supply chain management (SCM) exist in literature and practice (Mentzer et al., 2001). Supply Chain Management is an integrative idea that aims to manage the total flow of goods from suppliers to the ultimate consumer, as well as improve integration of business processes along the chain of supply (Feller, Shunk & Callarman, 2006). SCM was driven by rapid technological development and industrialisation in the 1980s and revolutionised textile and grocery industries in the 1990s. Wal-Mart, one of the largest firms in the world in terms of sales in 2006, refined this method (Johnson, 2006).

Agriculture food chains reappeared in the 1990s as a result of the above mentioned *filière* approach. Later, some studies combined food safety with agriculture food chains in Europe. This created an effective analysis for implementing public food standards. Public food standards contain legislation, which includes process activities in the food supply chain and final product characteristics. The legislation states that dealing with food safety brings forth various issues such as rearrangement of value chains and bargaining powers (Hammoudi, Hoffman & Surry, 2009).

A turning point in the industry occurred with the introduction of Global Commodity Chains (GCC), also introduced in the 1990s. GCCs encouraged researchers to use value chains in globalisation and international trade issues. The most well-known author to introduce this concept was Gary Gereffi (Gereffi, 1999). Gereffi and others used the framework of value chains to examine how firms and countries are globally integrated. The focus of GCC has been on industrial commodity chains, especially in Asia and Latin America, rather than on agricultural food products. In the 2000s, variations of the value chain concept emerged and appeared in all major disciplines.

2.1.2.3. Limitations

Clearly, VCs are complex with many challenges and limitations. Value chain analysis differs according to the type of product involved (Holweg & Helo, 2014). While helpful, this approach cannot solve all the problems in the food system (FAO, 2014a). The first limitation is that there is no agreement on how to implement the value chain method (FAO, 2007). This leads to a lack of worldwide agreement. This for example, can be seen through the number of research studies that are fashionably and incorrectly titled using the term, value chain.

Secondly, VC development is focused on mainly economic aspects and less on social and environment impacts. For a firm to be sustainable all aspects need to be taken into account: economic, social and environmental. This one-directional focus can lead to unsustainable value chains which will lower the chain's pursuit of sustainable competition (Fearne, 2012).

Lastly, VC development is a timely process. In practice, time and resources are usually limited, which leads to insufficient, and inadequate value chain analysis. This is true even if all the stakeholders understand and rigorously apply the principles of value chains. This increases costs and therefore reduces the number of impact studies conducted, resulting in a lack of concrete knowledge. Table 2.1

depicts the timeline of value chain analysis. The main concepts mentioned were discussed at the beginning of this section. Within each row demarcating a date in time, the concepts that were introduced within each of the major disciplines are marked with an x. Researchers in economics and business have been concerned with the movement in value ever since early work of Adam Smith. Smith distinguished use-value and exchange value (Tseng & Lin, 2005). In engineering and logistics, the primary focus has been on achieving operational efficiency.

Table 2.1: Value chain concept timeline (FAO, 2007)

Time	Concepts	Major Disciplines		
		Economics	**Business Management**	**Engineering and Logistics**
1950s	Input/ Output Analysis	x		x
	Agribusiness (Harvard)	x	x	
	Industrial Dynamics and Systems Science	x	x	x
1960s and 1970s	Industrial Organisation	x		
	Subsector Analysis	x		
	Filière	x	x	
1980s	Porter's Value Chain		x	
	Supply Chain Management		x	x
1990s	Agrifood Chains	x	x	x
	Global Commodity Chains	x		
	Transaction Theory applied to Vertical Coordination Analysis in Agrifood Systems	x		
	Policy Analysis Matrix (PAM)	x		
2000s	Value Chain (revisited)	x	x	x

2.1.3. The basic model

2.1.3.1. Introduction

The value chain is a model that describes a series of value adding activities connecting a company's supply side with its demand side (Rayport & Sviokla, 1995). As discussed previously, Porter first described and popularised the concept of the value chain with regards to manufacturing products on firm level (Porter, 1985b). Porter defined "value" as the amount buyers are willing to pay for what a firm provides. Porter considered the VC as a combination of nine "value added" activities operating within a firm – activities that work together to provide value to customers (Figure 2.1). These activities within a firm determine the firm's competitive position (Stonehouse & Snowdon, 2007). Here Porter's approach was restricted to firm level and neglects analysis of upstream or downstream activities (Recklies, 2001). On a positive note, however, for any product or service the process of delivery involves a number of stakeholders, which can cause complexity. Porter's traditional value chain model could be used to unravel this complexity by analysing each individual activity of the firm separately (Barnes, 2002).

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Rather than looking at departments or accounting cost types, Porter's VC focuses on systems. The system includes many processing steps and inputs. However, Porter's value system is mostly used as a tool in strategic management practices. One example of this related to the present study is livestock systems. A livestock system is characterised by long marketing chains including long distance travel, different phases of feeding and weight gain, many trades, and a number of processing steps and inputs (Rich et al., 2011).Throughout such a system, time and value adding occurs to produce a product.

2.1.3.2. Primary activities

Porter noticed firms could be organised into five primary activities, which are related to the physical creation, sale, maintenance and support of a particular product or service. All these activities add to or take away value from the product. The primary activities consist of inbound logistics, operations, outbound logistics, marketing and sales, and service. Inbound logistics refers to activities that deliver products or services to the end customer. This includes collection, storage, and distribution systems, which may be internal or external to the manufacturing firm. Operations include all the activities required to collect, store, and distribute the output. This primary activity creates value to the product or service. Outbound logistics include all activities involving collection, distribution, and storage of the product. Marketing and sales refers to all activities that inform buyers of the product or service itself, as well as benefits of the product. Service includes all the activities required to keep the product or service working effectively for the buyer after it is sold and delivered.

2.1.3.3. Support activities

Support activities play a role in each of these primary activities. Porter described four secondary activities: procurement, human resource management, technology development, and infrastructure. Procurement is the purchasing of inputs and resources for a firm. Human resource management consists of all activities involved in recruitment, hiring, training, motivation, rewards, and the retaining of its workers. Technology development refers to managing and processing technical knowledge. Lastly, infrastructure comprises a company's support systems and the functions that allow it to maintain daily operations.

So far, there has been no attempt to measure the non-monetary costs of primary and support activities discussed above. In doing this, it ignores linkages in the wider value chain. These linkages include the causes of purchasing price, the costs of activities related to the product, and the consequences of the product for the buyer's activities for example, transaction costs due to time delays have not been explored even though this can happen regularly in South Africa. As a result, opportunity for improving non-monetary areas in the value chain is lost at this level.

Although this research discusses the losses of biltong, these are not specifically assessed as part of the profit margins and value added time along the biltong value chain of the Western Cape.

2.1.3.4. Profit margins

The goal of primary and secondary activities is to offer the customer a level of value that exceeds the cost of the activities, thereby resulting in a profit margin. In other words, the value created by a company is the profit margin. Therefore, value created and captured minus cost of creating the value equals the profit margin. Members of a value system can cooperate to improve their efficiency and reduce their costs in order to achieve a higher total margin to the benefit of all involved. The 'marketing margin' is another important term used to represent marketing costs such as transportation, storage, processing, wholesaling, retailing, and advertising (Bakucs & Fertő, 2006). Studies of raw materials to retail profit margins date back from the 1920s in the United Kingdom meat sector (Tiffin & Dawson, 2000). Lately, price margins in agricultural commodity value chains have become more advanced in the newer literature. The margins are spread across the suppliers, producers, distributors, customers, and other role-players in the value system. An understanding of the margins along the whole value chain gives a more comprehensive understanding of the bigger picture regarding supply and demand forces.

The task of assigning margins at each stage of agricultural commodities in a value chain is simple. In this specific commodity, a price is decided upon at each activity in the chain. Therefore, price spreads evaluate how much value each particular activity adds to the product. One popular example is the coffee chain, which includes price margins in the value chain. Another example is that of the cotton industry, where price margins of organic and synthetic cotton are compared (Rieple & Singh, 2010). For this study, the framework of the cotton industry is adapted for the biltong chain and used to analyse the price margins along the biltong value chain of the Western Cape (Fitter & Kaplinksy, 2001; Winter-Nelson & Temu, 2002). The concepts discussed in this section, namely margins and primary and secondary activities, are conceptualised in Figure 2.1.
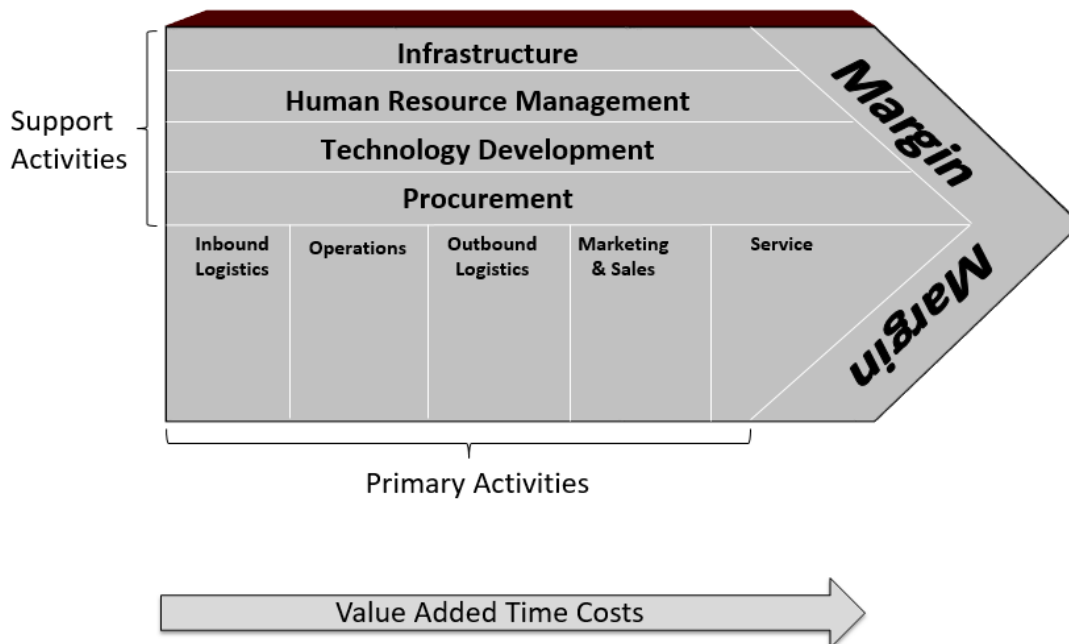
Figure 2. 1: The Basic Model of Porter, (Adapted from Rieple & Singh, 2010).

2.1.4. The concept of value

To bring the concept of value into focus, consider for a moment a person walking in the desert. This wanderer has been walking for two days without water. As the person travels, the one person only has water on his/her mind. At that specific moment in time, the person will not consider the container, flavour, price or who will be providing it. Water in this conceptualisation has a unique value to the person. In this example, one can see that value, like beauty, is in the eye of the beholder; The first principle of the lean approach, introduced by Womack and Jones (1996), stresses the importance of defining value from the consumer's point of view. Because value is derived from customer needs, activities that do not contribute to meeting these needs are 'non-value added waste', or 'muda' in the parlance of lean thinking (Ugochukwu, Engström & Langstrand, 2012). 'Value added' in SCM is therefore related to concepts such as quality, costs, delivery times, delivery flexibility, and innovativeness. Some activities along the chain thus adds value. Value added in Porter's value chain theory focuses on where value is added within the firm. Since 2000, value added expanded to all the actors in the chain. Value in this context is created at different stages and by different actors throughout the value chain. Where by streamlining the processes that generate the goods and services that customers value, fewer resources need to be exploited. As a result, the margin between customer value and the cost of delivery increases, improving a firm's profit margin. Streamlining the process can be done by analysing value added time.

2.1.4.1. Value added time

Value added time, also known as cash-to-cash cycle, starts the moment a business purchases raw materials and ends at final distribution. That time is represented by the number of days the inventory stays in the pipeline. This inventory can be raw materials, work-in-progress, goods in transit, time taken to process orders or issue replenishment orders, as well as time spent in manufacturing, time in

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queues or bottlenecks. Detailed analyses of logistic pipelines often reveal that the length of these cash-to-cash cycles can be significant – often measured in months rather than days. It is also likely that most of the time in the pipeline will be non-value adding time; in particular it will be 'idle time,' or time spent as inventory that is not on the move. Supply chain mapping can enable the identification of opportunities for reducing inventory and thus cost. Figure 2.1 shows an actual map for a particular product, a clothing item. The vertical lines reflect the average inventory over the period of investigation at each step in the chain. Reducing the cash-to-cash cycle is defined as a critical performance. Anything that can be done to refine the end-to-end time clearly means a release of working capital and a reduction in cost.

2.1.4.2. Distribution of Value Added

The distribution of value added along the chain depends on the bargaining power of the actors, information asymmetry between chain links, and technologies used. It has been shown that price changes at the retail level do not translate into an increase in change in prices at the farm gate (Fitter & Kaplinksy, 2001; Bacon, 2005). Bargaining power in communities with a strong social structure and high levels of trust plays an important role amongst the actors in the chain. Small-scale producers in a social network can strengthen their position in the value chain through social capital (Gulati & Kellogg, 1998). Trust plays a major role in business relationships. Trust increases due to duration of relationships and consistency of exchange between actors on social and economic level (Trienekens, 2011; Laeequddin et al., 2012; Tejpal, Garg & Sachdeva, 2013). Here, the margins depend on the negotiation structure of the value chain where each member will bargain to get a higher proportion of the end margin. Therefore stakeholders do not just add value, they reinvent it through relationships and by including new combination of stakeholders along the chain (Normann & Ramírez, 1993).

2.1.4.3. Framework of a Value Chain Analysis in a developing country

Research shows that a value chain is characterised by its network structure, the way value is added, and the governance structure of the chain (Trienekens, 2011).

- *Network structure:* A value chain's network structure originates from SCM and network theory. It can be applied on a local, regional and international boundary. SCM focuses on vertical links between actors who produce the product. Vertical links, or vertical co-ordination, refers to how products move through the value chain from production to consumption (Hobbs & Young, 2000). Network theory connects horizontal and vertical relationships between all actors in the value chain.

- *Value added:* This concept originates from SCM, new institutional economics and value chain analysis. Each of these areas of origin has a different focus. SCM focuses on how value is added through improving the quality of the product or reducing the value added time. The

focus of new institutional economics is transaction costs. Value chain theory focuses on where value is added in the value chain.

- *Governance:* The concept of governance originates from new institutional economics, value chain theory and network theory. Governance looks at which optimal governance structure will contribute positively to chain actors, where the bargaining position of chain actors is, and where the related distribution of value is added.

SECTION 2: FOOD LOSS ANALYSIS ALONG THE VALUE CHAIN

2.2.1. The conceptual implications of food loss

The food chain consists of stakeholders dedicated to manufacturing and processing raw materials and semi-finished products from agriculture, forestry and fishing. This transformation is of course heavily supported by logistics and operations (Manzini & Accorsi, 2013). The aim of the food value chain is to be efficient as a whole.

One way of measuring this efficiency is to reduce losses. Losses in this study are edible and non-edible foods that are wasted along the food chain. Many benefits can result from reducing food losses. Firstly, on a global level, food hunger can be uplifted. Secondly, stress on natural resources such as water and land can be lessened by using these resources more efficiently (Kummu *et al.,* 2012). Next, as food loss is taken to landfills which produce methane gas, a reduction in food loss will result in a reduction in air pollution (Dorward, 2012; Scholz, Eriksson & Strid, 2014). Finally, the economic impact of throwing food away can be reduced. This impact ultimately affects all organisations and individuals involved in the value chain, including the final consumer, so a reduction of this will be widely beneficial.

Food loss and waste has been recorded throughout the food value chain, from primary production to consumption (Eriksson et al., 2014). The Food and Agricultural Organisation of the United Nations (FAO) estimates that the annual value of produced and unconsumed food is as high as $936 billion (FAO, 2014). The FAO also estimated that about one third of the food produced worldwide is lost along the food value chain (Gustavsson, 2011; Kummu et al., 2012; Lipinski et al., 2013). Global studies showed up to 23-24% of the total use of water, cropland and fertilizer are used to produce total global losses. If these losses are reduced through a more efficient value chain, one billion extra people could be fed if only food crop losses could be halved (Gustavsson et al., 2011). For these reasons, food loss has started to attract the attention of governments, non-governmental organizations (NGOs) and major sectors involved in the food value chain, such as agriculture, food processors and retailers.

Unfortunately, global food loss research is constrained by limited data, especially in developing countries. Often the amount of loss is undervalued and not reported (Kummu et al., 2012). If awareness of food loss along chains is cultivated, solutions can be devised and implemented to minimise food losses. The significance of Food Loss and Waste (FLW) has become topical in global reports, studies, broadcasts and articles. This research aims to identify and quantify the total food loss generated along the biltong and dry sausage value chain in Western Cape and is the first such study of this commodity. Food losses in South Africa have been roughly estimated at 9.04 million tonnes per annum (Oelofse & Nahman, 2012).

2.2.2. The new conceptual framework for food value chain assessment

2.2.2.1. Unique Characteristics of a food chain

As discussed in Section 2.1.2. studies on agrifood chains appeared in the 1990s. Agrifood chains, also called food chains, have four unique characteristics that distinguish them from other value chains, such as manufacture chains. These four unique characteristics are:

1) Inclusivity: everyone is part of a food value chain. We are all consumers whose well-being is directly affected by the food we eat. The consumer has a strong impact on the nature of the value chain through a consumer's habits, preferences, residential location, and concerns.

2) Dependence: in developing countries, food value chains represent a large part of the economy. Many people derive an income from food chains. What is more, the world is facing food insecurity that poses a potential threat to these individuals. This problem of food insecurity can be partially resolved through food chain analyses.

3) Vulnerability: food production is closely tied to the natural environment and the life cycle of plants and animals. Therefore, the food value chain is influenced by factors beyond the control of stakeholders in the chain.

4) In relation to this, the quality of food products is also difficult to control in terms of uniformity and preservation over time. Quality throughout the food chain is control by physical factors such as temperature, humidity and light (Kong & Singh, 2011). Upgrading of these physical factors can be achieved through good agricultural practices, contracts, standards and maintenance of cold chains. Food quality and safety are important measures of efficiency along these value chains, and can be measured through an analysis of food loss.

2.2.2.2. Variety of methods applied to food chains

The aim of this section is to classify the basic pillars included in the conceptual framework of food value chains. A framework of Supply Chain Management (SCM) is used as the basis of the food value chain, even though the SCM focus is not explicitly on loss along food chains. SCM is used as a basis as recent studies have shown significant contributions from the combination of supply chain management and agrifood chains.

Food chains provide a flexible framework due to the variety of methods that can be used to improve the food chain efficiency. This study will use margins, value added time, and food loss methods along the biltong chain in the Western Cape, South Africa.

 One way to reduce food insecurity as well as identify quality and safety is to link food loss analyses to the food chain. If losses along the chain are high, compared to international standards and biltong makers' standards, then there is an economic and social problem. As discussed in the introduction, high food losses will lead to lower benefits. This identification of food loss can lead to more efficient processing methods that can reduce food losses, which will automatically increase quality and food safety standards. For example, if 1% of all products sold contains mould, the 1% will have to be transformed or discarded. If transformed to another product, economic value will be lost. If the product is discarded, social value will be lost. Identification of what causes the mould (loss) will improve the safety and quality of the product. For effective reduction in losses it is important to estimate the losses and the stages at which they occur (Appiah, Guisse & Dartney, 2011).

2.2.3. Quantifying food loss

2.2.3.1. Food loss defined at all levels

There is no single definition for Food loss and Waste (FLW). Definitions of FLW differ widely (Beretta et al., 2013). One most frequently utilised definition in the literature was created by the FAO in 2011: "Food losses occur at production to processing stages, while food *waste* occurs at distribution and consumption stages". Important to note is that the FAO definition only refers to edible food waste. Furthermore, the 'distribution' stage includes wholesalers, supermarkets and retailers; while the 'consumption' stage refers to waste at the household level (Nahman & de Lange, 2013). This definition has been revised a few times; in 2014 (FAO, 2014) and 2016 (FAO, 2016).

For the purposes of this study, the term food loss will be used, where food loss and food waste are synonymous in this context. Food loss occurs at all stages in the food chain. The type of losses along the value chain are categorised at each stage of the value chain: harvest losses, postharvest losses, processing losses, distribution losses, and consumer waste.

There are a number of different causes of food loss. Harvest losses refer to food loss during harvesting, such as fish being discarded during fishing operations. Post-harvest loss is loss that occurs when the product leaves the farm for handling, storage and transport. For example, a significant change in temperatures when fish is stored and transported can lead to waste. Processing loss occurs during industrial or domestic processing, such as fish being spilled or damaged during canning. Distribution loss occurs during distribution to market, including losses at wholesalers and retail markets. Consumption losses are losses at the home level or at businesses, including restaurants and caterers (Lipinski et al., 2013).

In the media and in public discussion about food loss, retailers are often accused of being the main contributors to food loss. However, research shows that retailers have the lowest food loss. Papers on food loss at distribution level are limited and often limited in scope. Some studies do show rough estimates on national levels, but published literature often investigates a limited number of retailers (Eriksson et al., 2012). Furthermore, the methodology and data used in the majority of these papers is unclear. For example, a typical distribution level analysis from 612 retailers showed that food loss at sales amounted to 1.3% for dairy and 4.2% for fruit and vegetables. Twenty-eight percent of this discarded food had reached their expiry dates, but had no problems otherwise (Lebersorger & Schneider, 2014). Research often only investigate a limited number of outlets and only focus on specific commodity groups (Eriksson et al., 2012, 2014).

There are, however, a few studies that do provide helpful insight to food losses. The first detailed data on food losses on a retailer were reported in 2013 in the UK. An advantage of this paper is that it covered a large sample size of the total food outlets in the country. The food loss percentages for the retail stage are similar to the results of previous publications (Lebersorger & Schneider, 2014).

Food loss can be expressed as the total weight of food loss per year (tonnes/year) or per capita (kg/year or kg/day). Consumers in Europe and North America waste on average 95 - 115 kg of food per person per year, respectively. Consumers in sub-Saharan Africa waste only 6 kg of food per person per year (Gustavsson et al., 2011).

Stakeholders in the chain who experience the most loss are those on farm level. Farm level has the highest loss due to natural disasters, insufficient availability of postharvest machinery, and product damage through animals or incorrect handling (Tefera, 2012). Excluding agriculture, national loss estimates range between 5% in the German food value chain, 6.5% in the Swedish food value chain and 7.6% in the UK food value chain (Lebersorger & Schneider, 2014).

The stakeholders analysed for food losses are the secondary processers and retailers. Loss identification in the biltong chain in the Western Cape of South Africa will require new field work.

2.2.3.2. Defining food loss for the study
The appropriate definition of food loss in the context of this study for the distribution and consumer stage reflects the definition forwarded by Parfitt, Barthel & MacNaughton (2010). This definition describes food loss at this stage as: "food losses occurring at the end of the food chain, which relate to retailers' and consumers' behaviour".

Processing losses do not follow the same definition as above. Losses identified by stakeholders in this study include three types of process losses: pre-process loss, process loss, and post-process loss.

1. *Pre-process loss*: Pre-process loss occurs when raw meat enters the secondary processors. The raw meat is trimmed and prepared. These losses are associated with the quality of the

meat bought from primary processors. This includes losses due to meat quality, blood loss and sinew. This type of loss includes all that is purchased by the processor and will not be transformed into biltong.

2. *Process loss:* Process loss occurs when product is discarded after drying and packaging. This is due to the product being unfit for selling. The product can contain spoilage factors or be inconsistent as pertaining to production specifications.

3. *Post-process loss:* Post-process loss occurs when the quality of the product decreases after it has been sold. This refers to spoilage such as mould, and degradation such as discolouration.

This definition includes both the edible and inedible portions of the loss stream, so features such as blood and bone are included (Nahman & de Lange, 2013). See a conceptualisation of this in Figures 2.2 and 2.3. However, the paper by FAO focuses specifically on the edible portion of fish (FAO, 2016). This definition also excludes food that is discarded by consumers (post-consumer food loss). For the purposes of the thesis, food waste was defined broadly to include losses that arise before food reaches the end-user (pre-consumer food losses), as well as food that is discarded by consumers (post-consumer food waste). A question to consider when discussing food loss in the biltong industries is: "What is the main problem that causes biltong and droëwors losses?" The most common problem in the biltong industry is mould growth. Mould growth in biltong and droëwors were reported in literature from as early as 1976. The South African National Standards have set out legal microbiological requirements for biltong but the limits of moulds are not stated in this legislation but are currently being drafted. Mould growth is undesirable to consumers, therefore results in economic losses for secondary processors and retailers (Van der Riet, 1976). Moulds thrive in a wide range of temperatures, even if the products are stored during low temperatures (Cook, 1995). As mould growth are becoming an increasing concern in the biltong industry, a more studies to identify the cause of moulds, would be of interest.
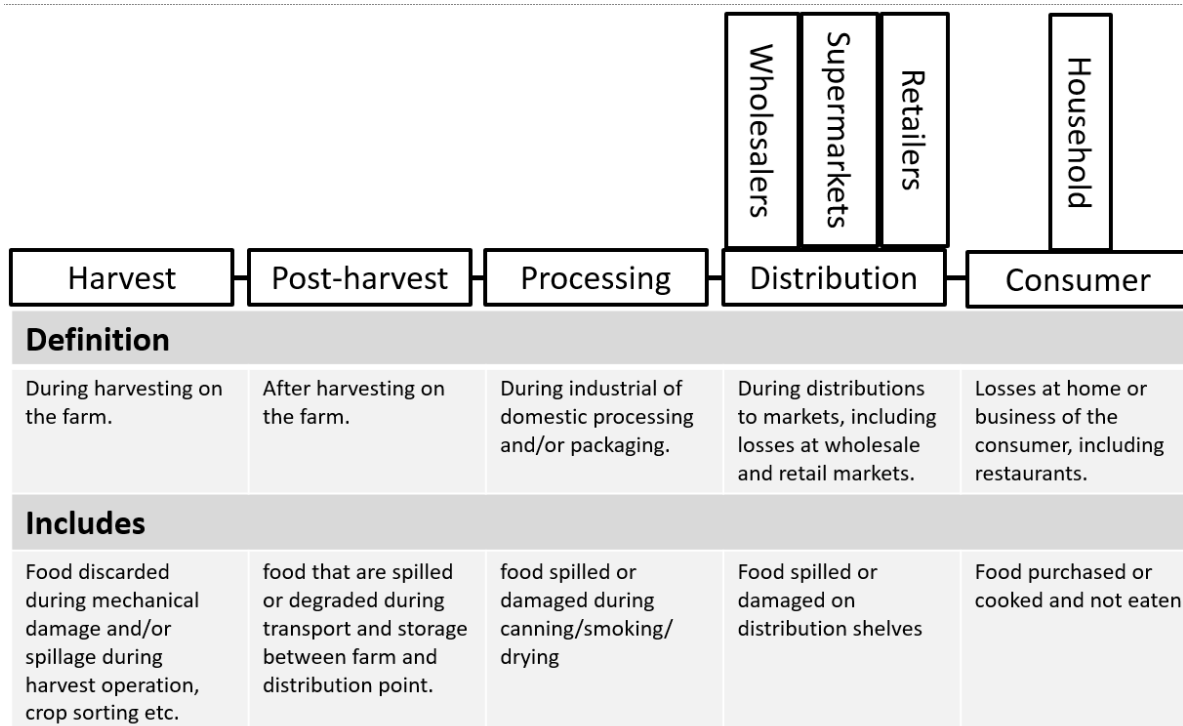
Figure 2.2: Brief explanations of food losses at different stages. Adapted from Gustavsson (2011) and Lipinski et al. (2013).
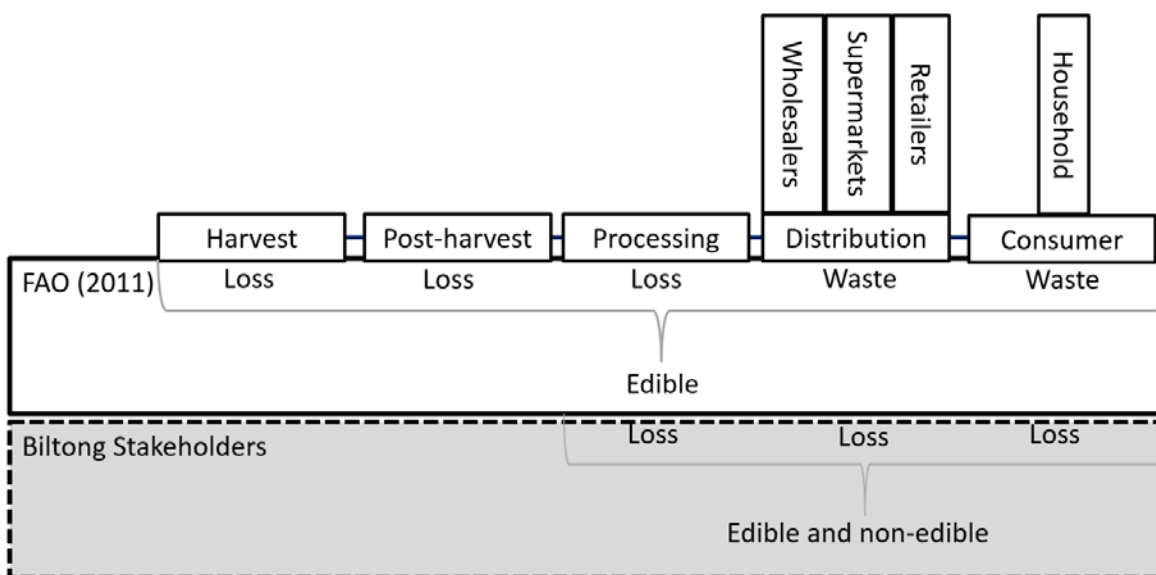
Figure 2.3: Food loss along the value chain. Adapted from Lipinski et al. (2013)

2.2.3.3. Developed and developing countries food losses

Food loss varies across countries. This is mainly due to income, and levels of industry development. In developing countries, two thirds more food is lost at the post-harvest and processing levels. This is mostly attributed to poor agricultural practices, technological, financial and labour restrictions as well as poor infrastructure for storage, processing and transport (Chalak et al., 2015). Food loss is

considered a threatening factor for current and future sustainable development and food loss systems (Thi, Kumar & Lin, 2015).

On the other hand, in developed countries a considerable fraction of food loss occurs at the level of consumption. This is largely driven by consumer values, behaviours and attitudes (Lebersorger & Schneider, 2014). Most of the food is wasted either after excessive cooking, preparation or serving (along with improper storage), as well as it not being consumed before its "use by date". This is believed to be a direct result of over-shopping that is driven by poor planning and impulse or bulk purchasing (WRAP, 2009).

At consumer loss, developing countries generated lower food loss at consumer level when compared to developed countries. South Africa's total food loss is estimated at 9 040 000 tonnes per year. This amounts to 31.4% of the average annual agricultural production which is 28.79 million tonnes per annum (Oelofse & Nahman, 2012). Germany stands at total food loss of 12 257 998 tonnes per year (European Commission, 2010).

To conclude, the value chain of a commodity needs to be described to understand the industry in which the commodity operates. To do so, Firstly, the origin, definitions and limitations of the value chain concept needs to be described. Then only, can the term be used to relate to the main research objectives of the thesis. The objectives were to describe the structure of the biltong value chain, with specific focus on secondary processors and biltong retailers in the Western Cape, South Africa. Only after an understanding of the value chain at specific stages, can food loss be identified. Food loss and value chain have one common trait; they both are defined differently in numerous literature papers. After food loss is defined the second objective can be answered, to identify and quantify food loss along the biltong chain. Chapter 2, introduced new concepts to value chain analysis. Two concepts introduced from value chain analysis in this thesis is value –added time and distribution of value added. These two concept supported the third objective of the study, to identify and compare prices along the value chain for both beef and game biltong. The importants of this chapter is to understand the concepts used in the thesis later on. As well as understanding the reason for different methods used.

CHAPTER 3: RESEARCH DESIGN AND METHODOLOGY

3.1. Introduction

As stated in the first chapter, the main purpose of this study was to measure critical loss points at two stages of the biltong chain. The stages are secondary processor stage and retail stage. The secondary objective of this study was to analyse beef and game biltong prices. In order to achieve these objectives, a case study approach was used. Data was collected using qualitative and quantitative interviews. Certain authors consider the analysis of governance essential for completing the understanding of value chains (Gereffi, Humphrey & Sturgeon, 2005; Ponte & Gibbon, 2005). The present study does not include this type of analysis as the chosen methodology is sufficient for the purpose of this study. Generally, food value chains focus on a specific product, which gives accurate data on one type of product. For example, pork chops in the pork chain. This also aids in comparing products which can be substitutions (FAO, 2007). In order to complete food value chain analysis in a way that supports design, planning, management and control along the chain, the food chain needs to be defined clearly (Manzini & Accorsi, 2013). This can be done by describing the following characteristics:

1. The target assessment (e.g. safety, quality, sustainability and environmental friendliness)
2. The involved value chain links (e.g. raw materials, wholesalers, processors)
3. The involved stakeholders (consumers, processors, retailers)
4. The discipline of interest (e.g. processing, packaging, logistics)

This information will provide a comprehensive understanding of the food chain being studied as it covers the most important characteristics to complete a food value chain.

3.2. Conceptual framework

3.2.1. Introduction

The present study focuses on the formal chain of beef and game meat ready-to-eat products within South Africa. These ready-to-eat products include biltong and dry sausage. Conceptually, the study was based on two different formal value chains. For simplification of the value chains, one will be called Game chain and the other Beef chain. Although game meat is often referred to as venison, it is important to differentiate these two terms. Venison generally refers to meat originating from farmed animals, such as the deer in New Zealand and Europe. Game meat in South Africa, on the other hand, refers to wild, free-roaming animals (Hoffman & Wiklund, 2006). In this report, the term game meat will refer to meat taken from wild ungulate species including springbok, kudu, eland, blesbok, wildebeest species, zebra, and the like. Ostrich is not included under this term because it is venison meat originating from a farm animal.

Two surveys were conducted, one amongst secondary processors (n=14), and the other amongst retailers (n=3). The secondary processors are stakeholders in the secondary process and retail sector. Twelve out of the fourteen stakeholders process and retail both game and beef dry meat products. The remaining two stakeholders process and retail beef dry products only. These secondary processors are mainly located in urban areas and are legislated by the relevant municipal authorities. The retailers who were surveyed receive biltong from integrated secondary processors. In this context, an integrated secondary processor refers to a processor that includes wholesale activities. These processors follow the typical flow of an urban market in that dry meat products are distributed to both wholesalers and retailers (Bekker, Hoffman & Jooste, 2011).

The type of losses explored in the survey were processing losses. The processing losses of biltong and dry sausage were investigated by means of qualitative and quantitative data. The qualitative data used was open-ended questions that could generate an idea of how the individual feels about certain situations in the biltong industry. Quantitative data such as loss expressed in percentages and amount produced per month were used. The data collected were used to create flow charts for both game and beef value chains. These value chains were used as a guide for identifying critical loss points along the chain. The informal market was excluded in this study due to the difficulty in identifying and contacting role players.

The research was carried out between December 2015 and August 2016, in collaboration with the SARCHI Chair in the department of Animal Sciences at the University of Stellenbosch (South Africa) and CIRAD (France).

Table 3.1: Conceptual Framework

Objectives of the study	- Draw the value chain for beef and game dry meat products.	
	- Characterise the difference between the beef and game value chain.	
	- Identify the critical loss points along the supply chains for both game and beef products.	
Informant	Retailers	Secondary processors
Area	Stellenbosch	Cape Town, Stellenbosch, Strand and Central Karoo.
Sampling size	1 Supermarket, 1 biltong shop, 1 national retail meat buyer.	3 butchers, 11 biltong processors.
Data collection tools	Structured questionnaires	Structured questionnaires

3.2.2. Study Area

The study focused mostly on suburbs in Cape Town, Stellenbosch and Strand in the Western Cape province of South Africa. The population of the Western Cape was estimated in 2014 as 6 116 300, which makes up 11.3% of South Africa's total population. The Western Cape has remained at around 11.1% of South Africa's population in more recent estimations (StasSA, 2016). Figure 3.1 demarcates the areas where interviews were conducted in the Western Cape. The "stars" show the areas where the secondary producers were interviewed. The arrows indicate where the dry meat products where sold at different type of retail points.

Figure 3.1: Map of the study area.

3.3. Case studies

3.3.1. Introduction

The case study approach is an established research design. It first appeared in the social sciences, especially in clinical practice and research. This study can be applied to departments of Education, Business and Management, Nursing and Public Health, Public Administration, Anthropology, Sociology, and Political Science (Yin, 2009). Case studies are mostly qualitative in nature and can be comprised of a mix of qualitative and quantitative evidence (Yin, 2009). Research that involves the

integration of quantitative and qualitative research has been common in recent years. The combination of the two is sometimes called multi-strategy research.

If multiple research tools such as multiple methods and sources of data are used it will enhance the validity of the research. This is called triangulate (Mathison,1988). When using these methods different aspects of the multi-strategy methods needs to be considered (Bryman, 2009). These questions include:

1. Are the quantitative and qualitative data collected simultaneously or sequentially?
2. Which method has priority?
3. What is the reason for integration? For example, triangular, exploratory or diagnostic.
4. At what stage in the research are multi-strategy methods used? It may be at question formulation, data collection or data interpretation.
5. Is there more than one source of data and research method?

One of the most important features in defining qualitative from quantitative data is the kind of sampling used (Sandelowski, 2000). Qualitative research gathers information that is not in numerical form.   For example, open-ended questionnaires, unstructured interviews and unstructured observations. Qualitative research is also helpful when answering more questions such as asking how or why something occurs. These questions can provide important situational and context-specific knowledge which is not always accessible through other research approaches. Qualitative research is also useful for studies at the individual level, and to find out in depth, the ways in which people think or feel. Qualitative data is typically descriptive data and as such is harder to analyse than quantitative data. The Quantitative research gathers data in numerical form which can be put into categories, or in rank order, or measured in units of measurement. This type of data can be used to construct graphs and tables of raw data. Therefore, the use of multiple sources of data has supported the research objectives in this study.

The focus group is similar in other food chain studies, such as cotton, coco and pork, where the findings are based on a specific group of companies in a specific value chain (Taylor, 2005; Rieple & Singh 2010; Fitter & Kaplinksy, 2001). The specific group of companies in this study are biltong makers and biltong retailers focusing on formal chains for both meat (beef and game) value chains.

Any methodology has its advantages and disadvantages. This is usually influenced by three factors: the type of research question, the influence the investigator has on the study, and if the focus of the study is on present or past events. One advantage is that the case study approach is one of the most well-known approaches utilised in value chain analysis, which is suitable in this study. Another advantage is that case study approach is a preferred method when obtaining detailed information about a specific issue in 'real-world' events, such as actual food loss in a value chain. Case studies

may also be used to support, expand or raise doubts about existing theories because the method is so adaptable (Taylor, 2005). One of the practical challenges of this method is that it has different methodologies and theoretical backgrounds which can result in a less systematic approach (Flyvbjerg, 2006; Crowe et al., 2011).

3.3.2. Number of samples

The selection of retailers and processors for structured interviews were based on availability, accessibility and willingness of these persons to be interviewed. All interviews were conducted face-to-face. One formal meat trader, who is directly involved but not situated in the area, was interviewed via telephone. The printed questionnaires were not written in English but rather in the South African language, Afrikaans. No group interviews were conducted. Each interview lasted between 45 and 120 minutes. The study was grateful to the fourteen large processors and three retailers who contributed data to this study. They will remain anonymous as confidentiality was ensured when their participation was requested.

3.3.3. Mapping the value chains

The second step in value chain analysis is mapping the value chain (Kaplinsky & Morris, 2001). Mapping is a descriptive process that shows the flow of a particular raw commodity through many different stakeholders and range of consumer markets.
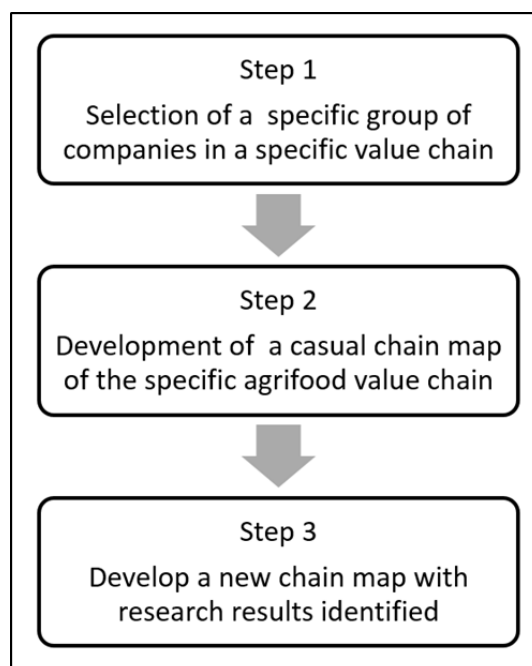
Figure 3.2: An approach for Value Stream Mapping (VSM) for determining 'waste' in the agri-food supply chain. Adapted from Folinas et al. (2013)

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The questionnaires were supplemented using casual value chain maps (Figure 3.2). This step helped to identify links in the chain where exchanges are made in the production as well as processing steps of game and beef biltong development. This map also helped to identify the main losses and prices along the value chain, which characterised the processing losses into three groups. These were pre-processing loss, processing loss, and post-processing loss. The final maps were derived after informal discussions with processors (n=14) and retailers (n=3). Appropriate literature from journals articles were used for this as well.
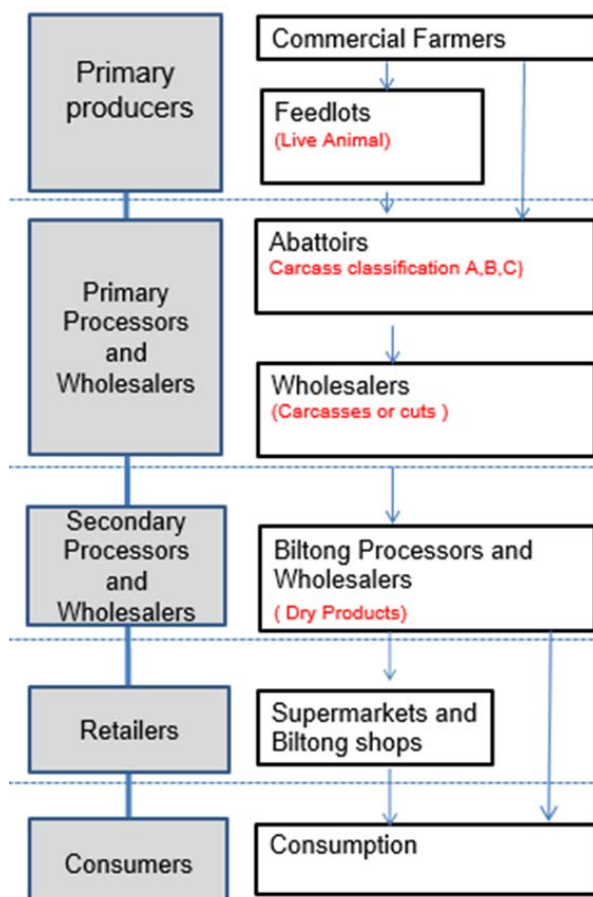
Figure 3.3: Casual value chain map.

3.3.4. Questionnaire content

The questionnaires for both retailer (Addendum A) and producer (Addendum B) consist of questions to enable a subsequent analysis of different statistical categories (e.g. yes and no). In the case of questions with numbers (e.g. 10 tonnes), the answers were filled into an empty space. At each step of the chain, losses were quantified as percentages of the overall volume of produce entering the step. With meat cuts, for example, the analysis was initiated from the moment the meat was received at the destination. The second questionnaire (Addendum C) contains price information. In the next section, the layout and purpose of the questionnaires are discussed.

Section A: Identification

The first section of the study aimed at identifying the type of activities practised by the stakeholder being questioned. This included any other activities excluding biltong processing that the processor may mention. These other activities were processing of raw meat products, wholesaling and retailing. The aim was to investigate the degree of integration in the biltong company. Next, the type of dry meat products (e.g. nuggets, snap sticks, etc.) and species (e.g. springbuck) of the dry products were identified. The number of employees was also accounted for and, finally, the type of clients/retailers (e.g. supermarkets, private shops, etc.) were identified.

Section B: Production and suppliers

During the second part of the questionnaire, respondents had to complete two tables. The first table contained information about total biltong and dry sausage sold from game and beef. The second table included suppliers of dry products, raw meat and quantities bought. Respondents were asked to provide as accurate an estimate as possible.

Section C: Loss of biltong and dry sausage (secondary processed products)

Losses in this study are edible and non-edible foods that are wasted along the food chain. To measure the loss of biltong and dry sausage, respondents' perceptions about loss in unsold and returned products per month on average, were recorded. The measurements were in percentages or Kg/month. Additional information was requested regarding the main problems that cause the loss and how retailers resolve it. One of the most important open questions requested personal opinions about the differences in quantities lost and types of problems surrounding game and beef ready-to-eat products. Finally, this section included a table to show the destination of the losses at processing or retailing level.

Section D: Loss of raw materials (carcasses, cuts, etc.)

This section was only included in the processor questionnaire. The aim of this section was to determine if processors have experienced loss due to quality of the raw materials. This section identifies the problem and the destination of the loss.

Addenda C: Price information from Secondary Processors in August 2016

Using the case study of biltong in the Western Cape, this thesis' secondary research objective was to analyse the presence of price asymmetry in price spread across beef and game biltong producers and retailers. Price asymmetry at different locations will was analysed. The task of assigning value is relatively easy in the biltong industry, as a price is struck at each stage in the value chain. This also gave a good indication of where most value is added in the biltong industry.

The biltong process starts at the primary processor (abattoirs) where biltong cuts are removed as primal (whole muscles) cuts, and the process ends at retail stage. Prices are obtained where the biltong process starts and finishes as the prices gathered include value-added tax. The result of the interviews with stakeholders regarding the buying and selling prices of products were compared with the data declared by the previous and next link. This gives a greater accuracy to the estimated prices (Fitter & Kaplinksy, 2001). Thus, the retail price declared by biltong shops was compared with the price declared by the seller. So far, there has been no attempt to measure non-monetary costs. For example, loss of production due to electrical load-shedding has not been measured even though this can occur regularly in South Africa.

The secondary process questionnaire involved prices of raw meat. This included carcasses, buttocks, shank (leg) trimmings, and prime cuts. Prime cuts include both topside and silverside. Stakeholders were also asked if raw meat prices stayed constant during the year. If not, they were asked to indicate what factors influenced this change of raw meat prices. Prices for finished products were also recorded for both secondary processors and retailers. Retail prices were gathered by visiting shops in the Western Cape during August and recording beef and game biltong prices.

Addenda D: Images and descriptions of the secondary processors and retail points.

Addenda D consist of images and description of the secondary and retail points. This aided the understanding of the biltong value chain and the different losses.

CHAPTER 4: RESULTS AND DISCUSSION

4.1. Introduction

All research data for losses were captured in the first middle quarter of the year at two-hour interview sessions in the Western Cape. A secondary questionnaire was sent four months after participation to capture price data. This was done to reduce the amount of data asked for in one session. Often, prices can be sensitive data to stakeholders. In addition, a better relationship with stakeholders was established after the first interview. Multiple comparison tests were conducted to compare game to beef prices as well as quantifying losses along the biltong value chain. All the questionnaires were completed. Therefore, all data sheets were used.

4.2 Biltong stakeholders profile

4.2.1. Introduction

This section discusses results of the first objective of the study, which is to describe the structure of the biltong value chain. As per section A and B as described under Chapter 3 (page 30-31). During the first part of the study, respondents had to complete several profile questions. The first set of questions included size and type of products traded. Furthermore, respondents were also asked to indicate on the casual value chain map where changes and details should be added.

4.3. The Stakeholders in the beef and game value chain

In the first section, the beef value chain will be focused on. This section includes a brief description of all the stages along the beef and game value chain in South Africa. The biltong and droëwors value chains begin with the primary producers of commercial cattle farmers and game farming or game ranching and ends at the consumer. It covers all stages from pasture to plate. The thesis described first the beef value chain, then the game value chain, for biltong and droëwors up to the end of primary processors and wholesalers. In Chapter 5, the value chain is discussed in more detail at the secondary processors and wholesalers' stage, as well as retailers.

4.3.1. The Stakeholders in the beef value chain
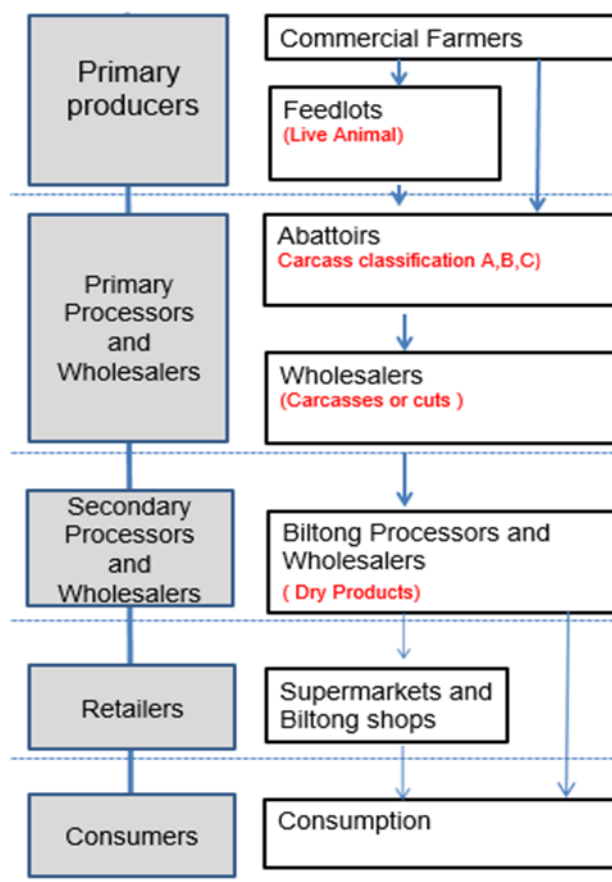
Figure 4.1: Beef value chain.

4.3.1.1. Commercial cattle farming in South Africa (Primary producers)

In South Africa, commercial and non-commercial livestock farming is one of the most successful agriculture activities in the country. Where 122.3 million hectares (68.61%) of land in South Africa is suitable for raising livestock (DAFF, 2011; Soji et al., 2015). South Africa has an estimate of 35 000 commercial farmers. There is a clear distinction between the commercial (formal) sector of the industry and the non-commercial (informal) sector. In 2005, the national cattle herd numbers were at an estimated 13 million to 14 million heads and has been said to be stable since. This includes beef and dairy cattle for both commercial and non-commercial production (Robinson, 2007).

4.3.1.2. Feedlots (Primary producers)

Feedlots (Figure 4.1) in South Africa differ in size. The standing capacity ranges from few head to one of the largest at 120 000 cattle, at any point of time. The larger feedlots with 10 000 plus animals are situated near Johannesburg, Witswaterand and Pretoria where they are closer to the corn/maize belt. In the formal beef supply chain, more than 70% of all beef slaughtered in South Africa come from commercial feedlots (Figure 4.1). South Africa also imports 150 000 to 300 000 weaners a year

to be finished off in feedlots (Jonker, van Vuren & Wepener, 2009). The largest feedlots in South Africa at any point in time are Karan Beef (120 000 head of cattle), Bull Brand (40 000 heads of cattle), Sparta Beef (40 000 head of cattle), EAC group (35 000 head of cattle), Beefcor (25 000 head of cattle) and Beefmaster (20 000 heads of cattle) (DAFF, 2012).

4.3.1.3 Industrial Abattoirs (Primary processors and wholesalers)

The Industrial Abattoir sector is an important stakeholder in the South African red meat supply chain because industrial abattoirs are responsible for converting live animals into meat. (fFigure 4.1). There were 88 registered industrial abattoirs in total in South Africa in 2011. An Industrial Abattoir is a slaughter facility which has been approved, graded and registered in terms of the Meat Safety Act, 2000 (Act 40 of 2000). The approval, registration, monitoring and control of Industrial Abattoirs are the responsibility of the veterinary public health units of provincial government in their respective areas of control (Bekker, Hoffman & Jooste, 2011). Most of the larger Industrial Abattoirs are owned by the feedlot industry, thus vertical integration in the chain is common.

Industrial Abattoirs purchase animals from their own feedlots or from farmers at live weights of approximately 400 kg to 450 kg. In order to yield a carcass weight of 250 kg at a dressing percentage of 52-58%. live weight should vary around 400 kg to 450 kg. Suppliers of live animals are paid by the Industrial Abattoirs according to the South Africa Carcass Classification based on two main components, namely age and carcass fat content (Soji et al., 2015) (Table 10).

The main difference between the formal and informal slaughtering is meat inspections and carcass classification. The reasons why communal farmers do not follow the formal chain is due to the lack of proper slaughter facilities within reasonable distance. Another reason is also that the informal market seldom provides carcasses that meet the requirements of the formal processing sector. The requirements for animal identification in the informal supply chain are unfortunately not always adhered too. Informal supply enters the formal supply chain illegally and legally at the processing and wholesaler points (Soji et al., 2015).

4.3.1.4. Wholesalers (Primary processors and wholesalers)

The term, ''Wholesaler'' refers to enterprises that trade in the formal market with approved carcasses and/or value added products. The Value added products are products that has gone through a number of activities such as deboning, cutting, packaging and distribution. Wholesalers mostly sell vacuumed cuts to secondary processors. Some wholesalers also sell whole carcasses that they received from approved abattoirs (Bekker, Hoffman & Jooste, 2011). Wholesalers process and pack by themselves, or through contractor co-packers. All wholesalers' final value added products are distributed from centralized distribution centres. Some wholesalers only sell cuts which are packed, which is a more popular choice for biltong processors. For the biltong and dry sausage/droëwors chain, cuts such as

silver side and topside (mainly for biltong), knuckle and trimmings (for use in droëwors production) are purchased from the wholesalers.

Biltong processors interviewed in this study sourced meat from more than one supplier. Three secondary processors sourced carcases straight from an industrial abattoir. This included mostly butcheries that are not exclusively into selling biltong production but also sell other meat (fresh and processed). The butchery activities include primary processors and wholesalers. This is where the deboning occurs. The butcheries also include secondary processing activities such as cutting, mixing, spicing and drying. Four processors receive their cuts from wholesalers, where one of the four imported from a wholesaler in Botswana. The majority received their cuts from vertical integrated companies. In addition to this, feedlots are also vertically integrated downstream in the VC to wholesaler level and, in some cases, up to retail level. These companies include companies such as Sparta, Karan Beef, Morgan Meats, Bravo Meats and Beef Master.
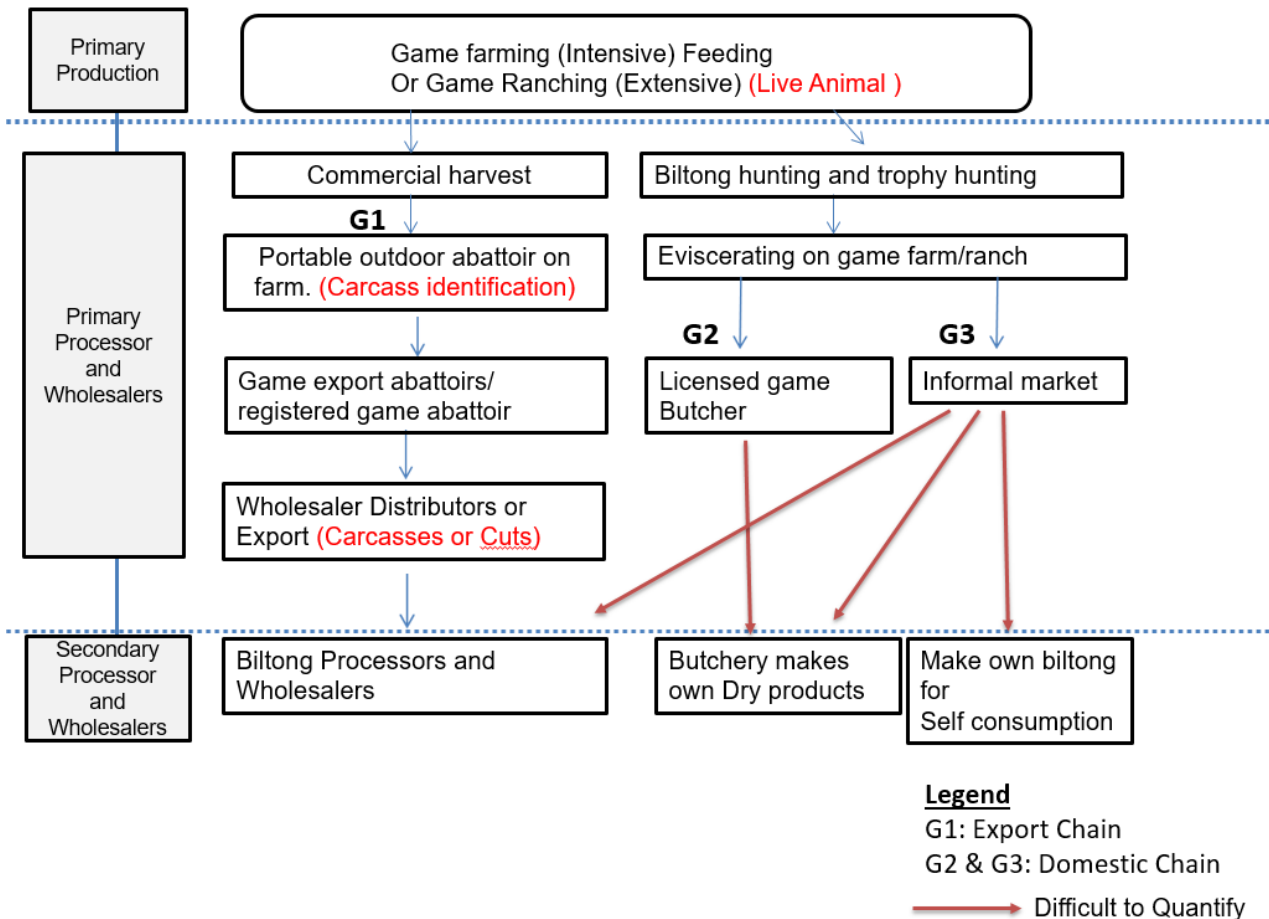

Figure 4.2: A typical game meat supply chain found in South Africa.

4.4.1. Stakeholders in the game supply chain of South Africa.

Throughout the game meat chain, there are different stakeholders (Figure 4.2). Each is responsible for the supply of a wholesome and safe product to the consumer. The control of game meat in South Africa lies in all three levels of government throughout the supply chain, namely national, provincial and local government (municipalities). Other stakeholders in the control of game meat include the game farmer, the hunter and hunting associations, Industrial Abattoirs, processors, wholesalers, retailers and consumers. The role-players who aid in the quality, safety and traceability of the game meat supply chain are the State Veterinary Services, and officials and inspectors from the Department of Health.

4.4.2. Primary production

The consumption of game meat is popular in southern Africa, especially in its dry form (D'Amato et al., 2013). The game meat production potential of various species of game found in southern Africa has long been recognized (Bekker, Hoffman & Jooste, 2011). Most common species hunted for meat products are springbok (*Antidorcas marsupialis*), impala (*Aepyceros melampus*), kudu (*Tragelaphus stepsiceros*), blesbok (*Damaliscus Dorcas philipsi*) and blue wildebeest (*Connochaetes taurinus*), (Van der Merwe et al, 2013). Despite the growth of the game industry being documented, it is still not reliably quantified. Moreover, there is remarkably little economic research on the industry, and as a result, the industry is often poorly understood.

The surface area used for wildlife ranching increased on average at 5 - 6% per year. This phase peaked around mid-2000. In 2011, privately owned game animals were estimated to be at 2.5 million head, which is estimated to be four times more than that found in government owned parks in South Africa (van Hooven, 2011).

Game farming and game ranching is used synonymously in many cases even though they refer to different primary production systems. Game farming is a primary production system where wild species are kept in domestic and semi domestic systems by being in closed small areas and provided with regular feeding. This is mainly done to breed specific animals that adhere to specific characteristics (frequently horn size or hide colour) and where harvesting for meat is a secondary product. Game ranching is where selected ungulates are kept in large areas in a semi-wild state that excludes regular feeding a (although this might be provided in drought years) at a level that game harvesting/hunting can occur regularly. Game ranching can be seen as extensive while game farming intensive (Carruthers, 2008; McCrindle et al., 2013).

4.4.3. Primary processors and wholesalers

There are two main supply chains for game meat production in South Africa (Figure 4.2). One is export-focused (G1), while the other focused on domestic supply, is also subdivided into two supply chains (G2 and G3). The chains compared in the game supply chain included game carcasses for

export purposes (G1), game carcasses intended for the local market but subjected to specific health and safety guidelines (G2), and game carcasses intended for the local market but not subjected to health and safety guidelines (G3). The export-focused chain includes commercial harvesting (G1) and the domestic supply chains (G2 and G3) include trophy hunting and biltong hunting. Therefore, game meat is produced from three different activities on game farms and game ranges.

A commercial harvest (G1) for game meat is the most efficient method of obtaining game meat in comparison to trophy and biltong hunting (G2 and G3). This is because commercial harvesting involves professional hunters. The marksmen who shoot large numbers of game animals (within a short period of time and usually at night) do not need to be selective of which animals they aim for, whereas trophy and biltong hunters do. Commercial harvests shorten the time requirements of personnel and therefore reduce costs. Slaughtering is also more efficient because qualified staff are available as well as resources such as a portable industrial abattoir and cold trucks.

This supply chain is described in detail by van Schalkwyk & Hoffman, (2016). Carcasses obtained during commercial game harvests for export (G1) must reach the registered game industrial abattoir or portable industrial abattoir within two hours after the fatal shot. A portable outdoor Industrial Abattoir on a farm is where evisceration and removal of heads, legs and skins occurs. This is also where identification and labelling of carcasses is carried out where each carcass and its pluck needs to be marked with identity tags. The tags also include a serial number which traces the name of the ranch, the harvesting date as well as the name and number of the harvesting team. Tagging thus ensures the traceability of meat back to the ranch of origin and it provides a profound knowledge about the health status of animals utilized. The carcasses are then transported in chiller truck at seven degrees (˚C) to game industrial abattoirs. At the game industrial abattoirs, product disassembly occurs. This is when an animal carcass as a whole unit is split into a variety of raw finished products also known as primal cuts. Of interest in the biltong and droëwors industries are topsides, silverside and shanks. Another name for game industrial abattoirs in this study, is game wholesalers.

Domestic supply has historically never been controlled and no regulations or guidelines currently apply to game carcasses sold domestically (Bekker, Hoffman & Jooste, 2011). Fresh unapproved game meat (not inspected and approved with an Industrial Abattoir stamp) is available at butcheries and some of the bigger retail outlets during the hunting season (Van der Merwe et al., 2013). The delivery of head- and skin-off dressed carcasses and the general lack of regulations increase the chances of species mislabelling and product substitution or fraud (D'Amato et al., 2013).

 The quantities of game meat in the formal and informal supply chains is unknown, although a report by the National Agricultural Supply Council (2006) stated that 1350 tonnes were consumed domestically per year during the early 2000s. Van der Merwe et al. (2013) stated that game meat contributes 10 – 20 percent of the total fresh red meat consumption in South Africa during the five

month hunting season (which is generally between May and September). Neither the source of these data nor the methods used to estimate the figure were provided. Biltong and trophy hunters' statistics are difficult to monitor or quantify. If the percentages are correct, the estimate amount of game meat sold using red meat production figures in South Africa is 44360 – 118500 tonnes during the 5 month hunting season. In another study, most game meat consumers had purchased the game meat in butcheries and then prepared it at home (Bekker, Hoffman & Jooste, 2011).

Throughout the game meat to biltong VC there are different stakeholders, each of which is responsible for the supply of a wholesome and safe product to the consumer. For individual farmers to supply their game meat profitably, remains a challenge. The volume of meat a single farmer can supply is not enough to interest wholesalers (Hoffman et al., 2005). Although there are more than 6 000 game farms in South Africa, there is not a huge surplus of game meat, as most game farmers concentrate on the leisure/biltong market. If the correct hunting, slaughtering and marketing methods are encouraged and supported, local game farmers could respond by increasing supply to butchers or game wholesalers by the amount required. This could expand the local market and thus drive down prices.

4.5. Main difference and similarities between beef and game chain

Primary production and primary processing stages of the beef chain are different to that of the game chain. Farm management of cattle compared to game is different and other skills and resources are needed, for example, game farmers need more permits to farm with game compare to cattle. Especially in the harvesting activities of game many permits and certificates are needed. The main difference is at the formal industrial abattoirs. Beef arrive alive at the Industrial abattoir. While game arrive dead. In the formal industrial abattoir, game carcasses arrive with skin on, and enter a cold room through a different gate than the live animals, they then leave the cold room, get skinned and then the primary process is the same as with other animals. Which include deboning and packaging. These are one of the main hurdles policy makers face when drafting The Meat Safety Act 40 of 2000. The Meat Safety Act 40 of 2000 (MSA) that regulates the meat industry in South Africa makes provision for five different regulations. Regulations for red meat, poultry, ostrich, game and crocodile. After five years of negotiations (from 2004 to 2010), the game meat scheme was declined after it has been published for public comment. Presently, there is a new scheme out for public comment.

Similarities also occur at the secondary processing phase for both the beef and game supply chain. Secondary Processors also use similar cuts for the production of biltong, these are in ascending order of importance and preference (although price does play a role in this choice) are silver side, topside and knuckle (the latter is typically used for the making of droëwors). Although producers will use the loin (*longissimus* muscle), the price of this cut prohibits the use thereof, nonetheless it is regularly used by traditional hunters for the making of biltong. Some producers who receive whole carcasses

use all the meat possible for biltong and the trimmings for droëwors. The labelling of game meat and biltong relies mainly on secondary processors (D'Amato et al., 2013).

All secondary processors use similar spice brands. Historically, the spices originated from the Cape colony due to the abundance of spices available due to the fact that the Cape of Good Hope was a stopover on the old spice route from the East to England and Europe. Today South Africa has a number of large spice companies. All the secondary producers interviewed are trying to supply major South African retailers such as Spar, Pick n Pay, Shoprite, Checkers and Woolworths. Supermarkets emerge as major drivers within the biltong supply chain. Due to the unique position of the supermarkets in South Africa, these supermarkets exert power through the conditions of sale in contracts with secondary processors. The incentive for secondary processors are due to the steady market as well as the large market size.

In this scenario, Secondary processor to retail point the industrial abattoirs slaughter and class beef, where game Industrial Abattoirs only remove the skins. Industrial Abattoirs sometimes undertake deboning and packaging activities. Industrial Abattoirs can also be wholesalers for packaged cuts or whole carcasses. Wholesaler distributers specialize in deboning, packaging or selling whole carcasses. Game is distributed in the form of dressed carcasses and cuts to supermarkets and butcheries by wholesalers or hunters (D'Amato et al., 2013). Biltong processors mainly receive game in prime cuts for biltong. The secondary phase starts at the biltong processors (Secondary Processors). It involves opening the meat (package), cutting, trimming of biltong pieces (trimmings and fat are normally used for making of droëwors), spicing and tumbling biltong strips and droëwors and, finally drying.

4.6. Product variety and suppliers of meat

Firstly, secondary processors will be discussed, followed by retailers. These results explained the scope of the secondary processors interviewed. Firstly, the level of integration for the suppliers was discussed, followed by type of raw cuts, size and type of dry products produced by secondary processors. The sample size for retailers are small, describing only the type of retailers. The sample size for retailers are small due to all secondary processors who also include retail activities. Therefore, the limited time of data collection was focused on secondary processors who produce large amount of biltong and would therefore expect to have higher losses.

4.6.1. The suppliers of raw meat to secondary processors (n=14)

This section describes the scope of activities of biltong processors and wholesalers (secondary processors) in the Western Cape. Secondary processors or biltong processors and wholesalers, includes activities such as cutting, mixing, spicing and drying. Inputs are raw meat cuts and outputs are dry products. The section describes type of suppliers, whether suppliers are integrated or not, type of cuts and size of the secondary processors.
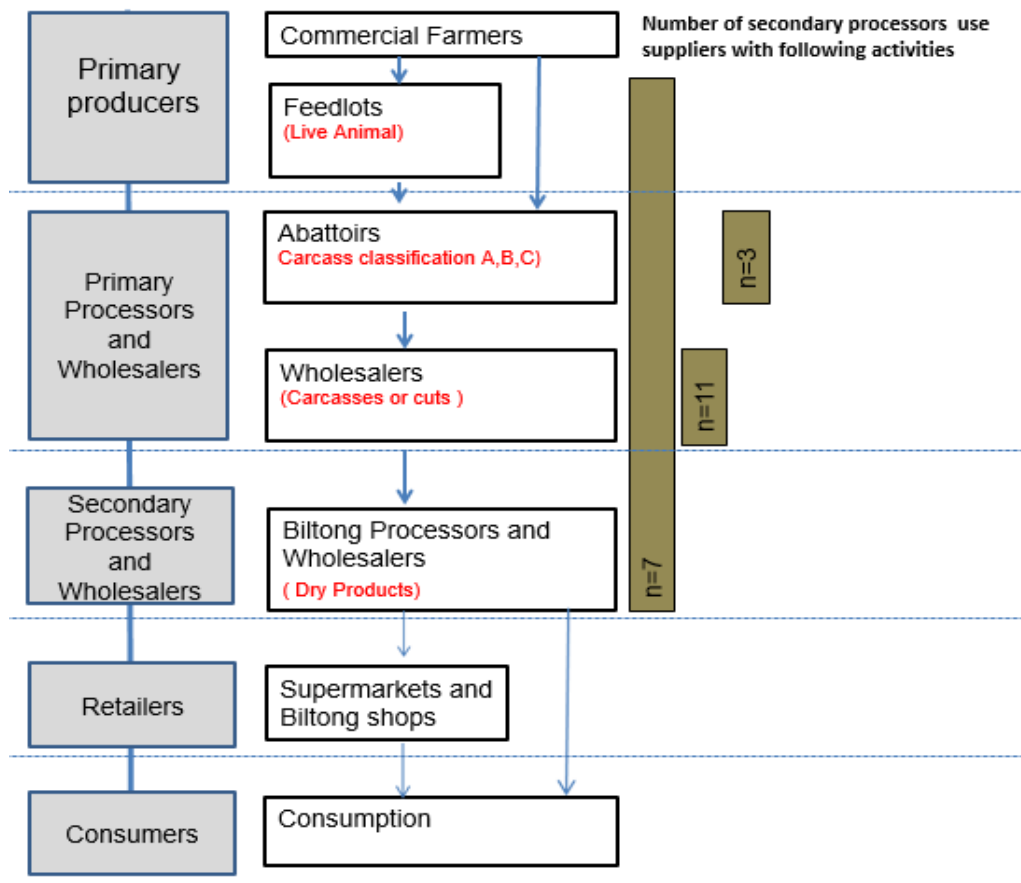
Figure 4.3: Secondary processors who make use of integrated suppliers.

Figure 4.3 shows the type of beef suppliers the secondary processors used. The "n" shows more than one answer from all respondents. Seven out of 14 respondents made use of Integrated companies. Integrated from Commercial farmer to Secondary processors and wholesalers, the feedlots range from 50 000-120 000 heads of cattle. Suppliers such as Sparta, Karan, Beef Master, Morgan Meats, Bravo Meat and Country Meats were named; these are all known to be large commercial vertically integrated systems from feedlot, through an abattoir to a wholesaler company. Eleven out of fourteen respondents used suppliers who are only primary processors and wholesalers. These companies include further cutting and packaging as well as storing large carcass cuts. Some examples where Mountain Meats, Excellent Meats, Airport Meats, typically these would buy their meat/carcasses from abattoirs. All these suppliers are in the study area (Western Cape province). Out of 14 respondents, three receive their beef from Industrial Abattoirs directly. All three respondents were butcheries and would typically use the whole carcass to process into different cuts and products. One respondent also used meat imported from Botswana and Namibia. Few biltong processors used a single supplier; therefore, more than one answer was given to construct the shaded columns. According to the respondents, the decision whether to use an integrated company or not depends on the amount of raw meat the respondent processors monthly. The different sizes of the secondary processors will be discussed later in the study when the different sizes of the secondary processors are discussed.

Table 4.1: Game suppliers for processors

Game Meat Suppliers	Number of statements	Percentage of total statements
Game Meat Wholesalers	8	42%
Professional Hunters	5	26%
Biltong and Trophy Hunters	6	32%
Total Statements	**19**	

The game meat is bought in various forms from carcasses, fresh cuts, shanks or pre-dried products from game wholesalers. Table 4.1 shows 42 % of the game meat is purchased from game wholesalers. One wholesaler (Closwa, Namibia) supplies the majority of game biltong. Other respondents also receive game meat from hunters: 26% from professional hunters and 32% from biltong hunters. According to the respondents, the decision to choose the type of supplier, depends on the availability of game meat for biltong processing. Therefore, most of the game processors used different suppliers. One major problem with game for all the suppliers is that it is a seasonal product. The secondary processors (biltong makers) are competitive when searching for reliable game suppliers. One popular species of game meat   respondents (biltong makers) mentioned is kudu. This is a surprising finding considering the springbok to be the most out sourced game specie for biltong. Secondary processors mentioned they are uninformed of game wholesalers, which causes a problem when sourcing game meat.

In order to legally build up the game value chain, the primary processors should only accept carcasses that have been harvested by registered professional harvesting teams and undergone all regulations. Some secondary processors (biltong makers) indicated that hunters are in their perspective, uninformed on how to treat carcasses to ensure a clean carcass. As example, respondents' mentioned carcasses often have unfavourable odours when the carcass undergoes inspection, a typical sign of microbiological spoilage.

Table 4.2: Type of cuts and class secondary producers use to make biltong

Cuts and grade of raw meat used	Grade	Respondents	Percentage of total respondents
Topside, Silverside	A	5	36%
Silverside	A	4	29%
Silverside	C	2	14%
Silverside, Topside	A	1	7%
Buttocks	A	1	7%
All cuts possible	A	1	7%
Total respondents		**14**	

The beef meat received to process biltong is classed according to the South Africa carcass classification system. This system has animal age (tooth eruption) as one of its main distinguishing

features, subcutaneous fat is another import determinant. Carcass age can be divided in four main classes (A, AB, B or C), which is determined by the number of permanent incisors: A (0 teeth), B (3-6 teeth), C (more than 6 teeth). The subcutaneous fat depth/content is measured on a scale from 0-6. The optimal fat content is 2 or 3. A grade is the most common grade meat used by biltong processors (Table 4.2). No processor uses B grade but 2 processors use C grade. All producers indicated that A grade is the best quality meat for biltong, due to less sinew in the prime cuts (Soji et al., 2015).

4.6.2. Secondary Processors size
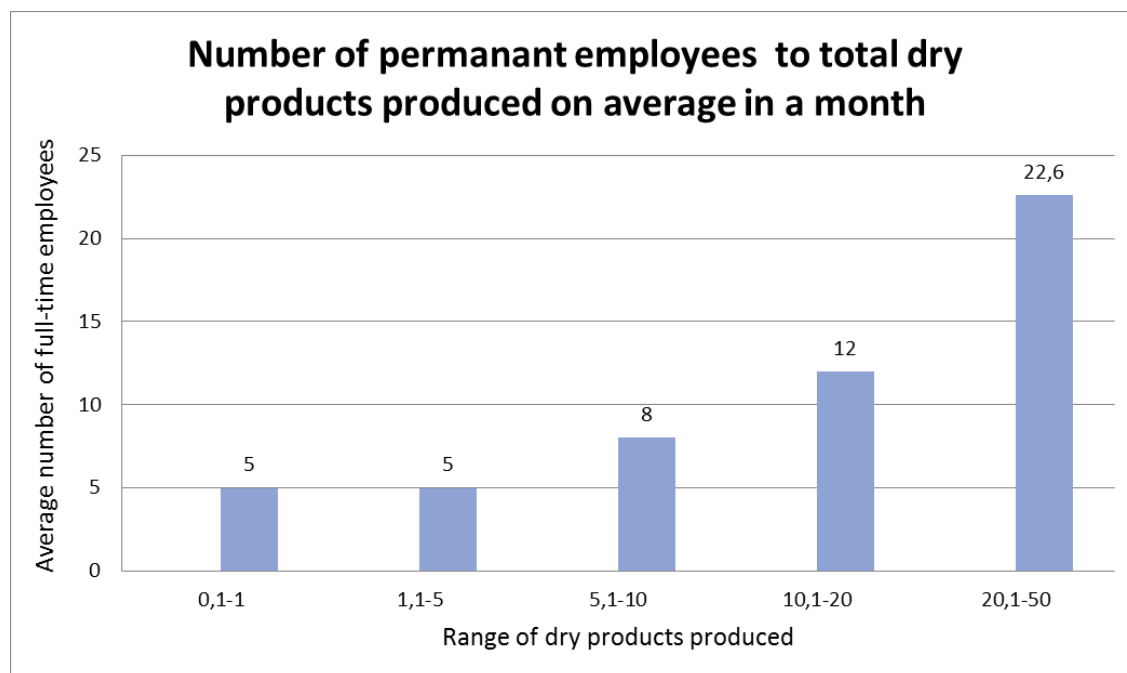
Figure 4.4: Secondary Processors and retailers size and quantities produced per month.

The size of the biltong companies can be sub-divided into three main types (Figure 4.4) depending on the total amount produced monthly 1) Small-scale: biltong makers producing 0.1-5 tons per month with an average of 5 employees which consisted mainly of small family businesses and butcheries. 2) Medium-scale biltong makers: producing 5.1-10 tons per month with average of 8 employees. These biltong makers supply biltong at a local and regional scale. They rarely supply to Supermarkets. 3) Large-scale biltong makers: producing 10.1-50 tons per month with an employment number ranging from 13 to 50 employees. Large-scale biltong makers supply products nationally and internationally. Nationally the market focus is large franchise supermarkets. Internationally they export mostly to African countries. This finding shows the different sizes of secondary processors interview in the study. The size of the secondary processors determined if they could approach integrated or non-integrated suppliers of raw meat. Only large-scale biltong makers can make use of integrated companies such as Sparta, Karan and Beef Master.

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Table 4.3: Meat products traded by meat processors. (More than one answer is acceptable.)

Dry Meat Products	Number of respondents trading in the product (ranking)	Percentage of total respondents
Biltong	14	100%
Droëwors	14	100%
Snapsticks	12	86%
Chilli Bites	9	64%
Chips	6	43%
Powder	7	50%
Baby Biltong	4	29%
Heart Biltong	2	14%
Nuggets	4	29%
Wagon Wheels	2	14%
Total Statements	**74**	

Over the years' biltong manufacturers invented different forms of biltong. Biltong sticks, biltong nuggets, chips, baby biltong, and powdered biltong. Biltong chips are short (few cm) meat cut thin (2-3mm). Baby biltong is beef biltong cut into smaller sizes with no strong spices or coriander added. This biltong is made for babies to chew on and is a believed to be a great remedy for baby teething problems. One of the most popular forms of biltong is biltong sticks, especially those with chilli spices called chilli sticks/bites. Biltong, as an ingredient product, is growing in South Africa. The most popular form of biltong as an ingredient is biltong powder. Another form is Biltong slices which is used for biltong breads and biltong salads.

Concerning the number of different meats and meat products traded, all the respondents traded with biltong and droëwors – not surprising as the questionnaire was focused on these secondary processors. Interestingly, the third most popular product being snap sticks (82%), followed by chilli bites (64%). The rest of the products such as chips, powder, baby biltong, heart biltong, nuggets and wagon wheels are not commonly sold products (Table 4.4). Two of the 14 respondents traded with a total of seven types of dry products. One processor traded eight different meat dry products, the majority traded six and five different types of dry products (4/14). From interviews with secondary processors, it can be seen that biltong and droëwors are the most popular products traded. These findings support respondents' comments of most popular products produced relative to total produced per month. The majority of the respondents (75%) said that 70% of total dry products sold per month is biltong and remaining 30% composes mainly of droëwors, followed by other products. The finding indicates that biltong is the highest valued product sold.

Table 4.4: Type of species used to make Dry Products. (More than one answer is acceptable).

Species used for Dry Products	Number of respondents (rankings)	Percentage of all respondents
Beef	14	100%
Game	11	79%
Ostrich	7	50%
Pork	5	36%
Chicken	3	21%
Total Statements	**40**	

In terms of the most popular species used to process dry products, results indicate that all respondents used beef. Followed by game, which was used by 11 respondents (76% of all respondents) and thirdly ostrich this was used by seven respondents (50% of all respondents). Five out of total respondents of 14 made pork biltong (36% each for all respondents). Surprisingly, three of the 14 respondents (21%) made chicken. Beef was most popular species used due to the popularity amoung consumers compare to game, pork and chicken. Furthermore, beef availability is more constant, where game and ostrich supply is not consistent. Ostrich is a biltong species, which has grown in popularity for the niche market in Cape Town metropolitan area, which can explain the high percentage thereof. Pork and chicken biltong are new in the biltong market and still need to gain recognition.

 For the thesis, "biltong" includes large cuts pieces, plain cut pieces, chilli biltong products and snap sticks. Secondary processors also produce more game droëwors compare to game biltong due to the large amount of trimming from whole game carcasses supplied by professional hunters and biltong hunters. Furthermore, beef is supplied in a form of boneless prime cuts to secondary processors, leading to less trimmings to process into beef droëwors Another reason is secondary processors avoid processing game due to personal dislike, or difficulty of sourcing game meat from registered processing facilities or a lack of reliable game wholesalers.

4.6.3. Retailers (n=3)

This section responses to the three retailer's interviewed. "Retailers" refer to selling points where no secondary processing occurs, retailers such as local supermarket, biltong shops, restaurants (including hotels), or any other place where the processed product is made available directly to the consumer (Bekker, Hoffman & Jooste, 2011).

All three retailers who participated are engaged in selling dry processed dry meat products and purchase products from secondary processors. Retailers sell small amount of dry products compare to second processors, discussed earlier. The amount is at average 800 kg of dry products. The products at retail point include packaged as well as open dry products. The majority of the species sold are beef and game. One observation made is retailers have more game droëwors than game biltong available This is because Secondary processors have more game droëwors available due to the large amount of trimmings available after deboning a game carcass. Many of the secondary processors sell to

supermarkets as well as other typical retails, as explained above. The reason for the small sample size of retailers is due to the insignificant loss percentages collected from the interviews. Therefore, one of the main objective to identify food loss was more significant at secondary process level due to the larger quantity of dry products moving through the secondary process. Time was also a limiting factor in the study due to the period needed to schedule interviews and summaries the data. The time acquired to source the contact details, schedule meeting and summarise data was five days working days per stakeholder. The availability of secondary processors were also scarce. The main reason was that data collecting was during the demanding biltong season.

CHAPTER 5: LOSSES ALONG THE BILTONG AND DRY SAUSAGE/DROËWORS CHAIN IN SOUTH AFRICA

5.1. Introduction

The type of losses along the supply chain, according to literature, are categorized according to stages in the value chain: harvest losses, postharvest losses, processing losses, distribution losses and consumer waste (Lipinski et al., 2013). The losses that were evaluated further in this study are the processing losses. Here, losses in terms of quality (mould, odour and rancid) and quantity (Dry weight) were considered. Secondary Process losses are subdivided into three phases: pre-process loss, process loss and post-process loss and are defined as:

- **Pre-process loss** is when beef and game vacuumed raw prime cuts (silverside and topside) enters the secondary processors' facilities. The raw meat is trimmed and prepared. These losses are associated with the quality of the meat bought from primary processors. This includes losses due to meat quality (mould, odour and rancid), blood/drip loss and sinew.

- **Process loss** is product discarded after drying and packaging. These products are unfit for selling.

- **Post-Process loss** is when the quality of the product decreases after it has been sold. Refers to spoilage (mould) and degradation (rancid).

This study seconed objective aimed at identifying a critical loss point (CLP) at each three subdivided process losses (Figure 5.1), and any good practices to reduce process loss were documented. A critical loss point is a point in the food supply chain where food losses have the highest impact on food security and economic loss. Therefore, three CLP were identified at each of three subdivided Secondary process losses:

1. Pre-process loss
2. Process loss
3. Post-process loss

A further important feature of the full chain map is that it plots the interactions between the companies, which is particularly important in highlighting interface loss. Here, Figure 5.1 shows a summary of all the percentages of loss at each critical loss point for process losses. Post-process loss was the main focus in this study and which include post-process losses for both retailer and secondary processors.

5.2. Processing losses at the secondary processor and retail point
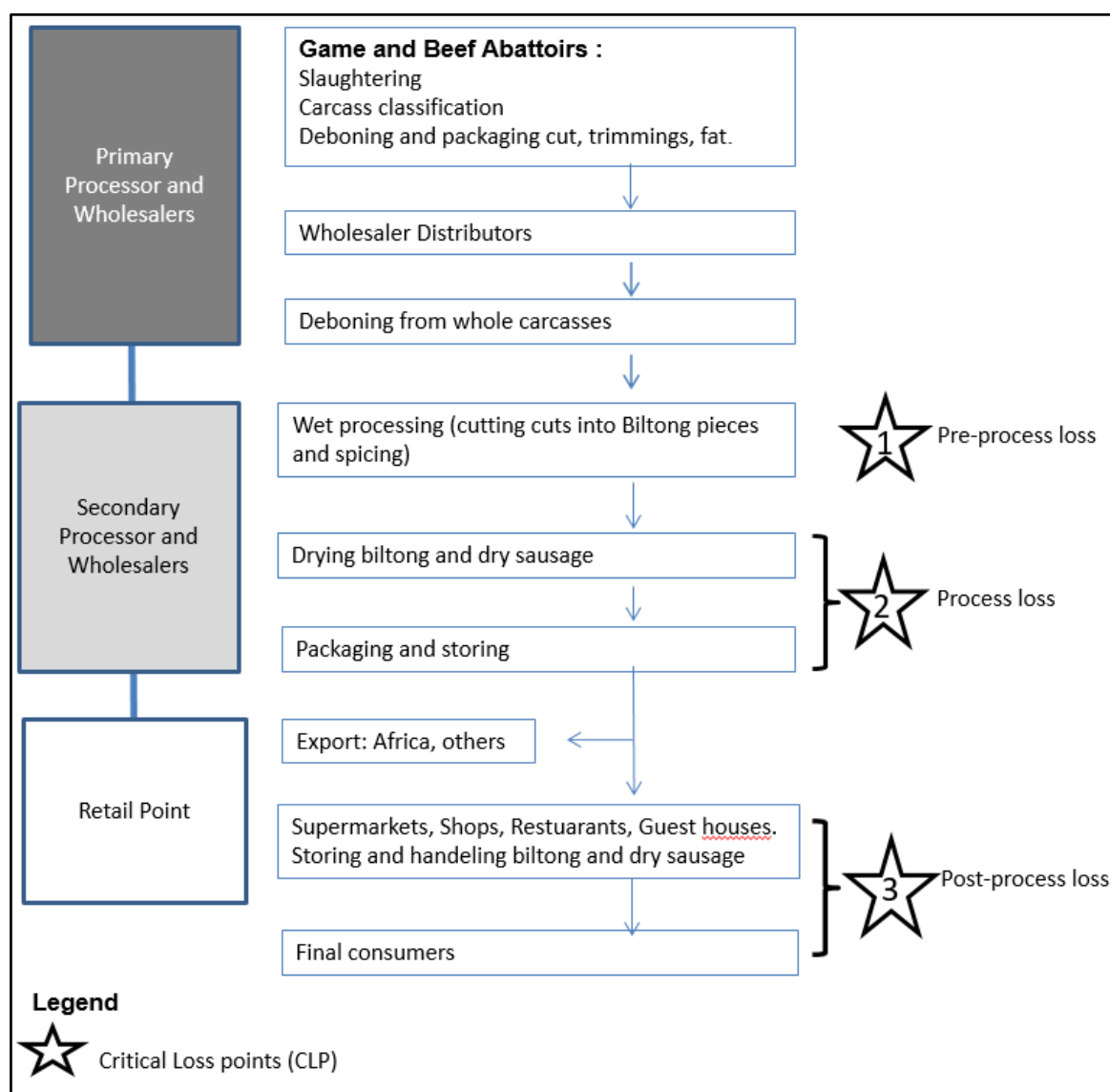
Figure 5.1: Activities and critical loss points from secondary processor to retailer points in biltong and droëwors supply chain.

First, the pre-process loss will be discussed. This is followed by the process loss and finally the post-process loss. The post-process loss was identified as being the most critical loss point, however, the post-process loss can be reduced by correct handling, storing and packaging techniques.

5.2.1. Pre-process loss

Pre-process loss is when raw meat enters the secondary processors' facility. The raw meat is trimmed and prepared. These losses are associated with the quality of the meat bought from the primary processors and include losses due to poor meat quality, blood loss after opening vacuumed bag and

sinew. In essence, it includes all that is purchased by the processor and that will not be transformed into biltong.

Table 5.1:Pre-process loss

Pre-process loss (%)	
Cutting raw <u>silversides</u> and <u>topsides</u> at secondary processors and wholesalers	**Weight loss %**
Blood loss from opening vacuumed packed cuts	1-10
Blood loss when you cut the prime cuts.	2-4
Sinew	1.2
Waste in the process of tumbling (spicing) meat that is thrown away	1

Prime cuts used for biltong are silverside, topside and knuckle. Silverside is mainly used for large biltong pieces. The majority of the Topside is used for snap sticks and knuckle for small biltong pieces. Figure 5.2 illustrates the uses and pre-process losses for silverside at wet processing. Wet processing is preparing raw meat for the drying process. Silverside is the most common prime cut used for making the highest value product, biltong. Typically, the silverside is trimmed into a neat rectangle from which the large biltong slices are cut by hand. The largest portion (65%) of the silverside is used for making the biltong slices, 19% of the cut (normally larger pieces) is used for other products such as nuggets, wheels, chips etc., whilst 10% trimmings is used as ingredient in the production of droëwors. The silverside contains some subcutaneous fat with the extra fat (~2%) being trimmed off and being used in the droëwors processing. The remaining fat is part of the biltong slices and other products. Around 3% (by wet weight) of the silverside weight can be classified as pre-process loss consisting mainly of blood loss, sinew (a piece of tough fibrous tissue uniting muscle to bone) and waste (small meat pieces).
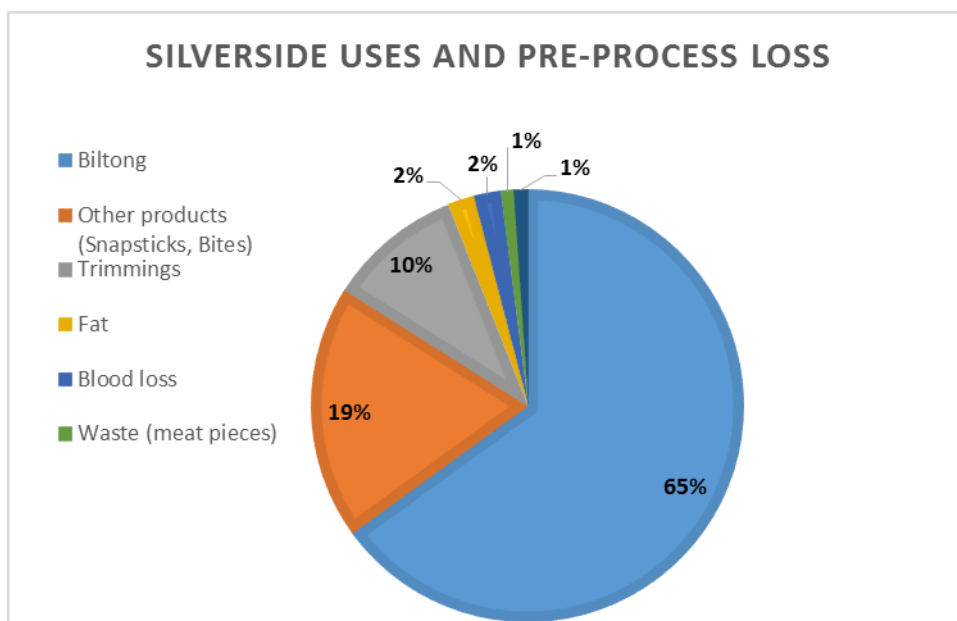
49

Figure 5. 2 : Silverside uses and pre-process losses.

5.2.2. Process loss

 Of all the respondents, only three were able to give detailed response on the amount (%) of products unfit to be sold (Table 5.2). The total loss was 0.01% for these three respondents, with an additional six secondary producers indicating a process loss equal to zero.

Table5.2: Producer process Loss of unsold Biltong and droëwors at producer level

Unsold Biltong and Droëwors Products

Respondent	Percentage of unsold from total produced
1	NO answer
2	NO answer
3	0.01
4	NO answer
5	0.01
6	NO answer
7	NO answer
8	0
9	0
10	0
11	0
12	0
13	0.01
14	0

5.2.3. Post-process loss

Post-process loss is when the quality of the product decreases after the secondary processor sells it to the retailer and the retailer sell it to the consumer. These post-process losses typically refer to spoilage (mould) and degradation (rancid). The highest quantity of products returned from one retailer to biltong processors was 4%. The reasons for these returns could not be determined, except for two cases:

- Products removed two weeks prior to shelf-life date expiring to avoid bad quality products which would affect the brand's reputation. Consumers have poor understanding of different food labels, which indirectly cause retailers to remove products. Consumers tend to assume that these dates are linked to food safety when in reality they are more often based on food quality (which will deteriorate over time without necessarily becoming a health hazard).

Many kinds of date labels coexist, some of them not intended to inform consumers but rather to help retailers manage their stock. Other date labels are directed to inform consumers, but their purpose can be different as pertaining to whether the indicated date is related to food safety rules, or related to marketing strategies to protect consumers' experience of a product in the view to safeguard its reputation (Lebersorger & Schneider 2014). This could be the reason for removing the products two weeks prior to shelf-life date.

- Another reason for post-process loss was rancidity. According to the findings from the respondent's drawers was more likely to be rancid than the biltong. In addition, ostrich droëwors was the one species that stood out as being the most rancid for specific large retailer, who sells 15 tons of dry products per month nationally. Reason for this is unclear,

This was not a case for the rest of the two small retailers, who sell on an average of 800 kg per month. The two small retailers experienced insignificant post process losses, which were at 0% and 0.06%. Returns from consumers to retailers is even more insignificant at 0-0.1%.

In Table 5.3, percentage of total products returned to secondary processors from retailers range from 0.01% - 0.05%. Returns are mainly due to post-process losses. These include:

- Spoilage by mould (see Table 5.4).
- Products too dry or with white crystals on the surface.
- Some products returned due to an undesirable taste and/or having past its expiry date.

Table 5.3: Retailer returns to secondary producers due to post-process loss.

Respondent	Percentage of returns from total sold
1	0.05
2	0.02
3	0.01
4	0.01
5	0.01
6	0.01
7	0.05
8	0.01
9	0.01

10	3	
11	0	
12	0	
13		0
14		0

Table 5.4: Main post-process losses of dry product for processors in the Western Cape

	Number of statements	Percentage of all statements
Mould	9	64%
Too dry	2	14%
White	2	14%
Rancid	1	7%

Ways to minimize or eliminate post-processing losses for dry products were identified by stakeholders. One producer mentioned that when the wind blows, their mould problem is higher; an analyses of their factory indicated that the walls were not airtight and this may be a means that the high humidity air could enter the facility. This specific factory was close to the sea. Seasons also influence mould growth; during summer months; spoilage loss also tends to be higher. This is most probably because of higher temperatures accompanied with strong summer winds. Another problem identified is that when the product is dried too fast the outside looks fine (although this is a classical case-hardening effect) but the inside is too wet, and if the product is packaged the chances of post-process loss is as high as 80%, mostly due to mould growth formation. To reduce mould growth, producers apply different methods. Some add sodium bicarbonate to the biltong slices whilst others use vinegar. The bicarbonate is believed to lessen case hardening of the outer surface area of the biltong whilst vinegar is used to lower the pH and thus inhibits mould growth. Not many producers use nitrites as they believe the consumers do not find the red colour appealing and South Africa has strict regulation around the use of nitrites/nitrates. Others use specific packaging whilst others have specific ways of drying the biltong. Innovations in packaging were brought about due to the area to which the producers supply. The metropolitan study area has much higher demands for these ready to eat products, although in smaller sold quantities. Most processors in these area use nitrogen flushing or vacuum packaging (Burfoot et al., 2010). Nitrogen replaces oxygen in the packaging and therefore inhibits the growth of mould (Day, 2008). This differs from the local processors, especially the butcheries who still use the traditional method. The traditional method consists of hanging the large pieces of biltong or droëwors in the butchery (frequently with a small fan blowing over the products) for customers to see. The customer can choose (frequently there is a plastic bag/glove available for the

customer to use if he wishes to "feel/squeeze" a specific slice to judge its perceived quality/moisture content) his/her preferred piece and the butcher slices it and places the product in brown paper bag. The brown paper bag ensures continuous moisture exchange with the external environment (and thus minimises the formation of mould, but could result in the slices becoming too dry) but the biltong is perishable and should be consumed within two days and stored in dry cool place.

Many processors felt the cause of post-processing losses was due to the way the retailers store, display and do stock taking. One of the larger (30 tonnes biltong per month) secondary processor respondent has agents on the road to check that the retailers are handling, storing and displaying the biltong correctly. This processor has his own brand and this activity is seen as part of the strategy to ensure brand quality.

One clear loss identified by the stakeholders was weight loss. Weight loss is easy to observe and measure. It does not necessarily mean food loss, since it can result simply from a reduction in moisture content. Moisture loss during drying was therefore not defined as a food loss. However, the specific weight loss referred to by the stakeholders was that occurring during the display prior to selling. Unfortunately, this weight loss was not quantifiable as it is determined by numerous environmental factors such as air relative humidity, temperature, airflow, etc. Market losses was also identified from few stakeholders where it was a fault in orders, price differences, and weight differences between processors and retailers. This data was not requested in the questionnaires.

Stakeholders believe the loss for game products is lower than for beef products as game is a dryer product, meaning the biltong has a lower moisture content. Lower moisture means less chance of post-process loss particularly that linked to spoilage like mould growth. In addition, game biltong does not have any fat and thus rancidity is a lower spoilage cause in low-fat dry game meat products. Losses also occur at different times of the year. During the summer, post-process loss is higher, due to higher temperatures and relative humidity. Stakeholders also identified other post-harvest losses including salt precipitation, and rancidity differently. The true meaning of these losses are unclear to the stakeholders of the biltong and dry sausage supply chain. The stakeholders see loss as physical weight loss when drying the product through the secondary processor phase. Mould is the most common loss and stakeholders are experimenting with different packaging methods to increase the shelf-life of large wet biltong strips. Currently the large vacuumed pieces can maintain a good taste for three months in the current packaging. Stakeholders believe the consumers demand a wetter (beef) product with a 50-55% moisture content. However, the percentage of consumers who prefer wetter biltong is not known. This matter calls for further research and investigation.

5.3. The destination of dry product after it has been classified as a process loss.

5.3.1. Pre - process loss uses

Table 5.5 indicates what happens to the pre-process loss. Pre-process is defined as the process when raw meat enters the secondary processors' facilities to be processed into biltong/droëwors. One secondary processor returns ~200 kg of beef meat per annum. Another secondary processor returned ~24 kg of game meat per annum. Six other respondents did return raw meat in the current year but the amount was so insignificant that the respondents could not estimate the amount. The normal loss of raw products during processing include bone, sinew and meat. This is a small amount compare to the average amount of raw meat purchased in a year by the secondary processors, which can range from 7 tons to 100 tons of raw meat. One secondary processor producing 30 tons of dry products returned 24 kg of raw meat in a specific month. This is an indication of excellent hygiene and storage activities of raw meat suppliers. Products that are reused from the silverside and topside cuts are sinew, which is dried and sold as pet treats. Secondary processors who receive carcasses use their waste such as ostrich oesophagus and bones to sell as pet treats or to sell at a low price into the informal market. Dried sinew average retail price is set at R12 a piece, dried ostrich bones at R25 and small bones at R12 and ostrich oesophagus at R14 a piece. Two respondents reported that they throw the products away

Table 5.5: Destination for loss raw products.

	Number of statements	Percentage of all statements
Return to Supplier	8	47%
Re-use	5	29%
Give to Someone	2	12%
Throw Away	2	12%

5.3.2. Process and Post-process loss uses

The process loss is at ~0.01% based on the total amount of dry poduct which move through the biltong process in one month. If products are too dry to sell to retailers, the product can be dried further and changed into biltong powder. Post-process losses of retailers are ~4%. Retailers return dry products to secondary retailers. Secondary retailers transform ~50% of the returns to biltong powder and the other ~50% is discarded. Secondary processors typically remove the mould with vinegar and convert the biltong into powder (Table 5.6).

Table 5.6: Loss destination for all post-process dry products.

	Number of statements	Percentage of all statements
Re-use (powder, pet food)	4	50%
Throw away	4	50%
Do not want to say	0	0%
Give to someone	0	0%

The losses experienced along secondary processing and retailer point for both beef and game dry products are insignificant. Total pre-process loss is 3% per 8 kg silverside which include sinew and blood loss. Process loss is 0.01% which is the lowest loss between all three processing phases. This includes dry product not fit to sell to retailers. The highest loss identified is secondary producer post-process losses which ranges from 0.01% to 0.05% of the total monthly produce sold. One retailer post-process loss is 4% of monthly sold. The average secondary processors sell 7 tons per month of dry products compare to a retailer, who sell around 800 kg per month of dry products. The most common post-process loss for both secondary processors and retailers is mould. Further, this study shows no difference in losses between game and beef dry products. Additional quantitative studies should be conducted to see how retailers display, store and handle perishable biltong and dry sausage products. This will aid in identifying whether the cause of post-process loss is at the processing stage or at retail point.

One of the reasons for the low percentage in losses stated by biltong stakeholders is the fast flow of product through the secondary processing stage to the retail point due to the nature of fresh sales. This leads to another interesting feature of the value chain which reflect efficient distribution and production location due to value added -time. Value added time is a popular concept in the supporting theory, lean thinking.
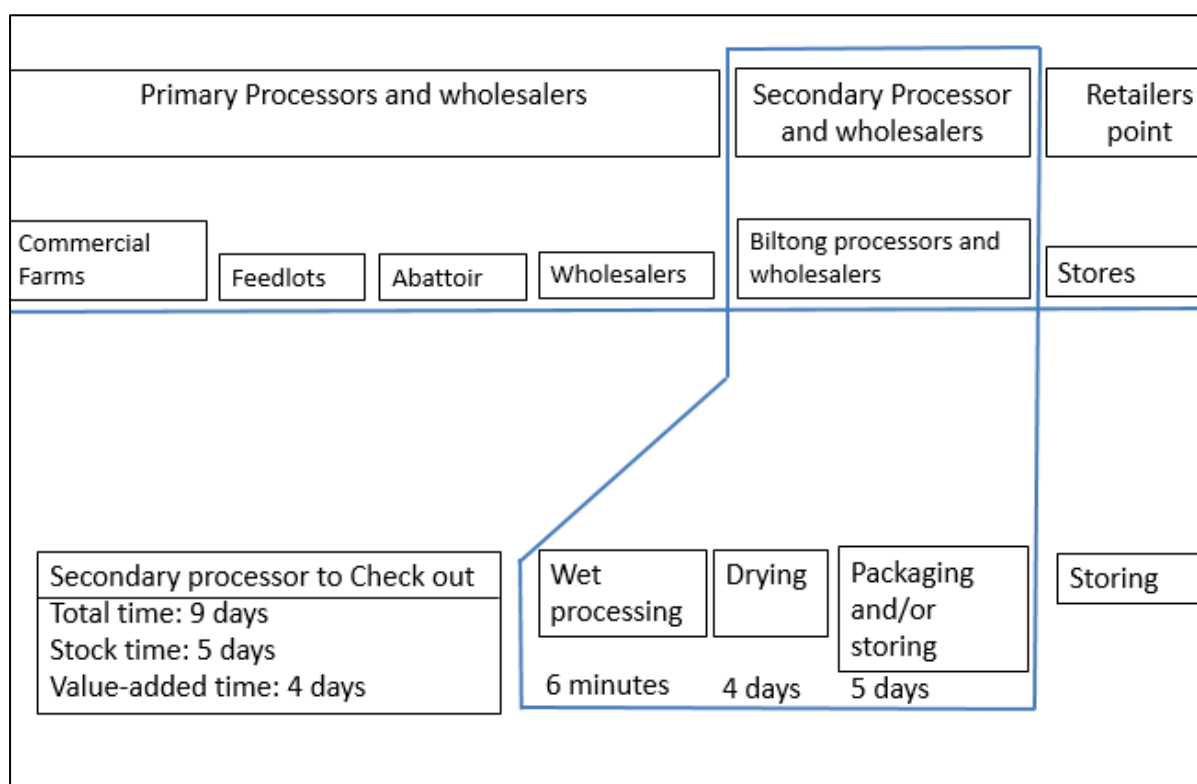
5.4. Value - added time

Figure 5.3: Value stream mapping for the biltong and droëwors value chains in the Western cape, South Africa.

Mapping the value stream to determine value added time is a method that has been adopted from multiple studies in the (UK) pork sector (Taylor, 2005; Taylor, 2006). Another related field where this research is applied is the fibre industry. The research investigated amongst others, at why inventory is carried by more than one stakeholder in the chain. Results show that the inventory is held by both parties as safety stock (Shively et al*., 2010)*. In this section, the time spent processing raw meat to make biltong by a typical large producer (30 tonnes of dry products per month) was be analysed, see Figure 5.3. This reveals the low levels of processing and retail losses, as well as aids in analysing the total value added time.

Feedlots purchase weaned calves ranging from 160 to 250 kg. The calves are fed for approximately 120 days, to an end live weight of 400 to 450 kg. Calves are weaned at an average age of 300. These weaned calves fall into the A-class meat bracket of younger than two years at slaughter. This is the meat classification mostly preferred by biltong makers. When cattle arrive at the abattoir, they stand in enclosure for few hours to a day before slaughter. The carcasses are then chilled for a 24-hour period and continued to the wholesaling stage. This stage includes cutting and maturing of prime cuts.

The most important stage of value adding in biltong is at the secondary processor and wholesaler stage, see Figure 5.3. Addendum D contains images if secondary processors and retailers. Here the

biltong undergoes three main processes: wet processing, drying and packaging and/or storing. Wet processing includes cutting and drying the meat. It takes a labourer approximately ten minutes to cut up a silverside into biltong slices. The spicing and tumbling takes another 20 to 30 minutes. The drying process differs across biltong processors due to different drying methods. The most common large-scale drying method is to use commercial dryers. The drying process can last from two to five days. Using fans and heaters, a process known as heat drying, can take up to seven days. Fans and dehumidifiers can take three to four days. Air-drying without heaters or dehumidifiers can take five to eight days. This range of methods is due to the influence of the seasons; hotter weather results in quicker drying. The drying rooms are therefore dependent on outside/ambient temperatures. After drying, products are packaged and/or stored the same day that drying is completed. Most stock produced by secondary processors is sold as 60% bulk and 40% packaged. Some secondary producers store the biltong in freezers at -10°C straight from the drying rooms over a five-day period.

The typical biltong maker distributes the products directly to the retail point after packaging. Therefore, no storing occurs at this point and "fresh" produce is delivered. At the retail point the product is handled and stored where it is typically sold within two weeks.

An interesting feature of the value chain and the flow of product through the secondary processing stage is the very short time period from pre-process to retailer. Biltong is generally delivered to retailers the same day as packaging or the day after and almost no processing losses occur during this stage/period.

5.5. Behind the price tag

5.5.1. Introduction

This section analyses the third objective of the thesis. The biltong process begins where special prime cuts are sold for the purpose of biltong making. In the case of game, it is common for the process to start at the carcass, as the whole carcass is used for many types of dry products as discussed in Section 4.2.3. The prime cuts, mainly used for both game and beef biltong, are the silverside and topside. Therefore, when discussing the difference in prices, the same prime cuts will be compared for each species. Only primary biltong prices will be compared in this section. Primary biltong product is the typical large piece of sliced dried meat. Primary Biltong is the most popular product that respondents take the most pride in, but is not the most expensive product. The most expensive product per kilogramme is snap sticks as they are labour-intensive to produce and dried at 70% weight loss.

Estimating the full range of costs at each stage can be difficult, and is beyond the scope of this study. Nevertheless, some conclusions can be drawn by gate prices at specific stages and points in time. Price information from participants are part of business strategies and is consequently seen to be confidential.

5.5.2. Game Prices

Very few studies have been carried out on game prices amongst hunters, game wholesalers, biltong processors and retailers. One study similar to the present study compares rural and urban bush meat prices (Society, 2001). Market information is usually collected on a local scale to determine game carcasses price per kilogramme. This can be time consuming for a farmer when seeking price information. To aid in overcoming this problem, this study collected prices on a regional scale from the eleven processors who trade in game products.

The two most common species used by the game biltong traders were springbok and kudu. The average price received for kudu cold carcasses was R28/kg. Prices ranged from R25/kg to R30/kg. The average price received for a springbok cold carcass from hunters was R30/kg. Prices for springbok ranged from R25/kg to R35/kg. While collecting the data, it was found that some hunters also sold springbok prime cuts to biltong processors and wholesalers at R65/kg.

The next phase is the game wholesaler stage. At this stage, or at game industrial abattoirs, carcasses arrive deceased at the licenced game abattoir. Here carcasses are further processed into prime cuts. The average price of kudu prime cuts was R60/kg (Table 5.7), and for springbok it was R90/Kg (Table 5.8). The average prices for subsequent stages remain the same for both species.

Table 5.7: Average price per kilogram of kudu raw meat and biltong for August 2016

Stage	Product	Price per Kg
Hunters	Cold carcass	28
Game wholesaler	Prime cuts	60
Biltong processor and wholesaler	Biltong	217
Biltong retailer	Biltong	308

Table 5.8: Average price per kilogramme of springbok raw meat and biltong for August 2016

Stage	Product	Price per Kg
Hunters	Cold carcass	30
Hunters	Prime cuts	65
Game wholesaler	Prime cuts	90
Biltong processor and wholesaler	Biltong	217
Biltong retailer	Biltong	303

5.5.3. Beef Prices

All respondents interviewed trade with beef products. When the second phase of data began when collecting prices, respondents in the study gave no data on receiving beef prime cuts bought straight from a company who only slaughters and includes no wholesaling activities. Beef wholesalers can be divided according to their number of activities. One company included activities such as feeding, slaughtering and wholesaling. Others included only wholesaling. The average price of silversides and

topsides for the multiple activities and single activity companies is R55/kg. The prices did not differ between the two companies. Some respondents experienced a rapid increase of R10/kg in prime cuts over a period of seven days. Beef biltong was sold to retailers at an average of R217/kg, which in turn was sold by retailers at an average of R284/kg. Biltong retail prices were gathered randomly in the study area at seventeen retail stores (Table 5.9).

Table 5.9: Average price per kilogramme of beef prime cuts and biltong for August 2016.

Stage	Product	Price per Kg
Abattoir	Prime cuts	No answer
Beef wholesaler	Prime cuts	55
Biltong processor and wholesaler	Biltong	217
Biltong retailer	Biltong	284

5.5.4. Differences between Game and Beef Prices

This section summarises information gathered from various sources on the price of beef and game biltong (Table 5.10). The data points to differences in game and beef prices. The making of biltong starts at the purchasing of prime cuts for the biltong processors and wholesalers. At primary wholesaler stage, game prime cuts are costlier than beef prime cuts. The same is true for when biltong processors and wholesalers sell the biltong to retailers. Game cuts and game biltong prices remain higher than beef throughout the value chain. Game Prime cuts are an average of R35/kg more for prime cuts. Biltong processors sell game dry products R15/kg more than beef dry products to retailers. Retailers also sell the game R16/kg more to consumers. Therefore, beef biltong is typically cheaper than game biltong. Price data collection showed that the price per kilogramme varied widely according to region. The Cape Town metropolitan area showed wholesale and retail prices to be much higher than areas outside this boundary. Respondents mentioned that an increase in prices for this area leads to increase in sales. If the prices increased outside this area, however, it caused a decrease in sales. The reason for these changes attributed by the respondents is that the metropolitan area sees higher price as higher quality. Areas outside this boundary do not see price as an indicator of quality. In addition, areas outside the metropolitan cannot increase their prices due to the community earning lower income per capita.

Table 5.10: Price differences between game and beef prime cuts and biltong.

Price (ZAR) Stages and Product	Selling price of beef per kg	Selling price of game per kg	Price difference between game and beef per kg
Primary wholesaler (Prime cuts)	55	90	35
Biltong processor and wholesaler (Biltong)	203	218	15
Biltong retailer (Biltong)	284	300	16

To conclude, Price margins help to identify problems and viewpoints. The customer demand for biltong seems to be seasonal as the secondary processors (biltong Makers) indicated total sales to be the lowest in August, where after sales gradually start increasing to December. The highest sales are experienced in February. For biltong producers to cope with these inconsistent demands, they will need to become customer-driven and focused on delivering quality products at competitive prices (Chang & Hwang, 2002).

5.6 Conclusions

The food losses identified and quantified are insignificant. This surprising finding considering the many activities occurs along the biltong value chain that can cause opportunities for food losses. Activities such as transport, processing, slaughtering, deboning, packaging, transporting, drying and storing between primary processors (supplier of raw meat), secondary processors (biltong makers) and retailers (biltong sellers).

The results for the value added time indicated to be an interesting method to describe the processors that occur at secondary processors (biltong makers). Reasons for insignificant losses was also identified through the detail understanding of the process through mapping the value stream and determining value added time. One main reason was the short time period from pre-process to retailer. Where biltong is generally delivered to retailers the same day as packaging at secondary processors (biltong makers).

In economics, prices can show a good indication of what drives the decision of stakeholders in a value chain. In this study, average price per kg was used to give a like for like comparison. This was useful method to identify and compare prices along the value chain for both game and beef biltong. The recording of prices started at primary processors to the selling price of retailers. One of the predictable results was that the secondary processor had the biggest price difference of all the stages in the value chain. This is due to weight-loss in the meat, labour intensive activities as well as special equipment used to make biltong. One of the surprising results of the study was the fact that the secondary biltong processors bought raw game prime cuts at much higher price than raw beef prime cuts. Further research should focus on the game meat industry from consumer related factors such as quality and price (Radder & Le Roux, 2005).

CHAPTER 6: GENERAL DISCUSSION AND CONCLUSIONS

6.1. Introduction

The purpose of this study was to investigate the scope, losses and prices of the Western Cape biltong value chain. Furthermore, it aimed to provide a clearer understanding of the structure of the biltong industry by identifying key stakeholders. This is important information to stakeholders in the biltong industry. Small amount of research has been done on these unique South African food products, which was a positive contribution of data to the dry meat industry of the Western Cape, South Africa. Biltong is growing in popularity and is a popular subject when discussing South African exports products. Currently, stakeholders want to enter global markets which emphases the importance of the research question. If food losses were high in the biltong chain, it could slow the process of exporting biltong.

The results showed small amounts of losses along the value chain. This allows the conclusion that biltong processors are efficient in identifying good quality raw materials as well as selling quality products. In addition, the product (dried meat/sausage) allows for a more stable shelf life product. Due to the sampling size of the biltong stakeholders, some caution needs to be taken when generalising the results to the Western Cape biltong producers overall. However, the stakeholders that were interviewed produce a large volume of biltong which can be seen in many franchise stores, some even nationwide. It is not clear how much biltong is produced in the Western Cape, but the total biltong processors and retailers interviewed is believed to make up a good share of the total amount produced in the Western Cape. This research was done in an open research environment that can be a good representative of real situations. Nevertheless, these results can be used as guideline for further value chain research on specific commodities.

6.2. Conclusions, limitations and recommendations

This Descriptive study has some limitations due to the small number of value chain stakeholders interviewed as well as the methodology used. Something to consider about the sample size of the secondary processors is that the amount of dry product produced by third of the interview secondary processors, contribute a great share to total biltong produced nationally. As these secondary processors supply to retailers nationwide. Retailers such as franchise supermarkets, shops, butcheries and gas stations. The number of stakeholders interviewed offers insights, but cannot be generalised to the entire area. Moreover, the fundamental problem of the value added concept is that analysis starts too late and ends too soon in the value chain. In this thesis, it stops at the completed sale, which is too soon. The result of this is that the effect of the consumer behaviour as a linkage in the chain is missing. Currently, no studies have been done on which factors such as quality, price and brand influence consumer choice of biltong.

When summarising the basic findings of the study, it becomes clear that further research needs to be dedicated to the South African meat industry about food losses. This should include losses at primary process, distribution and consumer stage. It is important to reduce food loss by consuming our resources more effectively in a world of a fast growing population. The methods used to collect loss data was successful. When investigating biltong prices, factors which effect the prices directly and indirect, should be included in the study. The information from this study will be of interest to all stakeholders in the supply chain for both game and beef meat. If stakeholders upstream have, a better understanding of the secondary processors and retailers downstream, long-term market decisions can be better informed. Policy makers and stakeholders should consider all impacts of any proposed changes to avoid unintended consequences of food losses. Even though losses are small at secondary processors and retailers, data collection and knowledge of food losses should be shared between stakeholders, and all stakeholders should have a shared understanding of the definition and scope of food losses. In addition, stakeholders should improve the collection, transparency and sharing of data, experiences, and good practices on food loss at all stages.

Previous research has investigated the safety of beef biltong by measuring microbial counts in biltong produced and marketed by formal and informal channels. Opportunities for processing and marketing biltong by small-scale cattle farmers has also been investigated. Some gaps were identified from this research. Firstly, no legal definition exists for biltong. Secondly, no guidance or "To Do Lists" exists for manufacturing biltong on a large scale. Even more so, no market data exists for dried meat products. One methodology to adapt in further research for both game and beef biltong is the use of the lean approach. The lean approach looks at the whole chain and can identify all areas of waste in the chain. The lean approach also constructs a chain map that looks at information flow and product flow between stakeholders in a specific chain. The lean approach also focuses on consumer demand. Therefore, this approach will extend the analysis to the end consumer. Which will lead a better understanding of why certain activities occur in the value chain.

Finally, as mentioned in the literature review, the results of this thesis cannot be generalised to other countries or to other products. However, it is suggested for future research to apply the methodology used in this study to investigate food value chains in different countries to gain a better understanding the value chain as well as food losses that occur in different commodities.

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ADDENDA

Addendum A : Retailler questionnaire

A. Identification

Date	
Type	/_/ Supermarket /_/ Shop /_/ Franchised shop
Location	
Name	

A.1. Number of employees at the retail point (equivalent full time).

A. 2. Is there others retailing points of the same companies/owners) selling Biltong/Droëwors/. How many?

/_/ In Stellenbosch:……………….

/_/ In Western Cape:…………….

/_/ in South Africa:……………….

B. Product sold and supplier

B.1. Type of Biltong and Droëwors (beef, game) and quantity sold (Kg/month). If you do not know the exact amount, please provide as accurate an estimate as possible.

Product	Kg/month	Beef or Game
Beef Biltong		Beef Biltong or Game Biltong
Game Biltong		
Beef Droëwors		Beef Droëwors or Game Droëwors
Game Droëwors		

B.2. Suppliers for the Biltong and Droëwors.

Product	Name of supplier processor/ wholesaler)	Place	Type of products (biltong, droëwors, etc)	Kg/month
Beef				
Game				
Ostrich				
Other:				

C. Loss of Biltong and Droëwors

C.1. Average loss per month

	Products	Kg/month	% of total sold
Unsold	Beef Biltong Game Biltong		
	Beef Droëwors Game Droëwors		
Customer returns	Beef Biltong Game Biltong		
	Beef Droëwors Game Droëwors		

C.2. Rank the main kind of technological losses (mould, rancid salt precipitation). If possible give % for each loss from total sold. What do you do to reduce the loss?

<u>1.</u>

<u>2.</u>

<u>3.</u>

<u>4.</u>

C.3. Is there differences in quantities lost and kind of technological losses between:

Droëwors/Biltong (explain)?

Beef/ game/ ostrich (explain)?

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C4. What mainly happens to unsold and customers returns. Rank the frequency and/or % (1 most frequent destination).

Send back to Supplier	
Take Home for myself, family	
Give to somebody else (friends)	
Throw away	
Re-use (dog food, biltong powder…)	
Don't want to say	
Other	

C.5. Do your suppliers sometimes refuse the returned products?

/_/ Yes

/_/ No

Thank you

Addendum B: Processor questionnaire

Identification

Date	
Other activities than Biltong/Droëwors processing	/_/ Wholesaler /_/ Industrial Abattoir /_/ Retailing shop /_/ Raw meat products processing
Location	
Name	

A.1. What kind of dry-products do you process here?

/_/ Beef   /_/ Game   /_/ Ostrich   /_/ Other:

/_/ Biltong   /_/ Droëwors   /_/ Cabanossi   /_/ Nuggets   /_/ Snap Sticks
/_/ Chips   /_/ Powder   /_/ Chilli bites   /_/ Wagon wheel   /_/ Others:

A.2. Number of employees in the processing unit (equivalent full time).

A.3. Who do you supply?

/_/ Supermarkets

/_/ Private Shops

/_/ Exports

/_/ Own Shops

/_/ Other:

A.4. What share of total Biltong and Droëwors produced in South Africa do you think you represent?

B.1. Type of Biltong and Droëwors (beef, game) and quantity processed. If you do not know the exact amount, please provide as accurate an estimate as possible.

Product	t/month (DRY)	Beef /Game
Beef Biltong		Beef Biltong/ Game Biltong
Game Biltong		
Beef Droëwors		Beef Droëwors/Game Droëwors
Game Droëwors		

B.2. Suppliers for the raw materials.

Product	Name of supplier (Industrial Abattoir/ wholesaler)	Place	Type of cuts/ carcass and grade	t/month
Beef				
Game				
Ostrich				
Other species:				
Spices				
Other:				

A. Loss of Biltong and Droëwors (processed)

C1. What is the quantities per month of loss for these products? And the type of loss?

	Product	Kg/month	% of total sold
Unsold	Beef Biltong/Droëwors		
	Game Biltong/Droëwors		
Retailers returns	Beef Biltong/Droëwors		
	Game Biltong/ Droëwors		

C.2. Rank the main kind of technological losses (mould, rancid, /salt precipitation, too fatty). If possible give % for each loss from total sold. What do you do to reduce the loss?

<u>1.</u>

<u>2.</u>

<u>3.</u>

<u>4.</u>

C.3. Is there differences in quantities lost and kind of technological losses between:

Droëwors/Biltong (explain)?

Beef/ Game/ Ostrich (explain)?

Season (explain)?

C4. What happens to loss in Biltong and Droëwors? Rank and give %.

Reuse (animal food, powder…)	
Give to somebody else (employees or others…)	
Throw away	

Don't want to say	
Other	

B. Loss of raw material (carcass, cuts…)

D.1. Do you sometimes have problems with the quality of raw meat?

/_/ Yes

/_/ No

D.2. What kind of problem, rank it? What do you do to reduce the loss?

1.

2.

3.

D.3.What mainly happens to these products? Rank and/or give %.

Return to supplier	
Reuse (animal food, powder…)	
Give to somebody else (employees or others…)	
Throw away	
Don't want to say	

Thank you………

Addendum C: Price information from Secondary Processors in August 2016

1. What is the average selling price for beef biltong (whole piece) per Kg to the retailer? eg: Supermarkets, hotels ect.
R/ Kg
2. What is the average selling price for game sliced biltong (Whole Piece) per Kg to the retailers? Supermarkets, hotels ect.
R/Kg
3. What is the buying price for raw <u>beef</u> prime cuts per Kg?
R/ Kg Silverside and/or R/Kg Topside
4. What is the buying price for raw <u>game</u> prime cuts per Kg?
R/Kg Silverside and/or R/Kg Topside
5. What is your <u>beef</u> biltong prices in your store?
R/Kg
6. What is your game biltong pries in your store?
Springbok R/Kg
Kudu R/Kg
7. Does your prices differ according to time of year? If yes, reason.

Addendum D: Images of the biltong value chain at secondary processors and retail point.

Stages	Description	Image
Secondary processors	Silversides arrive on secondary processing site.	
Secondary processors	Two silversides are vacuumed pack in a cardboard box. Weighing an average of 9kg each	
Secondary processors	Vacuumed pack are opened	

Secondary processor	Image Indicates blood loss when opening the vacuumed packs.	
Secondary processor	Sinew is removed first on the prime muscle (silverside)	
Secondary processor	Sinew removed from prime cuts. Will be dried and sold as pet food.	
Secondary processor	Silverside cut up in three subsection.	

Secondary processor	One of the silversides subsections are prepared for biltong. The trimming can be seen on the right; this will be used for droëwors.	
Secondary processor	Biltong pieces are cut, ready to be spiced and marinated in tumblers.	
Secondary Processor	Wet, spiced snap sticks laid out on grid. Prepared for the drying process.	

Secondary Processors	Droëwors. being dried with fan in the Karoo climate	
Secondary Processors	Snap-sticks after drying.	
Secondary Processors	Large sliced biltong, ready to be packaged.	

Retail Point	Biltong store in Supermarket	
Retail Point	Biltong store in supermarket	
Retail point	Biltong bar inside a gas station food shop	