ECONOMIC ASPECTS OF LOSSES AND WASTE:

CASE STUDY OF THE

SOUTH AFRICAN TABLE GRAPE SUPPLY CHAIN

by

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I declare that the dissertation that I hereby submit for the degree in Agricultural Economics at the University of Pretoria has not previously been submitted by me for degree purposes at any other university.

SIGNATURE:……..…….. DATE: ……

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ABSTRACT

Economic aspects of losses and waste: Case study of the South African table grape supply chain

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Globally, 1.3 billion tons of edible food is wasted per annum. Having regard for the economic, social and environmental consequences, the management of food losses and waste is an obvious priority in pursuing a sustainable, sovereign global food system. A study was undertaken to explore the phenomenon of food losses and waste in the South African Table Grape Industry's export value chain. A mixed method approach was used to develop a framework to guide the identification and quantification of losses and waste within the particular chain. Practically, the framework is a tool for stakeholders to guide policymaking and decision making at industry and operator level to manage losses and waste. The application of the framework to selected South African table grape export chains suggests that the bulk of the losses and waste historically occur at the production and intake stages of the chains. An approximate figure of 9.5 % (R270.5 m) of losses and waste occurred between the production

and intake stages and 2.2 % (R93.2 m) and 3.8 % (R0.4 m) occurred between intakes and exports and between the importer to retail depot, respectively. Reducing losses and waste requires more thoughtful and customised alignment between stakeholders to enhance overall supply chain performance by managing losses and waste.

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ACRONYMS

FLW =	Food losses and waste
GDP =	Gross Domestic Product
PHI =	Post-Harvest Innovation Programme
ROI =	Returns on investment
SATGI =	South African Table Grape Industry
SATI =	South African Table Grape Industry body
TGSC =	Table Grape Supply Chain
FFV =	Fresh fruit and vegetables
VC =	Vertical coordination
FSC =	Food supply chains
SPS =	Sanitary and phytosanitary measures

CHAPTER 1
GENERAL INTRODUCTION

1.1 INTRODUCTION

The Food and Agricultural Organization (FAO) estimates that 1.3 billion tonnes of food that is fit for human consumption is wasted globally per annum. Annually, consumers in developed countries waste 222 million tons of food, almost equivalent to that of the Sub-Saharan Africa's net food production of 230 million tons (FAO, 2011). To put this into perspective, globally, 900 million people or about one in nine people do not have enough food to lead a healthy and active lifestyle. The poor global distribution of food is also evident from poor nutrition, which causes 3.1 million deaths per year in children younger than five years old (WFP, 2015), while 1 billion people are overfed (FAO, 2013a). Current consumption and production trends indicate that food production will need to increase by 60 % by 2050 to support a population of 9.6 billion people (FAO, 2013a). Therefore, reducing food losses and waste (FLW) is a priority in achieving a sustainable food future with efficient food systems (Lipinski, Hanson, Iomax, Kitinoja, Waite & Searchinger, 2013).

The FAO defines food losses and waste (FLW) as "*the decrease of food in subsequent stages of the food supply chain intended for human consumption"* (FAO, 2011). Food loss and food waste occur throughout the entire food supply chain, with losses being more prevalent at the consumption stage for medium- and high-income countries, while in low-income countries, the phenomenon occurs at the early and middle stages of the food supply chain (FAO, 2011). Food waste in low-income countries is primarily attributed to financial, managerial and technical limitations in areas such as pre- and post-harvest techniques, infrastructure, and intermediate activities related to proper storage, packaging, distribution and marketing. On the other side of the spectrum, food losses in middle- and high-income countries are related to the lack of coordination between supply chain role players and consumer behaviour, such as improper purchase planning. It is evident that food losses and waste have negative impacts on food security and increase the wasting of resources used during production and distribution, with consequential impacts on the environment (FAO, 2011).

In the South African context, Oelofse and Nahman (2013) determined that food waste amounts to 9.4 million tonnes of local production per annum. If imports and exports were to be incorporated, this would indicate that 10.2 million tonnes of food are wasted or lost in South Africa, annually. Fruit and vegetables alone contribute 44 % of the total waste generated in South Africa (Oelofse & Nahman, 2013). The total cost of food waste, based on market prices excluding disposal costs, amounts to R61.5 billion, equivalent to 2.1 % of South Africa's gross domestic product (GDP).

In consideration of the sheer volume of waste and losses in the food value chain, in general, this research has developed a framework to identify and quantify the key problem areas where losses are suffered and waste is generated in the export value chain of the South African Table Grape Industry (SATI). The South African Table Grape Industry provided research funding to analyse the impact of FLW on its export chain due its economic importance. The aim of the research was to develop a framework that will inform decision-making and guide actions to alleviate the negative externalities created by losses and waste throughout agricultural supply chains. Increased knowledge about where and how different kinds of waste are generated in the chain is essential for enabling improved decision making and potentially greater collaboration, accountability and alignment of supply chain incentives among role players to reduce the impact of losses and waste.

1.2 PROBLEM STATEMENT

The economic evaluation of FLW in a value chain context is underdeveloped. As a consequence, the economic dimensions of FLW in chains like SATI's export value chain are inadequately understood and developed to drive decision making in the chain. The significance of the problem is evidenced through the impacts on the Returns on Investment (ROI), the primary motivation, for the chain stakeholders (HLPE, 2014; Segrè, Falasconi, Politano & Vittuari, 2014; Rosegrant, Magalhaes, Valmonte-Santos & D'Croz, 2015).

Beyond the challenge that FLW poses for the ROI of supply chain stakeholders, significant controversy also surrounds the analysis of FLW in general. This research specifically addressed the absence of an economic perspective with respect to FLW in agricultural supply chains. Ultimately, economic incentives (and sanctions) drive the decision-making and actions of supply chain stakeholders, which justifies undertaking an economic analysis of FLW in the chain context (HLPE, 2014; Segrè et al., 2014; Rosegrant et al., 2015).

Traditionally, FLW reduction strategies have been prioritised on two premises, the one being a food perspective with the associated food security issues, and the other a sustainability perfective coupled to environmental concerns (HLPE, 2014). The main problem with these approaches is that they lack a focus on the economic decision-making process that underlies actors' actions within the value chain. Rutten (2013) notes that FLW literature lacks detailed empirical studies on the economic, social and environmental impacts of reducing FLW. This is aggravated by the absence of reliable and consistent data, and by discrepancies in the definitions, including as to the scope and extent, of FLW. Current applied literature available on FLW only represents the scale of the problem and does not consider the wider economic impacts on the demand and supply model, price mechanisms, second-order effects in reducing FLW, and supply chain interactions (Rutten, 2013).

Moreover, the deregulation of the South African fruit sector and the availability of information continuously drive the evolution of agricultural value chains, globalised trade, and power relations within the table grape value chain, which emphasises the importance of economic decision making in FLW reduction strategies (Symington, 2008; HLPE, 2014; Segrè et al, 2014). The discord among institutions and actors and the export market proliferation have reduced the levels of coordination among actors in areas of mutual interest in fear of increased market share competition affecting FLW prevalence (Symington, 2008). However, with increased levels of coordination, greater attention has to be given to appropriate risk management in reducing FLW as chains become more fragile to exogenous changes (Jordaan, 2016).

1.3 OBJECTIVES

The dissertation's research questions are addressed through the general objective, which is the overarching theme of the dissertation. The specific objectives are a delineation of the general objective, which will be discussed throughout the various chapters to address the overall theme of the dissertations research questions.

1.3.1 General Objective

The general objective of the research is to develop a framework to identify, describe and quantify the economic losses and waste in agricultural value chains. This research will be conducted in the context of the South African Table Grape Industry (SATGI) and is aimed at

supporting policy and strategy development to improve supply chain management and coordination among the various role players to manage the phenomenon of losses and waste.

1.3.2 Specific Objectives

The specific objectives addressed in the dissertation are to:

- Identify the key areas prone to loss incidence and determine the kinds of losses and waste generated throughout the table grape supply chain (TGSC).
- Develop a method to quantify losses and waste in the TGSC.
- Determine why losses and waste occur.
- Identify, where possible, the activities responsible for generating losses and waste.
- Determine the approximate economic extent of FLW in a chain context.
- Suggest measures or policies that could be taken to deter the occurrence, and improve the management of, loss and waste generation as well as enhance accountability among role players.

1.4 PROPOSITIONS

As a consequence of identifying and quantifying losses and waste in the TGSC, the research attempts to facilitate improved supply chain management to improve the financial well-being of all the participants in the TGSC. Three propositions have been identified which will form the three core chapters aimed at addressing the issues in hand:

1. Macro-, meso- and micro-factors contribute to FLW in the SATGI chain. These factors vary in their significance and impact on FLW in the SATGI chain.

2. Various supply chain activities within SATGI contribute to FLW, although certain activities within the chain play a more prominent role than others do.

3. The extent of FLW in the SATGI chain can be quantitatively and qualitatively described and approximated, depending on the type and quality of information available throughout the chain and the role players' willingness to share the information available.

This dissertation develops a framework to assess FLW, taking into consideration the quantitative and qualitative characteristics revealed in the analysis of the specific context. The

framework could ultimately serve as a tool to align supply chain incentives, to enhance supply chain transparency, and to enable the measurement of FLW and the management thereof. The following section elaborates on the methodology and analytical framework used to conduct the research. The methodology will be discussed in accordance to its relevance in addressing the dissertation's research questions and objectives.

1.5 METHODOLOGY AND ANALYTICAL FRAMEWORK

This section will discuss the dissertation's research methodology which is based on a mixed method design. This methodology will encompass an operational and perceptual analysis in order to capture the nuances of FLW in the South African TGSC. However, the operational and perceptual analysis will follow in the subsequent chapters. Here, the focus will be on addressing the appropriate design for answering the research questions.

1.5.1 Mixed method design: A survey within a case study

Based on the nature of the dissertation's research question, the research lent itself to a mixed method approach. The appropriateness of this research method is supported by Kirsten (2004) and Doyer and van Rooyen (2001) who make the case that the combined approaches of constructivism and positivism provide a more holistic understanding of the complex phenomenon eminent in agricultural value chains. The understanding and reconstructive capabilities of constructivism allow the researcher to assume multiple, apprehensible and often conflicting social realities in reconstructing the "knowledge" and to apply it to the real life complexities of business interactions in supply chains.

The mixed method design, and specifically the embedded single case study design to be followed in this dissertation, requires holistic data collection strategies to be followed, while surveys/stakeholder interviews are needed to collect data on the embedded units of analysis. As a result, the mixed method research requires the methods and procedures to share the same research question, the collection of complementary data, and the conduct of counterpart analysis. Therefore, the confinement to a single study obliges the mixed methods to be integrated, thus allowing the embedded single case study design to gain ample opportunities for extensive analysis in enhancing the insight into the prevalence of FLW in SATGI (Yin, 2014). Therefore, given the nature of a mixed method research design, different methodologies are used and discussed in each chapter to address the overarching methodology discussed.

1.6 OUTLINE OF STUDY

This dissertation is organised into five chapters. Following this introductory chapter, the second chapter is composed of a literature review providing an insight into the global extent and causes of FLW. Chapter 3 is composed of three sections 1) industry overview, 2) supply chain analysis and 3) institutional analysis, which provides the theoretical background for the empirical methodology. The results are discussed in Chapter 4. A summary of the study and concluding remarks are given in Chapter 5.

CHAPTER 2
LITERATURE REVIEW

2.1 INTRODUCTION

There is general consensus that the basis of competition has shifted from it being between firms to being between supply chains. As a result of this shift, firms increasingly recognise the importance of supply chain performance and that being part of a well-performing supply chain generates benefits for the individual firms in the chains (Bell, Autry & Griffis, 2015).

Porter's (1985) value chain model has, as an overarching outcome, the generation of a margin in the process of delivering on customer requirements. At the same time, supply chains also aim to achieve specific goals for the companies aligned in a supply chain. Typically, these are to achieve efficient fulfilment, create value for customers, enhance responsiveness, build resiliency, and to facilitate financial success (Gibson, Hanna, Defee & Chen, 2014).

An analysis of the phenomena which impact, either positively or negatively, on the supply chain margins is therefore essential in assessing whether the purpose of aligning in a chain is achieving the goals of such alignment in a chain. In this regard, the analysis of food losses and waste (FLW) and the impact thereof on supply chain goals is a contemporary theme (Jedermann, Nicometo, Uysal & Lang, 2014). Losses and waste comprise a particularly relevant dimension of food supply chains where the product value deteriorates over time. Supply chain management strategies are continuously being challenged to address FLW in supporting the achieving of supply chain goals (Blackburn & Scudder, 2009; Segrè et al., 2014; High Level Panel of Experts, 2014).

Present literature highlights the necessity to limit and manage losses and waste in supply chains on the one hand, and emphasises the social, resource and food security complexities on the other (Parfitt *et al*., 2010; Lipinski, Hanson, Iomax, Kitinoja, Waite & Searchinger, 2013; HLPE, 2014). However, an analysis is neglected of the economic incentives, and the institutions involved in, and the governance of, supply chains in managing losses and waste (Rutten, 2013). Hence, this chapter will review the current literature on food losses and waste.

2.2 CURRENT LITERATURE

Traditionally, reducing FLW has been prioritised based on two principles. These principles are a food security and hunger perspective and an environmental perspective (HLPE, 2014). This dualistic approach in analysing FLW, however, contributes to ambiguity (and unreliability in data) and confusion regarding the definition and scope of FLW (HLPE, 2014).

In terms of food security, both producers' and consumers' overall well-being and access to safe and affordable food is negatively affected by FLW. From an environmental perspective, the wasted resources (water and land) and the emissions of greenhouse gasses (Lipinski *et al*., 2013) are the unwanted externalities of FLW. A generalised definition of FLW currently entails the following dimensions (Codex Alimentarius, 1985; FAO, 2011; HLPE, 2014):

> ***Food loss and waste*** *refers to the edible parts of plants and animals, fit for human consumption which are not ultimately consumed by people.*
>
> ***Food loss*** *refers to food that spills, spoils or is lost before it reaches the consumer which is mainly caused by the institutional and legal framework of the food production and supply system, the unintended result of agricultural process or technical limitation in supply chain infrastructure.*
>
> ***Food waste*** *is the removal of food fit for human consumption as a result of a conscience decision or negligence on the actor's part – this predominantly occurs at the final consumption stage, but not limited to it.*

2.2.1 Global analysis of FLW

The extent of global FLW is highly controversial due to differences in definitions, scope of FLW, and measurement protocols. Data collection related to FLW is often conducted on a once-off, ad-hoc, basis with a specific timeframe. Consequently, the contemporaneity, reliability, completeness and quality of primary and secondary FLW data is usually questioned (HLPE, 2014).

The FAO (2011) study on "Global food losses and food waste – extent, causes and prevention" serves as a primary source for many studies on global FLW. However, Parfitt (2013) and HLPE (2014) recognise the statistical limitations of the data presented by the FAO (2011) on global FLW. Assumptions and point-based estimates were made to close the knowledge gaps in

comparable regions, commodity groups and stages in the food supply chain. Data incompleteness and unreliability, uncertainty regarding the error margin of FLW, the frequency with which data is reported, and the evolution of global FLW raise concerns regarding the methodology used (HLPE, 2014; Parfitt, 2013).

A further dispute among literature studies is whether FLW data should be reported in weight or calories. Lipinski *et al*. (2013) argue that food types differ in terms of their water and caloric content and that weight is not an accurate measure of FLW. It is emphasised that different units of measurement (weight or calorie) will highlight different commodities' FLW incidence. FLW analyses are therefore not created equal because different food types have different social, economic and environmental impacts. Based on these arguments, Lipinski *et al*. (2013) concluded that FLW, in terms of caloric content, equates to 24 % as opposed to the FAO's (2011) weight estimate of 32 %, globally. Despite Lipinski's et al. (2013) argument regarding the unit of measurement, the authors relied on the same raw data from the FAO (2011) in formulating these arguments. Hence, the same statistical discrepancies are present and do not provide independent estimates of the extent of global FLW (HLPE, 2014).

Moreover, the different schools of thought in estimating global FLW have made it difficult to understand the extent of global FLW due to the lack of standardisation in definitions, measurement protocols, and data collection for different countries and products. As a result, no FLW data which is generated can be considered reliable without noting the associate methodology used to produce it (HLPE, 2014). This phenomenon has hindered the development of potential solutions and the development of a proper, standardised monitoring process of FLW on a global scale (HLPE, 2014). Currently, many organisations (among others the FAO, OECD, WRI and UNEP) have called for the standardisation, harmonisation and transparent development of global protocols for the measurement of global FLW (HLPE, 2014). Despite the limitations in the FAO's (2011) study, it is the only study currently available that incorporates all FLW data, from production to consumption, encompassing all food production sectors.

2.2.2 The extent of global FLW

FLW distribution differs greatly along the food value chain, depending on the product and region. Dietary transitions, away from starchy food staples towards more vulnerable, short shelf-life items, are associated with greater food loss and waste due to the highly perishable

nature of such items. Fresh fruit and vegetables (FFV) account for 44 % of total FLW, globally (see

Figure 2.1 below). Due to the highly perishable nature of the produce and inadequacies in pre- and post-harvest activities, losses are greater in developing/transitional countries than they are in developed countries for FFV (FAO, 2011). Despite the risky nature of food supply chains, urbanisation, contraction of the agricultural sector and globalised trade drive the need for more and longer food supply chains, which are associated with higher levels of FLW (Parfitt, Barthel & Macnaughton, 2010).

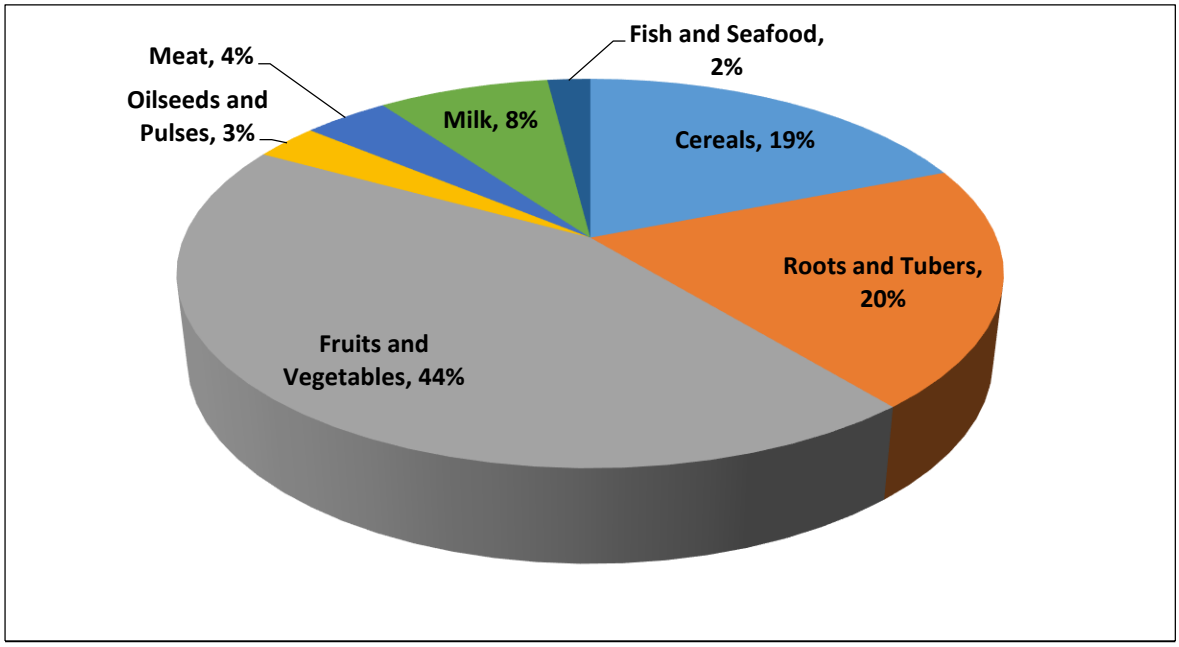


Figure 2.1: Share of global food losses and waste by commodity
Source: FAO (2011)

2.3 CAUSES OF FLW

FLW occurs throughout the food supply chain, from initial production to consumption. FLW in low-income countries is, however, more prominent during the production and processing stages of the chain, with much less waste being experienced at the consumer level. In medium- and high-income countries, food is most often wasted at the consumption stage, although it is still suitable for human consumption (FAO, 2011; BCFN, 2012; Lipinski et al., 2013; HLPE, 2014).

Various literature studies on FLW (Parfitt et al., 2010; FAO, 2011) have identified individual causes of FLW. The importance of the cause and its background varies according to the

produce, and the extent and the stage of the supply chain under consideration. This categorisation of FLW is an important process to be followed in the analysis of FLW so that strategies to deal with FLW can be tailor-made to appreciate and address the phenomenon in the appropriate context (BCFN, 2012; HLPE, 2014).

It is important to note that the causes of FLW are often interrelated and that immediate causes, to an extent, can be related to other primary causes that occurred earlier in the chain. Consequently, the HLPE (2014) provides a useful framework which identifies three different levels of causes to simplify the diversity and complexity of the causes of FLW. These levels are:

- **Macro-level causes of FLW**

  These causes account for how FLW can be explained by more systematic issues, such as malfunctioning food systems, and lack of institutional or policy conditions and coordination among supply chain role players. Macro-level causes favour the emergence of micro- and meso-level causes and are often the primary reason for FLW.

- **Meso level causes of FLW**

  These are secondary/structural causes of FLW. Meso-level causes can be found at the same/different stages of the chain where the FLW occurs. It can be a result of how different actors are organised, the relationships among supply chain members, or the state of infrastructure. Meso-level causes, therefore, contribute to micro-level causes or determine their extent. Meso-level causes include poor private and public infrastructure and a lack of investment in post-harvest research.

- **Micro-level causes of FLW**

  These causes of FLW occur at each particular stage of the chain, from production to consumption. Micro-level causes result from the actions/non-actions of individual actors in response (or lack of it) to external factors. Specific micro-factors include inappropriate pre-harvest agronomic practices and poor harvesting techniques leading to mechanical damage.

2.3.1 Macro-causes of FLW

Meso- and micro-level causes are driven by macro-causes. Macro-causes are those related to regulatory environments, policies and systematic causes that appear at the meso- and micro-levels.

- **The impact of policies, laws and regulations on FLW**

Policies and regulatory environments affect the ability with which supply chain members can reduce FLW. Regulations can have either a direct impact on FLW, such as food redistribution regulations, or an indirect impact, such as food labelling regulations (House of Lords, 2014).

With the evolution of food safety standards, Henson and Hooker (2001) noted that private, rather than public, standards are becoming the drivers of agri-food systems. Although private (voluntary) food safety and quality standards operate alongside regulatory systems, these have become *de facto* mandatory production standards for suppliers (Henson & Blandon, 2007). Wilson and Abiola (2003) have argued that smaller and poorer countries/economies will be further marginalised through the combined effects of institutional weaknesses and compliance costs. Developing countries often lack the administrative, scientific and technical capabilities to comply with food safety standards, a scenario which poses significant medium-term barriers (Henson, Loader, Swinbank, Bredahl & Lux, 2000).

With the rapid growth in production and globalised food trade, the incidence of FLW should prompt international food safety authorities to coordinate in better ways through closer linkages, internationally. The lack of policy coordination at regional levels causes food safety concerns later on in the globalised food chain (FAO, 2013b).

- **Systematic causes**

Systematic causes favour the emergence of micro- and meso-causes of waste and constitute the major contributor of FLW. Systematic causes for low-, medium- and high-income countries differ. In low-income countries, systematic causes are linked to financial, managerial and technical inefficiencies throughout the chain. Systematic causes for medium- and high-income countries relate more to coordination inefficiencies among supply chain role players and to consumer behaviour (HLPE, 2014).

With the rapid expansion of supermarkets in developing countries (Reardon, Timmer, Barrett & Berdegue, 2003; McCullough, Pingali & Stamoulis, 2008; Barrientos & Visser, 2012) and with the "standardisation" of fresh produce, there is also an increased risk for FLW increasing. Many farmers often lack the financial and technical abilities to comply with the strict private standards set by retailers (Berdegue, Balsevich, Flores & Reardon, 2005; Henson & Blandon, 2007). Non-standard produce ends up being rejected and discarded at various stages of the FSC.

A major systematic cause of global FLW is the lack of appropriate implementation of policies and a regulatory framework to facilitate the coordination among supply chain role players (HLPE, 2014), transparency (both on a qualitative and quantitative basis), and the adoption of good practices (Jakab, 2011).

2.3.2 Meso-causes of FLW

Micro-causes of FLW are often caused by other secondary meso-causes, resulting in stage-specific FLW. Meso-causes are the result of differences in structural/organisational and interrelationships among supply chain role players. This subsection focuses on some of the meso-factors that cause FLW throughout the supply chain.

- **Lack of investment and implementation of good practices**

The food sector, especially in developing countries, lacks access to finance and credit, which hampers their investment in technologies that would reduce FLW (HLPE, 2013). Despite improvements in microfinance programmes and community credit, Doligez, Lemelle, Lapenu and Wampfler (2010) showed that more than 50 % of African producers (except South Africa) had no access to any form of credit.

That lack of the implementation of good practices at the various stages in the supply chain can be attributed to a myriad of factors. Among developing countries, the Agreement on the Application of Sanitary and Phytosanitary Measures (SPS agreement), and the proliferation and enhancement of stringent food safety standards are major areas of concern (Wilson & Abiola, 2003; Henson & Wilson, 2005; Henson & Blandon, 2007).

Other factors relate to a lack of integration and coordination among supply chain actors, lack of initial and continuous training, insufficient market-based incentives in the short run to apply

good agricultural practices (GAP), good manufacturing practices (GMP), and Hazard Analysis and Critical Control Point (HACCP) (Henson & Blandon, 2007).

- **Insufficient private and public infrastructure**

Infrastructure-related FLW is the consequence of the use of infrastructure that is ill adapted for food supply chains. Private infrastructure relates to physical cold chain infrastructure, such as storage and processing facilities, whereas public infrastructure relates to support and enabling activities, such as facilitating access to inputs (including basic services such as water and electricity), logistics and marketing (HLPE, 2013).

- **Market infrastructure**

Adequate market structures are essential for reducing the incidence of FLW along the chain. Supply chain market infrastructure is, however, not only limited to physical infrastructure, but also includes the quality of physical infrastructure (such as handling facilities, storage and temperature control) which are crucial for ensuring a sustainable supply chain (HLPE, 2014). A recent supply chain study indicated that the network of infrastructure determines between 75 % and 80 % of supply chain cost. Managing these costs is therefore vital in reducing inefficiencies within the supply chain which contribute to FLW (Kosansky & Schaefer, 2011).

Market failure is common in the provision of infrastructure due to the public nature of the goods and asymmetric investment incentives. Government involvement is therefore required to address the underinvestment in infrastructure and coordination failures (White, O'Connor & Rowe, 2004).

- **Storage infrastructure**

Poor storage facilities and access to storage facilities constitute a major contributor to FLW in developing countries (HLPE, 2014). Kader (2005) noted that storage infrastructure in developing countries is often inadequate and lacks the necessary cooling facilities and the proper enforcement of sanitary regulations. Poor and unhygienic storage and handling conditions decrease the shelf life of produce, as the produce is then more susceptible to mechanical and biological degradation. Consequently, such produce poses a health risk to consumers owing to unhygienic practices or premature spoilage (FAO, 2011).

- **Cold chain infrastructure**

The efficiency with which cold chains operate either increases or decreases FLW in the chain. In developing countries, cold chain infrastructure is either non-existent or under-utilised and poorly maintained because of the costs involved in providing these facilities (Lan & Tian, 2013; FAO, 2014). Annually, 30 % of India's fresh fruit and vegetable (FFV) production goes to waste owing to gaps in the cold chain (Mittal, 2007). It is of utmost importance to maintain optimal temperatures for produce to ensure the extended shelf life and marketability of the produce (Opara & Mditshwa, 2013).

- **Processing infrastructure**

The seasonality of production and high investment costs often contribute to the limited access to and capacity of processing facilities (FAO, 2011). Processing facilities are often sparse in under-developed regions because of their reliance on proper and well-functioning infrastructure. However, the demand for processed fruit and vegetables is increasing in developing economies owing to dietary transitions (IBISWorld, 2014).

With processing facilities being sparse in developing regions (IBISWorld, 2014), such facilities also often neglect good management practices. Comprehensive sanitation standards, operating procedures, integrated pest management and maintenance programmes are often lacking, which contributes to food safety issues (Henson & Blandon, 2007; UN, 2007).

- **Lack of chain coordination and management**

Global food supply chains were characterised by state-controlled vertical coordination before the liberalisation of the food chain in the 1990s. State-controlled vertical coordination was politically motivated and driven by objectives to create rural employment, cheap food for urban markets, and the maximisation of foreign exchange earnings (Rozelle & Swinnen, 2004; Swinnen & Maertens, 2007). Major disruptions were caused in the food chain during the 1980s and 1990s with the liberalisation of prices and exchange, and the privatisation of firms and farms, which caused the collapse of state-controlled vertical coordination. With the deregulation of state-controlled vertical coordination, farmers no longer received input and price subsidies. It was also coupled with a decline in government research, extension services and government-subsidised credit (Swinnen & Maertens, 2007).

Private vertical coordination emerged after the above-mentioned food chain privatisation and liberalisation (World Bank, 2005; Swinnen & Maerstens, 2007). The increased use of private vertical coordination is caused by an increasing consumer demand for high quality produce, safety standards for processing the produce, dissatisfaction with the various market imperfections, poor public institutions that affect the reliability, consistency and timely supply of high quality food. Private vertical coordination is often seen as a "tool" for economic growth, rural development, and poverty alleviation (Swinnen & Maertens, 2007).

Various case studies (Gow, Streeter & Swinnen, 2000; Dries & Swinnen, 2004; Maertens & Swinnen, 2007) have found that the direct impact of private vertical coordination, in the form of vertical contracting, resulted in significant growth in output yields, farmers' income and investment. Indirect effects of private vertical coordination are linked to household spillover effects related to reduced risk, and increased access to capital and farm assistance. However, Parfitt et al. (2010) have identified issues related to contractual practices (such as the lack of food supply chains transparency, payment terms and poor demand forecasting) that might exacerbate FLW in the food supply chain, if mismanaged.

- **Food date labelling**

The multitude of approaches in food date labelling (see Table 2.1 below), and the confusion this causes, is a major indirect cause of FLW, at both the retail and consumer levels (Lee & Willis, 2010; Lipinski *et al*, 2013).

Table 2.1: Definitions of food date labelling

Type of date	Definition
Date of manufacture	Date on which the food becomes the product described.
Date of packaging	Date on which the food is placed in the immediate container in which it will be sold.
Sell-by or Display until	Tells the store how long to display the product.
Best-if-used-by or Best before	Recommended date by which to consume the product in order to experience peak quality and flavour. It does not pertain to the safety of the product.
Use-by	Last date recommended for the use of the product recommended from a food safety perspective.

Source: Codex Alimentarius (1985)

Although these dates are intended to provide consumers with information, they often become a source of confusion. Consumers view all of these dates as constituting a food safety measure and not a food quality measure (WRAP, 2011; Lipinski *et al*, 2013; Wyman, 2013). The confusion and consequent FLW that occurs because of this uncertainty emphasises the need for a uniform, coherent and customer-orientated dating system (HLPE, 2014).

2.3.3 Micro-level causes of FLW – stage-specific causes

The following subsection considers the stage-specific causes of FLW in the FFV supply chain. It is important to note that these causes are dependent on products and local situations. Clear linkages will be drawn from macro- to meso- and micro-level causes, where appropriate (HLPE, 2014). Figure 2.2 below depicts the percentages where FLW occur at different stages of the food supply chain. Substantial losses do occur at the early production stage, irrespective of the level of income of a country. Stage-specific FLW, however, differs among the income categories of countries, i.e. low-, middle- or high-income counties (FAO, 2011; HLPE, 2014).

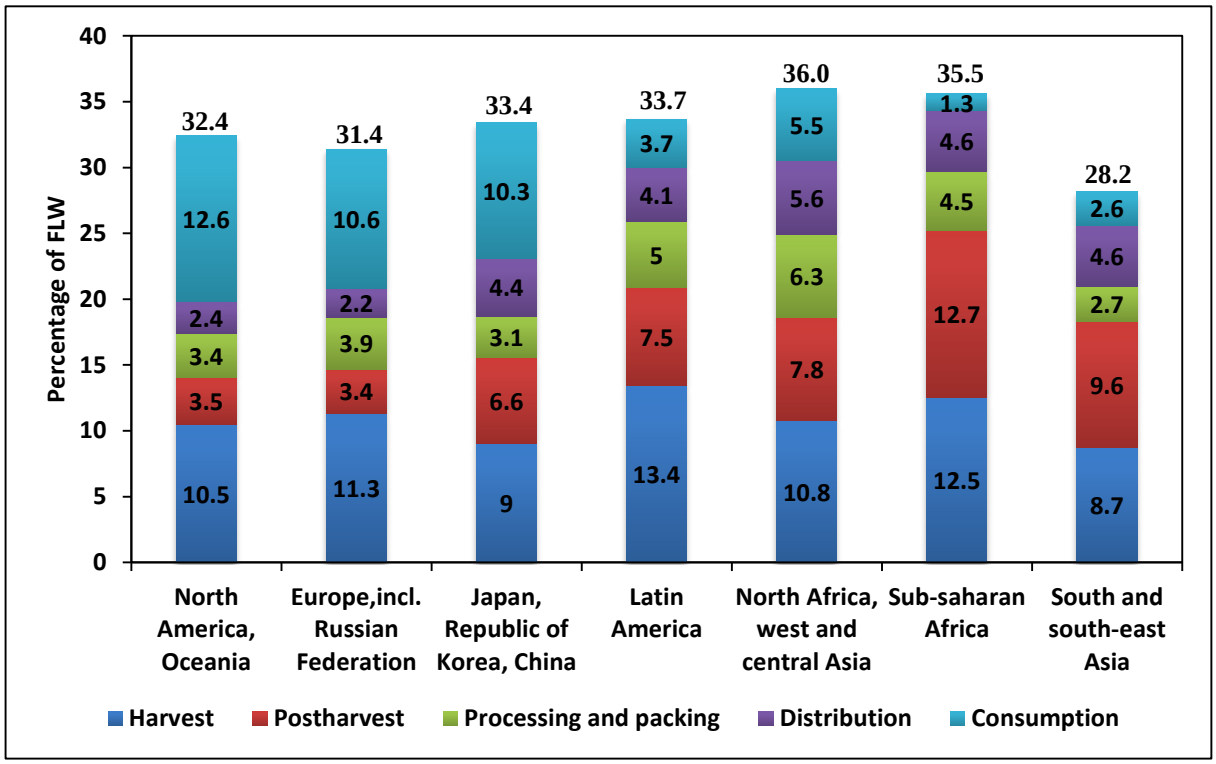


Figure 2.2: Distribution of FLW along the food supply chain in different world regions
Source: FAO (2011)

- **Production and Pre-harvest**

Production and pre-harvest losses are not included in the scope of "food losses and waste" but are nevertheless important, since pre-harvest practices affect post-harvest losses (Florkowski, Prussia, Shewfelt & Brueckner, 2009; HLPE, 2014). Florkowski et al. (2009) identified four pre-harvest factors that drive post-harvest losses: choice of crop varieties for the location and target market, agronomic practices, biological factors, and environmental factors. Weak management of these factors lead to high losses and waste later on in the chain. Significant

differences exist in this stage among developing and developed countries, thus affecting the FLW profiles among countries (FAO, 2011).

Agronomic practices for FFV have a significant impact on the product's quality, both visually and nutritionally. Poor management of agronomic practices results in a high percentage of rejections during product grading (Rolle, 2006; Florkowski et al., 2009). Poor pest/disease management at pre-harvest level is a major contributor to post-harvest losses because of latent infestation developing later in the chain as fruit matures (Thompson, 2007).

Stringent quality standards (as to size, shape, and colour) set by retailers and processors also contribute significantly to FLW and income loss to producers. Producers often overproduce to hedge against weather, and quality and quantity contractual obligations, which puts further strain on prices and areas in the supply chain that are susceptible to supply chain vulnerabilities (Stuart, 2009; HLPE & Wyman, 2014).

- **Harvest and initial handling (Post-harvest)**

Poor harvest scheduling and techniques are major contributors to FLW within the FFV chain. Maturity level (immature or overmature) at harvest is an important determinant for the quality and shelf life of the product (Rahman, Moniruzzaman, Ahmad, Sarker & Alam, 2014). In both cases, fruit is susceptible to physiological disorders, mechanical damage and poor eating qualities. This inevitably leads to reduced economic and nutritional value of the produce (Kader, 2008). Mechanical damage of FFV during harvest increases losses and waste, rendering exposed tissue more susceptible to pathogen infection, water loss and ethylene production, which enhances fruit maturity. Mechanical damage often occurs as a result of improper harvesting techniques and equipment, and limited harvesting time (Rolle, 2006; BCFN, 2012; HLPE, 2014).

Temperature management is also essential for ensuring the quality and marketability of fruit. Improper cooling facilities and a delay in precooling immediately after harvest contribute to spoilage later on in the chain due to microbial growth, softening and shrivelling (HLPE, 2014; Opara & Mditshwa, 2013). According to Kader (2002), produce that is harvested during the hot hours of the day are more prone to faster deterioration, and greater efforts are then required to cool such produce after it is harvested.

In developing countries, post-harvest losses account for almost a third of all FLW. Only 5 % of all agricultural research investment focuses on post-harvest issues, while 95 % focuses on strategies to increase crop production. Reducing post-harvest loss and waste is more cost effective and less time consuming than production strategies are (Lipinski et al., 2013). However, Goletti and Wolf (1999) have noted an increased consensus among international agricultural research organisations regarding the role of post-harvest systems in improving food security, alleviating poverty, and creating more sustainable agricultural practices, especially in developing counties. The study justified the importance of post-harvest research, based on its international public good nature. Furthermore, increased investment in post-harvest research will not only reduce FLW, but will also improve the socioeconomic wellbeing of farmers, businesses, and society as a whole (Lipinski et al., 2013).

- **Storage**

Storage is an essential mechanism to enable the marketing and consumption of fresh produce to be deferred (HLPE, 2014). It is important to note that optimal storage conditions, together with the appropriate packaging, will only reduce FLW depending on the initial pre- and post-harvest actions taken by producers (HLPE, 2014; Opara & Mditshwa, 2013). Suboptimal storage conditions and the mixing of products can aggravate product deterioration due to microbial cross-contamination, chemical and biochemical reactions (changes in colour, texture and taste) and chilling injury (Louw & Korsten, 2014). All these affect the quality and nutritional value of the produce, which could end up being discarded, either during storage or at the time of consumption (HLPE, 2014).

Post-harvest and storage inefficiencies contribute between 4 and 10 % of the total FLW generated in the FFV supply chain (FAO, 2011). Storage facilities are often non-existent or inaccessible to the majority of smallholder farmers in developing countries. The financial wellbeing of smallholder farmers is consequently adversely affected as they are forced to sell their produce regardless of the market price or face the risk of a total loss. In developed countries, storage facilities are well established throughout the entire chain. Improved post-harvest storage technologies, such as biological pest control, controlled atmosphere storage and 1-MCP are used to extend the shelf life and marketing period for FFV (Goletti & Wolf, 1999). Losses that do occur at this stage are attributed to poor management of conditions (such as temperature abuse and refrigeration system breakdowns) (HLPE, 2014).

- **Logistic management and transport**

Transport is also a major contributor to FLW in FFV. Improper logistic management increases the risk of mechanical damage and temperature variations which deter the quality and marketability of FFV. The loading and offloading of produce is often done by temporary, unskilled labour, causing extensive mechanical injury to produce due to poor handling practices (Rolle, 2006; Vermeulen et al., 2006; HLPE, 2014). IMechE (2013) have estimated that between 35% and 50 % of all FFV post-harvest losses occur because of poor infrastructure. The inappropriate use of packaging material, or the lack thereof, and poor infrastructure lead to substantial losses during transportation (Olsmats & Wallteg, 2009; Opara & Mditshwa, 2013). Sanitary and Phytosanitary (SPS) inspections at distribution centres are timeous and reduce the shelf life of fresh produce. Produce that fails to comply with the SPS standards is rejected, resulting in the whole shipment being dumped/destroyed if an alternative buyer cannot be found (HLPE, 2014; Opara & Mditshwa, 2013).

- **Processing and packaging**

The processing and packaging of fresh produce is often seen as comprising a way to reduce FLW and to increase the marketability, shelf life and economic value of crops (HLPE, 2014). Various studies conducted on packaging material (Olsmats & Wallteg, 2009; Opara & Mditshwa, 2013) have highlighted the importance of the appropriate use of packaging to securing a sustainable food system. Inappropriate processing and packaging in developing countries contribute between 25 and 50 % of all FLW. The use of appropriate packaging is essential to preserve product quality and safety and to reduce the incidence of FLW.

Losses that occur at the processing stage can be attributed to inefficiencies and technical malfunctions. Unsafe food with poor nutritional value is often the result of meagre process management. Defects in the end product are discarded for not complying with the required standards. The limited capacity of processing facilities in developing countries and the seasonality of produce (such as over production, supply exceeding demand) also contribute to high percentages of FLW (HLPE, 2014).

- **Retail**

Retailers dictate the quantity and quality of produce being displayed and supplied to them. An important cause of FLW at retailers is seen in discrepancies in demand forecasts. Producers

grow crops based on semi-formal demand forecasts by retailers, in addition to their own forecasts (Mena, Adenso-Diaz & Yurt, 2011). Demand forecast discrepancies often result in a 'bull-whip' effect further down the chain as each role player overcompensates for potential demand fluctuations (Lee, Padmanabhan & Whang, 1997). Retailers impose strict quality and quantity standards on producers, and in order to compensate for these, producers tend to over produce to comply with the contractual obligations set out by retailers. The extra produce is sold to an alternative buyer at a lower cost or discarded (Lipinski et al., 2013; Stuart, 2009).

An important cause of FLW at the retail level is the short shelf life of FFV. Improper stock rotation practices and the mixing of multiple "best before" or "use by" dates are a major contributor to retail FLW as consumers "date sort" for "fresher/newer" products (Swedish Environmental Protection Agency, 2008; Wyman, 2014). The inappropriate display of products in large volumes contributes to FLW in three ways. Piling fruit at different maturity levels decreases the shelf life of other fruit that would have otherwise have had a longer shelf life due to increased ethylene production and respiration rates. Produce will suffer mechanical damage as fruit of different levels of maturity are piled together and by customers rummaging through the pile in search for the best produce (HLPE, 2014; Wyman, 2014).

The "rule of the one third" is often imposed by suppliers on the shelf life of fresh cut fruit and vegetables. The aim of this is to allow customers to have a wide selection of fresh products. If processed food products fail to be delivered within the first third of their shelf life, retailers will reject the delivery, even though the food is still safe for human consumption (Natural Resources Defence Council, 2013).

The United Kingdom annually generates 6.5 million tons of FLW, of which 1.6 million tons is retailer waste. Lee and Willis (2010) indicated that 25 % of the total waste generated by retailers is classified as food waste. The majority of the waste was disposed of in landfills, despite it still being safe for human consumption.

- **Consumption**

Consumer waste is predominantly an issue in developed countries and emerging economies due to income growth that results in dietary transitions (HLPE, 2014; Parfitt et al., 2010). This conforms to Bennett's Law (Bennett 1941) where consumers move away from starchy staples to products that are more perishable with a shorter shelf life as household income increases (Parfitt et al., 2010). Studies conducted on household waste are greatly influenced by

country/region and culture. Consumers tend to underestimate their waste, as shown by surveys conducted by WRAP (2009) in the United Kingdom.

Common FLW causes mentioned at consumer level (Lipinski *et al*., 2013; WRAP, 2009) are:

- Poor purchase planning – impulsive or advance purchasing.
- Confusion regarding food labelling.
- Portion sizes and pack sizes.
- Poor food preparation techniques and lack of knowledge in consuming/using food more efficiently.
- Food consumption outside the home.
- Food being a symbol of prosperity, leading to larger propensity to waste as more food is purchased.

2.4 CONCLUSION

Contemporary studies, as reviewed in this chapter, highlight a multitude of economic and institutional aspects of FLW. Ironically, however, extensive economic analysis of FLW in the food supply chain is limited and a plethora of economic and institutional questions related to FLW in the value chain remain unexplored. Current analysis of FLW is historically biased towards food security or the resource-use dimensions of FLW. This shortcoming in the analysis of FLW presents an opportunity for the future consideration of the economic and institutional aspects in the research of FLW.

The current economic analysis of FLW in food supply chains only attempts to indicate the scale of the problem and does not consider the wider economic impacts on the demand and supply model, price mechanisms, second-order effects in reducing FLW, and supply chain interactions and impacts. Moreover, there is a clear need for an institutional analysis to be undertaken of the chains' operating environment, and of the actors, activities, outcomes and the enforcement and coordination mechanisms, in order to inform supply chain design and management so as to achieve supply chain goals. Rutten (2013) notes that research, policy and practice do not operate in isolation, but rather inform and benefit one another. It is therefore important to not only consider measures aimed at reducing FLW, but also to strive to understand and then address the underlying causes of FLW, which will yield long-term, sustained reductions for all chain stakeholders.

CHAPTER 3
OVERVIEW OF THE SOUTH AFRICAN TABLE GRAPE INDUSTRY AND SUPPLY CHAIN

3.1 INTRODUCTION

The formation of FLW is a complex phenomenon due to the myriad macro, meso and micro factors that cause FLW across supply chains (HLPE, 2014). Hence, this chapter will establish a theoretical background needed to understand the dynamic environment in which actors, activities, institutions, and outcomes (i.e. FLW) have an interdependent relationship among one another (Dorward, & Omamo, 2009) and how these have in impact on FLW in the SATGI. In order to understand the extent of FLW across the different supply chain stages and to develop stage-specific solutions to address FLW, it is crucial to understand the environment in which it takes place. Accordingly, this chapter is composed of three main sections. The first section will provide an overview of the South African table grape industry, while the second section will analyse the SATGI, based on the activities (production, packing, inspection and so on) and the actors (including producers, exporters and institutional organisations) involved in the activities. The third section will analyse the institutional environment of SATGI together with its governance structures, and is followed by a conclusion section. Consequently, this chapter will provide the necessary background and insight needed to develop the analytical chapters to follow later in this dissertation.

3.2 OVERVIEW OF THE SOUTH AFRICAN TABLE GRAPE INDUSTRY

Table grapes are among the most important types of deciduous fruit grown in South Africa, considering the sector's value of production, employment creation, linkages with support institutions, and foreign exchange earnings (Department of Agriculture, Forestry and Fishing, 2012). Agricultural exports amounted to R62 750 million during the 2012/13 production season. Grapes were the fifth most-important agricultural product in terms of foreign exchange earned, accounting for 7.29 % (R4 576 million worth of production) of agricultural exports (DAFF, 2013). Citrus fruit comprised the largest foreign exchange earner, bringing in 12.72 % (R7 981 million), followed by wine at 11.10 % (R6 965 million), maize at 8.44 % (R5 294 million), and apples, pears and quinces at 8.24 % (R5 172 million) (DAFF, 2013).

3.2.1 Production

An estimated 79 025 Ha of land was committed to deciduous fruit production in 2013. Fresh and dried grapes are the second largest deciduous fruit group grown in South Africa, with a total of 26 631 Ha under production in 2013 (Hortgro, 2013). A total area of 16 229 Ha was planted under table grape production during the same period (SATI, 2014). Grapes account for 34 % of the South African deciduous fruit industry, with pome and stone fruit accounting for 44 % and 23 %, respectively (Hortgro, 2013). Table grapes are mainly intended for fresh consumption, although they can be used for juice production or dried for raisins.

South African table grape production has fluctuated over the past 10 years. The decrease in production can be attributed to the introduction of new table grape cultivar varieties, orchard renewals, and adverse weather conditions, especially during the 2010/11 season where hail in the Hex River Valley and the flooding of the Orange River caused major crop losses (Barrientos & Visser, 2012). This had an adverse effect on produce destined for the export market, which absorbs between 85 % and 90 % of the total production, annually (SATI, 2014).

3.2.2 Producers, production regions and cultivars

The number of table grape producers declined from 466 in 2009 to 326 in 2013/14, a 30 % decline over 6 years (DAFF, 2012a; SATI, 2014). Barrientos and Visser (2012) have noted that a process of consolidation is taking place among table grape growers. Smaller-scale growers either downgrade or exit the market, as they are unable to compete in the demanding commercial environment. They often have high debt ratios, preventing them from undertaking orchard renewals and investing in high-value varieties. As a result, lower quality yields are produced and the growers are forced to focus on the local market, with correspondingly lower prices. They are unable to maintain their debt positions, forcing them to sell their farms to larger, more successful farmers in pursuit of economies of scale (DAFF, 2012a). The SATGI consolidation is therefore characterised by producers either downgrading or exiting the market. Larger-scale producers who are able to consolidate into the value chain are more capable of withstanding price variability, adverse weather conditions, and high financial investment costs of orchard renewal and new varieties. As a result of consolidation, they are thus able to satisfy the large volume requirements of retail buying programmes and secure better downstream linkages in the value chain (Barrientos & Visser, 2012). Table 3.1 below outlines the producer concentration and areas under table grape production in the different production regions.

Table 3.1: Producer concentration and areas planted

Region	Nr. of producers 2013/14	Nr. of farms per region 2014/15	Ha 2013/ 2014	Ha 2014/ 2015	Ha 2015/ 2016
Northern Provinces	51	78	1 205	1 449	1 578
Orange River	65	139	4 896	5081	5 368
Olifants River	22	33	1 192	1 210	1 240
Berg River	86	154	3 706	4 053	4 238
Hex River Valley	102	223	5 185	6 419	6 155
Total	**326**	**627**	**16 229**	**18 212**	**18 579**

Source: SATI (2014)

Due to South Africa's unique geographical and climatic differences (DAFF, 2012a), producers are able to harvest a wide variety of table grape cultivars, from October to April (SATI 2014). This gives farmers a competitive advantage as different varieties are ready for the market at different times, enabling producers to capitalise on higher prices (Vermeulen, Peter & Muller, 2013). The Northern Province is the first region to harvest, as harvesting takes place in Week 43. This is followed by the Northern Cape and Western Cape (Picklesimer, 2012). Figure 3.1 below illustrates the different grape cultivars planted in the different regions, ranging from seeded to seedless varieties.

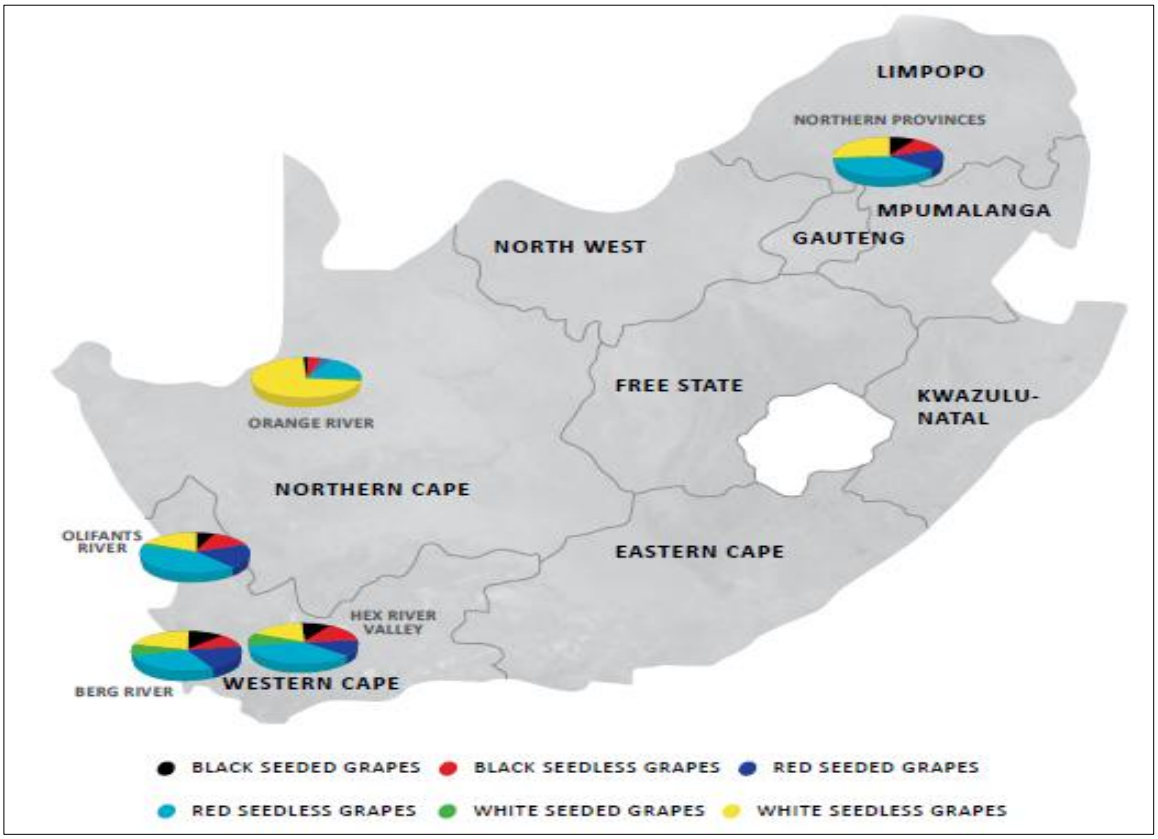


Figure 3.1: Cultivar varieties plant in each production region
Source: SATI (2014)

The top 6 cultivar varieties planted are Crimson seedless, Prime, Thompson seedless, Flame Seedless, Sugraone and Red globe. Figure 3.2 below illustrates the variety group growth over a period of 5 years. The demand for seedless varieties continues to increase, with white seedless being the most popular. Red seedless varieties have shown the biggest increase (147 %) over the past 5 years. It is evident that the demand for seeded varieties has been declining since the 2009/10 season (SATI, 2014).

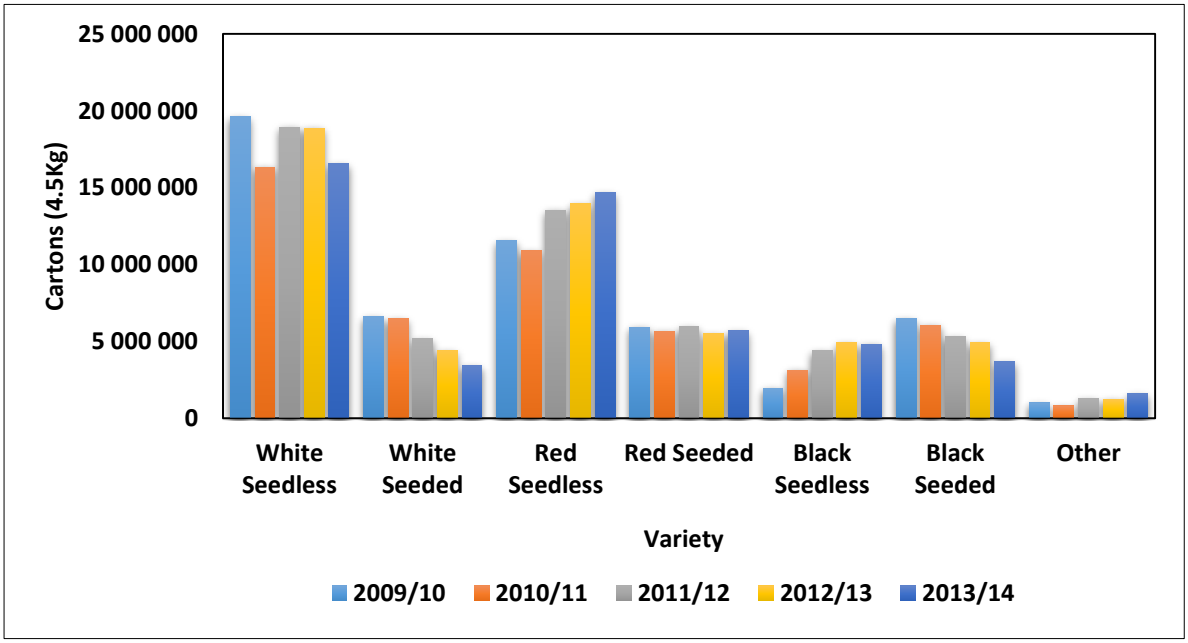


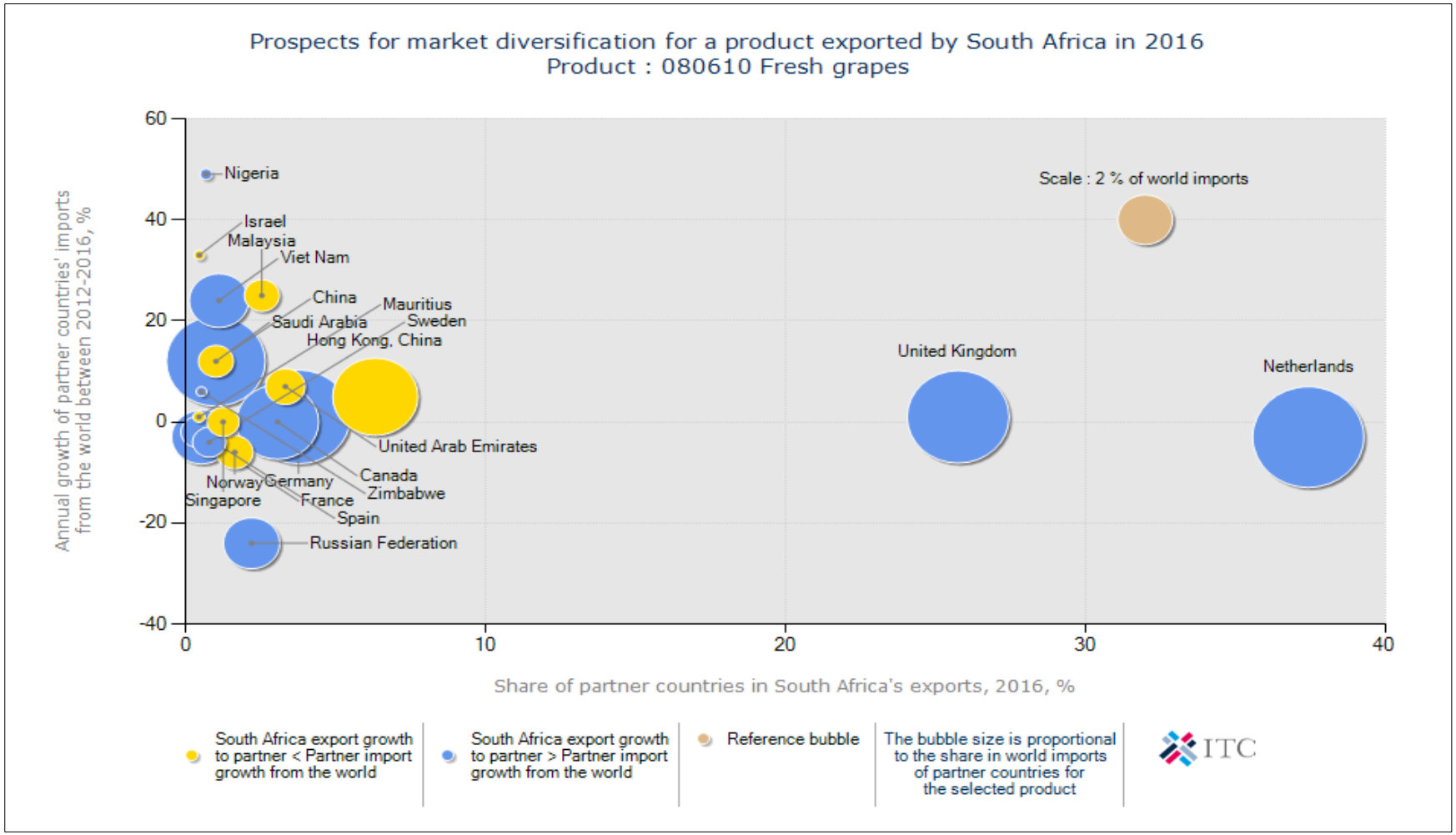
Figure 3.2: Variety group growth over 5 years
Source: SATI (2014)

3.2.3 Market dynamics

The South African domestic market absorbs a mere 10 % of the total production (SATI, 2014). The domestic market share of the total production depends predominantly on the quantity of grapes that pass export inspection. Table grapes which fail export inspection are diverted to the domestic market for fresh or processed consumption (DAFF, 2012a; NAMC 2014). The fresh produce markets (FPMs) absorbs 65 % of the domestic market supply, followed by the retail industry and informal markets, which absorb 34 % and 1 %, respectively (SATI, 2012). Since table grapes are considered a luxury product, with only 30 % of the South African population identified as frequent grape consumers (Picklesimer, 2012), the local market is not big enough to consume all the grapes produced (Vermeulen et al., 2013). However, the domestic demand for table grapes has shown an increase due to the growth experienced in the numbers of middle-income class consumers (Picklesimer, 2012).

South Africa is the world's sixth largest exporter of table grapes by value and third largest by volume (SATI, 2014; Picklesimer, 2012). Despite being a small table grape producer in terms of global hectares (DAFF, 2012a), SATGI exported 226 401 tons in the 2013/14 season, valued at USD 441 475 000 (SATI, 2014). South Africa had an 11 % global share in table grapes exported during the 2012/13 season (National Agricultural Marketing Council, 2014). The United Kingdom (UK) and Europe have been SATI's traditional export markets for over a century, accounting for 79 % of total exports (SATI, 2014). Export expansion and market growth potential into emerging markets are taking place as a result of an increase in consumers' disposable income, especially in the overseas BRICS (Brazil, Russia, India and China) countries, which have more favourable trade regulations than the EU (European Union) does (Barrientos & Visser, 2012; Picklesimer, 2012). The global recession in 2008 had an impact on consumer spending patterns, and as a result, the market's demand for table grapes in the EU and the UK has not shown any significant increase over the past 5 years (Vermeulen et al., 2013; Barrientos & Visser, 2012; SATI, 2014). Although the Netherlands and UK markets absorb a large volume of SATGs, the growth potential remains small. The Far East and Middle East have shown a 55 % increase in volume intake, with the Russian market also showing a 53 % growth rate over the past 5 years (Figure 3.3 below). Although the percentage of table grape exports to African countries (<1 %) remains small, there is a potential for growth as African economies are growing and becoming more stable politically (SATI, 2014).

Figure 3.3: SATI's market diversification prospects



South Africa is a net exporter of grapes and only imports to make up for out-of-season demand (Table 3.2 below). South Africa's out-of-season demand for table grapes has shown an annual increase from 2010. This can be attributed to the increase in the percentage of table grape consumers attributable to growth experienced in the middle-income class (Picklesimer, 2012). South Africa predominantly imports from Spain and Egypt, and to a lesser extent from Namibia and Zambia. Imports from Spain showed a 100.8 % increase from 2010 to 2014, followed by Egypt with a 96.37 % growth over the same time period.

Table 3.2: Quantity of fresh grape imports from partner countries

Partner country	2010	2011	2012	2013	2014	Growth percentage 2010-2014,%
			ton			
World	3 156	3 748	4 743	4 635	5 355	69.67
Spain	1 228	1 688	2 692	2 576	2 457	100.08
Egypt	7 44	982	1 187	1 630	1 461	96.37
Namibia	946	799	666	306	1 272	34.46
Zambia	0	0	0	0	112	112

Source: Trade map (2015)

3.3 ANALYSIS OF THE SOUTH AFRICAN TABLE GRAPE SUPPLY CHAIN

An analysis of losses and waste in the SATGI requires an intimate knowledge of the South African table grapes supply chain (TGSC). This includes analysing the component elements involving the activities along the chain, the actors and the institutions, and the outcomes (losses and waste in this case). A detailed export TGSC will be mapped, in which it will be analysed in relation to its role players, governance, and coordination mechanisms embedded within the structure of the TGSC. Dorward and Omamo's (2009) framework for analysing institutions forms the basis for the analysis. The framework for analysing institutions is founded in the general principles of the institutional analysis and development framework developed by Ostrom (2011) which promulgates an analysis of the action domain or the action situation. The action situation includes, amongst others, "(i) the set of actors, (ii) the specific positions to be filled by participants, (iii) the set of allowable actions and their linkage to outcomes, (iv) the potential outcomes that are linked to individual sequences of actions" (Ostrom 2011). The analytical framework suggested by Dorward and Omamo (2009) is applied in a number of supply chain studies including poultry (Davids 2014), organic spices (Bullock et al. 2017), wood (Kambugu et al. 2013) and cattle (Ndoro et al. 2015) confirming the general applicability of the framework to institutional analysis in chains.

This will enable a proper identification and categorisation of where losses are suffered and waste is generated. Dorward and Omamo's (2009) framework for analysing institutions will provide a broad overview of the elements in the theoretical and practical analysis of the institutions and the relationship among the elements. The structure and the behaviour of the action domain are largely affected by the environment which consists of the physical and infrastructural, socioeconomic, and policy and governance environments. However, the particular focus area of the research will be the action domain, as set out in Figure 3.4 below.

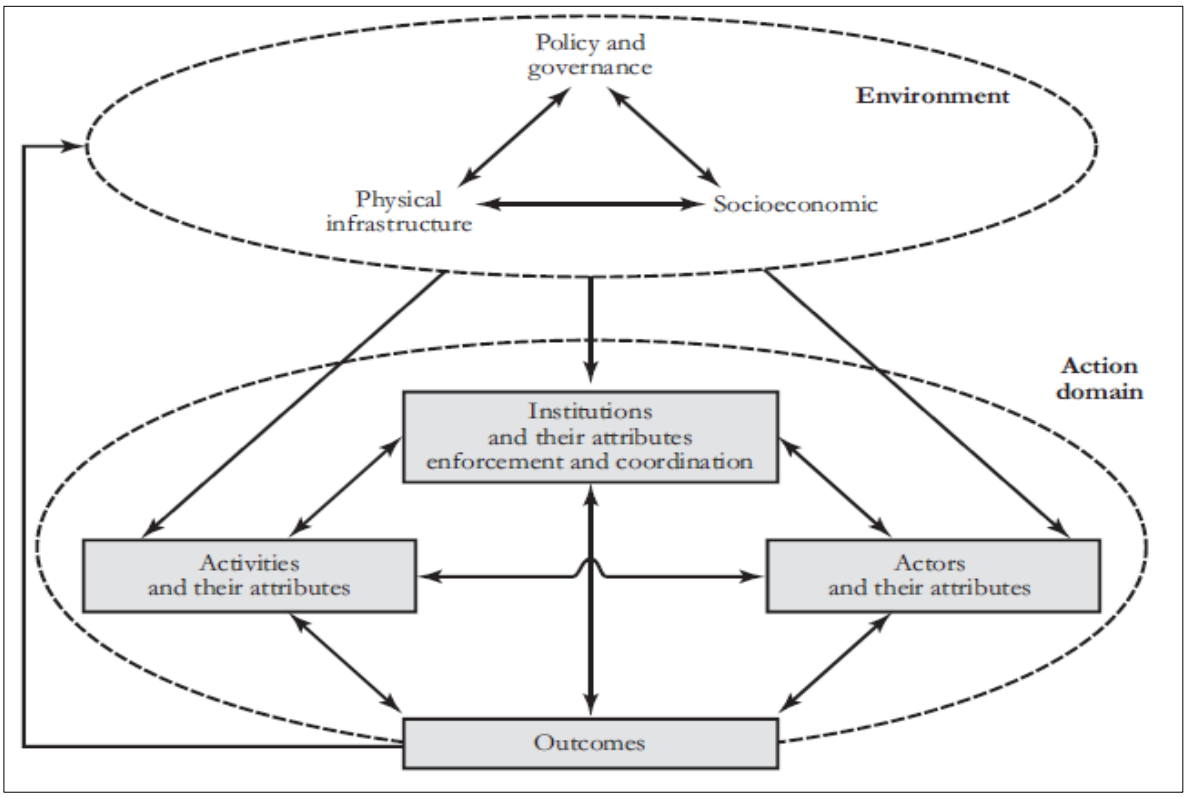


Figure 3.4: A conceptual framework for institutional analysis
Source: Dorward & Omamo (2009)

The rationale for the use of the framework is that there is a specific interaction between the outcomes in terms of losses and waste and the coordination mechanisms in the chain given the activities and actors. Changes in the coordination mechanisms are expected to bring about changes in the outcomes of the chain, specifically in terms of the losses and waste, in the context of the SATGI. The TGSC will be discussed in relation to the elements in the aforementioned framework, as set out in the action domain. The section will start by discussing the activities followed by the actors, institutions and outcomes to provide an 'isolated' overview of the elements in the action domain. It is important to remember that these elements

do not function in isolation, but rather coexist simultaneously in an interdependent environment where the actions of one affect the others within the action domain.

3.3.1 Activities within the SA TGSC supply chain

The sequential activities in the TGSC, as illustrated in Figure 3.5 below, will be delineated in the following paragraphs. These activities range from production and harvesting, right through to where the product is consumed by the consumer. It is important to understand the sequence of these activities, as the management thereof can lend itself to the formation of FLW (FAO, 2011; HLPE, 2014).

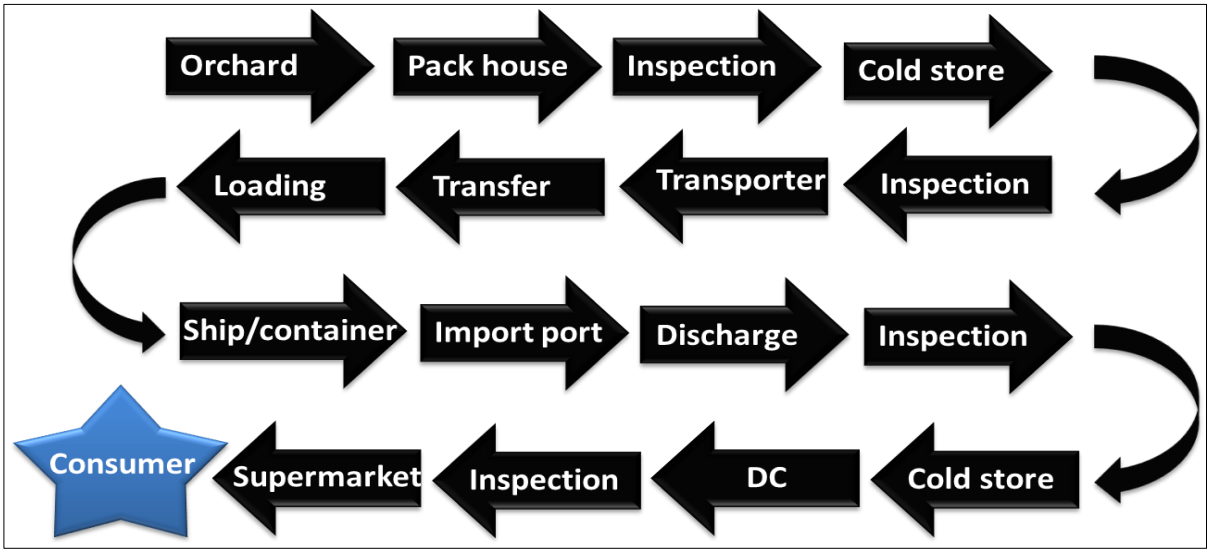


Figure 3.5: South Africa's fruit export logistic cold chain
Source: Haasbroek (2013)

The sequential activities are discussed in Table 3.3 below. The activities are grouped into three main categories, namely farm to pack house, pack house to importer, and importer to retailer. The same categorisation is used in the perceptual analysis discussed in Chapter 4.

Table 3.3: Sequential description of TGSC activities

Category	Activities	Description
Farm to pack house	Production and harvesting	Table grape production depends significantly on favourable weather conditions. The climatic and geographical differences within South Africa allows for the cultivation of varied cultivars. Once the desired fruit maturity is reached, table grapes are harvested by hand with trimming shears to minimise fruit damage during the picking process (Haasbroek, 2013). Grapes are placed in crates, after which they are transported to the cooling and pack house facilities. Table grape production, in general, is capital and labour intensive (Conradie, 2004). Table grape producers receive information on production and establishment costs per hectare from Vinpro. This information includes costs of soil preparation, table grape trellis growing systems, irrigation costs and direct production costs (SATI, 2016). Table grape production predominantly employs seasonal workers, and more specifically, women (Conradie, 2004). South African table grape production is governed by regulations under the Agricultural Product Standard Act, 1990, and the Marketing of Agricultural Products Act, 1996. These regulations set out mandatory production and marketing practices, such as those for food safety standards, marketing, and packaging of table grapes, and are referred to as public standards. Private standards and certifications are voluntary regulations (including GLOBALGAP Certified organic), are used over and above the public standards as a means to differentiate products, verify compliance with public standards, etc. However, these private standards and certifications are often de facto mandatory for producers in the export markets. These regulations are discussed in detail in section 3.1
	Pre-cooling	Grapes are usually packed on farm and transported immediately to a regional cold store to a pre-cooling unit to remove the field heat from the fruit (Freiboth et al., 2013; Haasbroek, 2013). Prompt cooling after harvesting delays the development of post-harvest diseases and product deterioration that reduces the storage/shelf life of the product which would limit the marketability of the fruit, making it more susceptible to FLW (Thompson et al., 2007; Haasbroek, 2013). The most popular pre-cooling methods include hydro-cooling, vacuum cooling, and forced air-cooling (Haasbroek, 2013). The minimum Perishable Products Export Control Board (PPECB) pre-cooling specifications require that temperatures between 15 °C and 18 °C should be maintained above dew point with an optimum humidity of 90 % ± 5 % (PPECB, 2015).

Category	Activities	Description
Farm to pack house	Pack house	Once the fruit has reached optimum pre-cooling temperatures, the fruit is moved from the pre-cooling facilities to the pack house. Here, the fruit is sorted into grades for local and export markets and packed according to the specific exporters' requirements for the destined markets. Fruit is placed into their respective cartons and placed into pallets (Haasbroek, 2013). Regulation 422 of the Agricultural Product Standard Act, 1990, elaborates on the standards, both as to the product (uniformity in colour and size, etc.) and packaging material (clean and correctly marked, according to producer and pack house codes, etc.) that should be adhered to in order to ensure safe consumption. Pack house temperatures should ideally be maintained at 25 °C. However, this is often not the case, as South African pack houses tend to be warmer, resulting in cold chain breaks and increased levels of FLW, which could have been prevented (PPECB, 2015).
Pack house to importer	Inspection	Samples are drawn for inspection by the PPECB from the packaged goods. Quality and physiological tests are conducted to ascertain whether the fruit meets the respective export market's product specifications (Haasbroek, 2013). PPECB is an independent South African service provider of quality certification and cold chain management services for perishable products. The PPECB's role will be discussed in section 3.3.2.6 of this chapter.
	Cold storage	The cooling process occurs in two stages. Firstly, the fruit pallets are moved into the cold store (refrigerated room) where the fruit pulp temperature of the fruit is brought down to the optimum low temperature, as prescribed by the PPECB's protocols. The PPECB outlines the basic protocols for grapes, such as storage temperatures, relative humidity, storage life and packaging requirements needed to achieve optimum shelf/storage life. The most common method used for cooling fruit in cold stores is forced air-cooling (FAC). With the FAC process, fruit is placed into cooling tunnels where additional fans are used to blow cold air to create a low pressure across the pallets, forcing the air through the fruit cartons. This cooling method increases the surface area that is cooled, with the result that the optimum temperature is reached within 24 to 48 hours (Freiboth, 2012; Freiboth, et al., 2013). Once the optimum storage temperature is reached throughout the total load, the FAC fans must be switched off to prevent moisture loss and chilling (PPECB, 2013). After the fruit has reached the prescribed temperature, the fruit is moved to a holding room to ensure that the optimum fruit temperature is maintained. The PPECB allows for a maximum temperature fluctuation of 5 % in the holding room. The fruit remains in the holding room until it is transported to the port (PPECB, 2015).

Category	Activities	Description
Pack house to importer	Inspection	Before the fruit is transported to the port, the fruit temperature, pallets and packaging are inspected against the required standards. Whether refrigerated truck transport of reefer containers (refrigerated containers) are used, the equipment is inspected to ensure that it operates within the PPECB's designed parameters and specifications (PPECB, 2015).
	Loading of a container	Once the fruit and containers have passed the inspection, the pallets are loaded into the container by forklifts. The process must occur as quickly as possible, as the fruit normally stands in an unrefrigerated loading bay waiting to be loaded (Haasbroek, 2013). The containers should not be pre-cooled, unless an airlock is used at the loading bay. This is to reduce container 'rain' when the moisture condenses against the container roof and walls once the doors are opened (Freiboth et al., 2013). Condensation 'rain' can cause considerable damage to grapes and serves as a source of microbial inoculation (Freiboth et al., 2013).
	Transportation to the port	Once a container has been loaded and locked, it is transported to the port. If the road transport exceeds two hours, the reefer container is required to have its own generator set (commonly known as a 'genset') in order to deliver power to the refrigeration system. However, the gensets are not designed to cool the fruit, but rather to maintain the fruit's required storage temperature as prescribed by PPECB. Gensets are not a prerequisite for journeys less than two hours (Freiboth, et al., 2013). The PPECB allows a container to remain unrefrigerated for total of six hours, of which 2 hours are reserved for road transport and the remainder for activities such as queuing at the port gate and offloading (Haasbroek, 2013).
	Export Port	On arrival at the port, the container is offloaded and transported to a specific location in the reefer stack (determined according to sailing schedule and loading plan of the export vessel) where it is plugged in and monitored to remain at its optimum storage temperature. The port of Cape Town uses a Refcon system which monitors the container's optimum temperature throughout its stay (Freiboth et al., 2013, Haasbroek, 2013).
	Loading onto a vessel	Once the vessel has arrived and is ready for loading, the container is removed from the reefer stack and transported to the quay. Gantry cranes load the container onto the ship, after which the container is plugged in and monitored at optimum storage temperature throughout the journey (Haasbroek, 2013).

Category	Activities	Description
Importer to retailer	Import port	Upon arrival at the destined port, the container is offloaded from the ship and placed in a reefer stack until it is collected by the receiver (Haasbroek, 2013).
	Inspection	The category managers (receivers of the fruit) inspect the fruit once it is offloaded to ensure that the fruit meets the prescribed quality standards of the supermarkets.
	Cold store and distribution centre	Once inspection clearance is received, the fruit pallets are transported to a distribution centre, where they are delivered to the respective supermarkets.
	Inspection	The fruit is again inspected on arrival at the supermarket to ensure that the prescribed fruit quality standards are met.
	Supermarket	Once cleared through inspection, the fruit is unpacked for display, to be sold as quickly as possible.
	Consumer	The fruit finally reaches the consumer for either immediate consumption or storage for later use, depending on the consumer's needs and target market.

Source: Conradie (2004); Freiboth (2012); Haasbroek (2013); Freiboth et al., (2013); PPECB (2015).

3.3.2 Actors within the South African TGSC

Given the complex nature of the TGSC, producers, exporters and industry organisations need to have a thorough understanding of the nature of the product and how it will affect the exporters' procurement strategies and consumer behaviour throughout the supply chain (Symington, 2008). This fosters a situation in which SATGI is entangled in a 'co-opetition' – a condition in which the role players simultaneously compete and cooperate with one another. Hence, the following sections will discuss the actors involved within the TGSC activities.

- **Producers**

Table grapes' pseudo-perfectly competitive market makes producers price takers due to the commoditisation of the product, based on aesthetic and quality requirements (Symington, 2008). Due to the homogeneous nature of table grapes, producers and their exporters endeavour to differentiate their products to avoid commoditisation by means of (Symington, 2008):

- Supplying a wide customer base, based on varied product quality and packaging material
- Offering value-added products by introducing new varieties
- Supplying organic grapes
- Ensuring that the product carries the 'fair trade' label
- Using product brand differentiation, where permissible

The EU and the UK have comprised the traditional export market for South African table grape producers; however, there has been a shift in the marketing of table grapes away from the Western countries to the Eastern countries (Symington, 2008).

- **Exporters**

'Exporters' is a general term used for companies who sell their own product or that of other suppliers offshore (Symington, 2008). Generally speaking, it is the exporters' responsibility to establish market access, manage the cold chain (logistics and handling) and be accountable for preserving the products' aesthetic/qualitative characteristics (DAFF, 2012a). Producers select an exporter based on their particular needs and the advantages offered by the exporter's

business model. Currently, four types of exporters operate in the table grape industry (Symington, 2008):

- **Marketing agents**

Marketing agents sell the product overseas on behalf of the producer. Agents add value to the consignment in terms of their product knowledge, marketing and coordinating of logistic service providers to move the product through the value chain. The agents charge the producers commissions on sales in exchange for their services.

- **Producer–exporter companies**

A producer–exporter company is an entity where the shareholders are the producers that supply the majority of the export product. A producer–exporter might consist of a single producer, marketing his or her own product, or a group of producers marketing their product through their own export houses.

- **Trading companies**

Trading companies buy produce from the supplier at a fixed price, set at some designated point in the value chain. The company sells the produce offshore, for its own account.

- **Brokers/facilitators**

Brokers are sole traders/companies that connect a buyer and seller through relationship marketing. The broker charges a brokerage fee and is not held accountable for any risk in the transaction or value chain service.

The following section will only discuss the marketing agents and producer–exporters which dominate the table grape export environment (Symington, 2008).

- **Marketing agents**

According to Symington (2008), pure agency implies that no money is guaranteed or advanced by the agent to the producer; however, this is not the case in the table grape export environment. Exporters compete for a supply base, grounded on financing a cash-strapped producer's expenditure. Therefore, the exporter's primary risk is in losing his or her supply base, over and above non-payment by importers and non-payment of producer loans. As a result, exporters

differentiate themselves from other agents, based on four types of business model (Symington, 2008):

1. Multinational companies

2. South African owned and based export agency

3. Foreign importing companies with branches in South Africa

4. Single producers that exports their own and fellow producers' crops

It should be borne in mind that each type of agency model has its own advantages and disadvantages and its associated level of risk. The type of marketing agent used by the producer will depend on the producer's level of risk aversion. However, the marketing agents' business models will not be discussed as this falls outside the scope of the research objectives.

The role of the marketing agent is one of a third party in the chain. This implies that no product ownership transfer takes place, which entails that the agent acts on behalf of the producer to market product and incurs costs in the supply chain to get the product to the final destination and sold in the export market (Symington, 2008).

- **Producer–exporters**

A producer–exporter can be defined as an entity where the shareholders are the producers that supply the majority of their produce for export. As mentioned earlier, producer–exporters can be a single producer or a group of producers exporting their own product. Hence, the marketer and the owner of the product is the same entity. The ideal number of producers in a 'marketing-cooperative' depends on the number of cartons to be packed, available cultivar varieties and the geographical spread among the production regions. The product is often produced and marketed according to a predetermined programme (Symington, 2008).

- **The South African Table Grape Industry (SATI)**

The South African Table Grape Industry (SATI) is the industry association of the table grape producers in South Africa. It forms part of Fruit South Africa (FSA), together with the other members, which is a non-profit organisation that addresses common issues in relation to all aspects of the fruit industry of South Africa.

SATI aims to create a progressive, equitable and sustainable table grape industry. SATI's four key areas of intervention are to gain, retain and optimise market share through market access and development, information and knowledge management, transformation and training, and research and technical transfer. However, a market function remains SATI's core activity. This function has three components: maintenance and improvement of existing market access, achieving access to new markets on a target basis, and re-opening closed markets. This function requires continuous attention to the demand and expectations of global markets, as well as industry stakeholders. A high level of cooperation with both foreign and local government agencies is required to maintain and increase South Africa's share in global food markets (SATI, 2016).

- **Perishable Products Export Control Board (PPECB)**

The Perishable Products Export Control Board (PPECB) is an independent service provider of quality certification and cold chain management services for producers and exporters of perishable food products. It provides inspection and food safety services assigned by the Department of Agriculture, Forestry and Fisheries (DAFF) under the APS Act, No. 119 of 1990. The presence of the PPECB in the export industry is furthermore enhanced by its recognition as an approved third country under the European Commission Regulation 543 of 2011. This agreement recognises the South African inspection systems as being equivalent to those of the EU inspection bodies and therefore requires less frequent checks at the ports of import into the EU (PPECB, 2015).

The PPECB delivers end-point inspection, mandated by the Department of Agriculture, Forestry and Fisheries, of perishable products destined for export. Its inspectors are stationed across South Africa at more than 1 500 locations (PPECB, 2015). Figure 3.6 below depicts the array of services delivered by the PPECB.

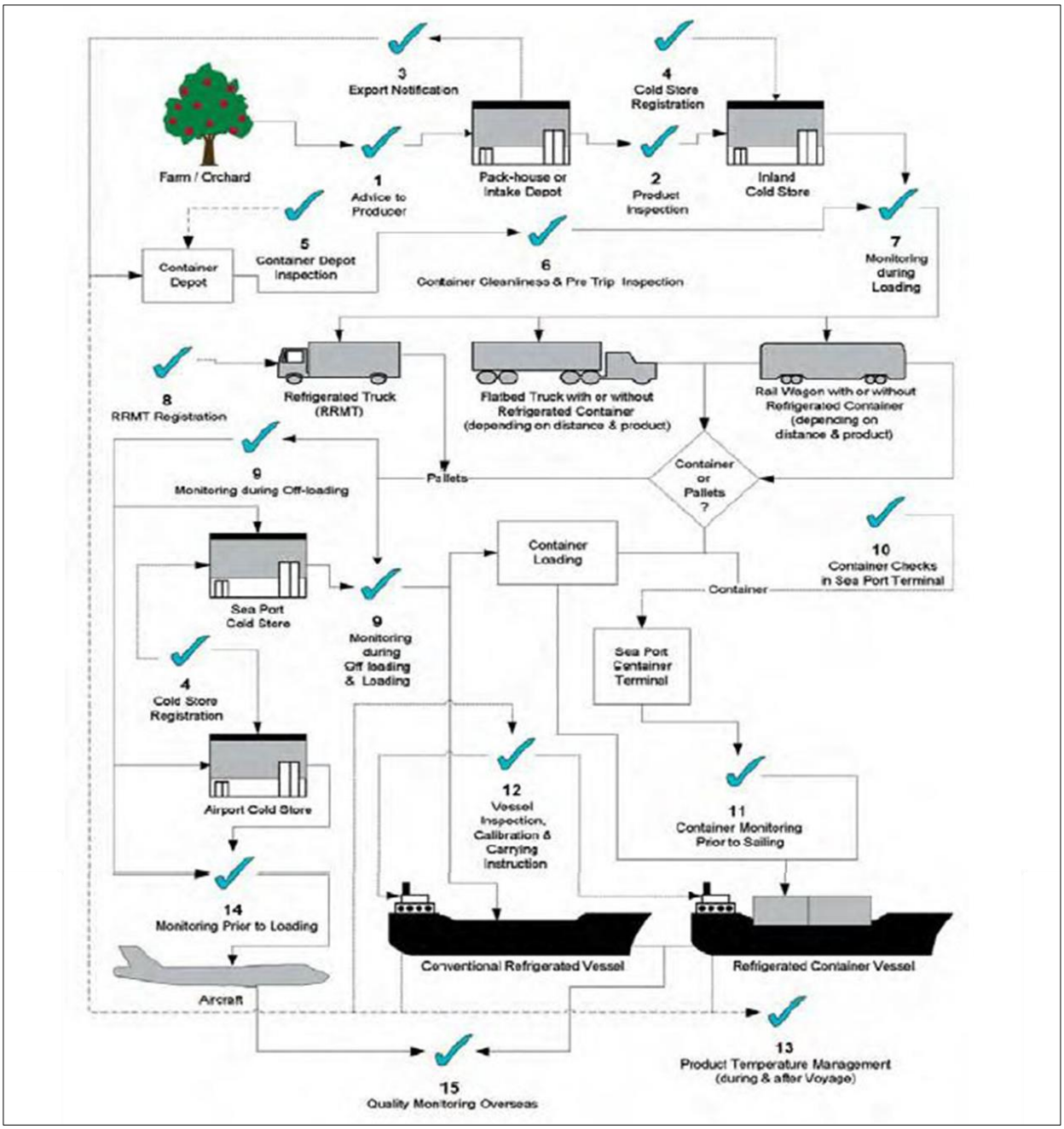


Figure 3.6: Services delivered by PPECB
Source: Haasbroek (2013)

The benefit of utilising the services offered by the PPECB is that they entail reduced risks and claims, as well as providing quality assurance. Risk inspection (identifying risks in the container loading process, faulty equipment and unfit vessels) prior to the export process reduces risks pertaining to potential income losses. The PPECB cold chain assessments (handling protocols, temperature and equipment specifications) reduce clients' claims, as all the role players in the cold chain must adhere to these protocols, thus providing quality assurance for the importing country (Haasbroek, 2013).

The PPECB annually publishes the 'Blue Book' that outlines the basic cold chain management protocols for each perishable product. Due to the non-climacteric nature of table grapes and low rate of respiration, they must be packed in cartons in polyethylene bags containing a sheet of specially prepared paper that produces Sulphur dioxide gas. They must be shipped and stored at a pulp temperature of minus 0.5 °C and a relative humidity of 95 % to avoid fungal decay and physiological deterioration (PPECB, 2015).

- **The Fresh Produce Exporters' Forum (FPEF)**

The Fresh Produce Exporters' Forum (FPEF) is also a member of FSA and is a voluntary, non-profit organisation. FPEF members comprise fruit exporters, producer–exporters, export and marketing agents, pack houses, and logistics and other service providers. Membership is voluntary and open to all South African exporting companies and industry service providers. The FPEF has strict accreditation criteria and a code of conduct to which members should adhere so as to ensure that only competent and reliable marketing agents and producer–exporters are admitted to the Forum. The FPEF also manages a number of projects for the benefit of the industry, such as training, mentorship and transformation initiatives: the Top of the Class (TOC) programme, and the Post-Harvest Innovation (PHI) Programme (FPEF, 2015).

The FPEF is the official Fresh Fruit Export Council in South Africa and provides a pivotal link between Government and the industry regarding market access and related matters. The Forum intends to create value for its members to help ensure a profitable, sustainable and globally competitive fresh fruit export industry (FPEF, 2015).

3.4 INSTITUTIONAL ENVIRONMENT

This section describes the institutional environment for the typical South African table grape chain. In this instance the institutional environment refers to the formal 'rules of the game' as defined in Williamson (2000)'s institutional hierarchy. The section is divided into two parts, (1) Rules and regulations governing the SATGI and (2) the governance thereof in terms of relationships between the actors. Each will be discussed in relation to the South African table grape export chain to the UK.

3.4.1 Rules and regulations governing SATGI

> *"Society's institutions – the rules of the game – largely determine the incentives of the entrepreneurs and thereby guide their actions* (Scott, 2001)"

North (1994) defined institutions as comprising the "rules of the game" that provide a framework of incentives that shape political, economic and social organisations. These institutions can be categorised either by formal rules (laws and constitutions), informal constraints (codes of conduct, norms of behaviour) or by enforcement which is carried out by third parties (law enforcement), second parties (retaliation) or first parties (self-imposed codes of conduct). Hence, institutions convey the rules of the game and the organisations and their associated actors are the players.

Therefore, for the purposes of this study's objectives, this section will only focus on formal rules (statutory and mandatory/voluntary rules) and the enforcement thereof in SATGI, based on Williamson's (1999) hierarchy of institutions. The analysis will focus on the institutional environment (formal rules of the game) and governance (playing the game), which is associated with New Institutional Economics (NIE) theory and which is discussed in the subsequent sections.

SATGI's institutional environment 'rules' are either regulatory or normative in nature, depending on which level the actor functions in, and on the particular marketing channel. Within the export marketing chain, the 'rules' will, to a large extent, be regulatory in nature, and will take effect much further along, down the chain, as compared with the local marketing chain. The normative pillar, in terms of certification and accreditation, is often de facto mandatory in the export chains in order to maintain competitive advantage, whereas in the local chain, it is distinctly more of a voluntary nature (Scott, 2001, Smith, 2009).

Figure 3.7 below depicts SATGI's institutional environment framework for the export and local market. Although not exhaustive, it highlights the most important 'rules' that govern the operations of the chain in the respective markets. The base (greenish) area of the diagram indicates the statutory rules (regulatory pillar), to which the export and local market must comply, while the mid and upper (greenish-orange to red) area of the diagram indicates the voluntary rules (normative pillar). The dotted line separates the export and local markets from one another due to the different rules and regulations that governs these markets. From the

diagram, it is clear that those players within the export market are subject to a higher level of statutory rules. However, both the export and local market, irrespective of the marketing channel, are compelled to comply with statutory requirements related to the marketing of agricultural products, food safety and quality.

Table 3.4 describes the diagram in Figure 3.7 with respect to the institutional tools and the monitoring and enforcement thereof. Figure 3.7 below is a one-dimensional diagram serving to simplify the institutional environment (Williamson 2000) of the typical South African. However, in reality, the institutional environment is complex and multidimensional since the different levels frequently overlap with the private sector that often fulfils the responsibility of the governmental sector due to partial consumer mistrust in the governmental enforcement of statutory measures (Smith, 2009; Henson & Hooker, 2001).

The occurrence of FLW within the institutional framework has an inverse relationship relating to the degree of public and private standards (Smith, 2009; FAO, 2011; Waarts, Eppink, Oosterkamp, Hiller, van der Sluis, Timmermans, 2011). It is possible, however, that lower levels of FLW might occur at public statutory levels than they do in the case of de facto mandatory private standards because of stricter product quality and safety standards. This phenomenon is further complicated by the interaction between the product itself and the environment within which the product is handled. It is therefore clear that the in the particular chain the ‘rules of the game’, as defined by Williamson (2000), drive and influence the institutions and the outcomes of the chain, including outcomes such as losses and waste (Dorward and Omamo 2009, Ostrom 2005).

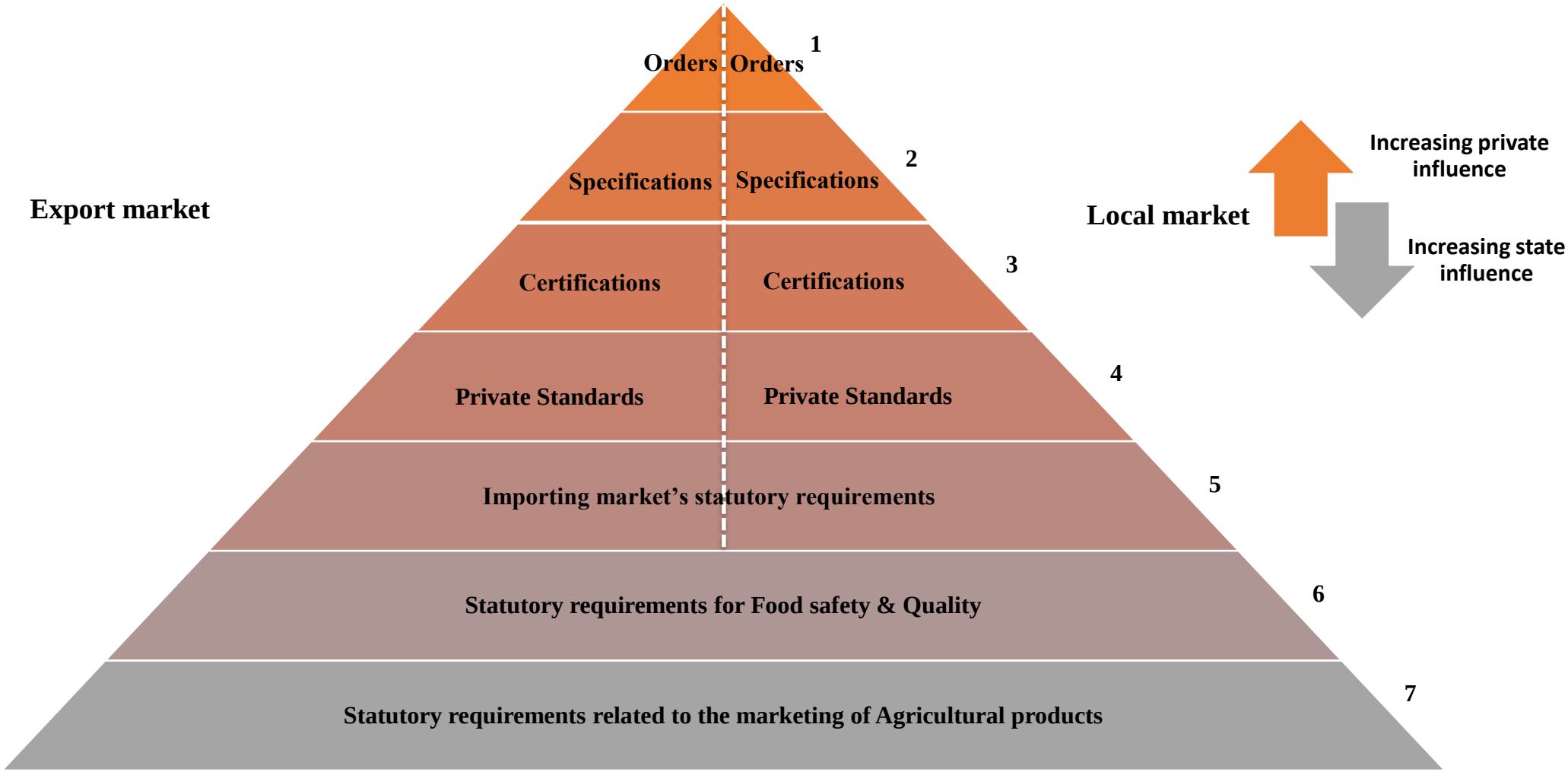


Figure 3.7: Level of control intensity throughout the supply chain
Source: Author's own elaboration (2015)

Table 3.4: Level of control intensity throughout the supply chain

Level	Institutional tool	Level summary	Monitoring	Enforcement
1	**Retail level orders** Orders include retail buying programmes or retail sourcing programmes	Orders relate more to volume and frequency at which the produce should be delivered to the retailers. This does not include product specification.	Retailers	Civil action
2	**Growing programmes** Growing programmes are an example of product specifications required by each specific retailer.	Retail specification would specify the type of product in terms of its grading, fruit maturity, packaging, etc.	Buyers	Civil action
3	**Certifications** Product certification in the table grape industry may include: ISO 22000:2005, Certified Organic, SEDEX, Field to Fork, Tesco Nurture N10, Supply Chain Security System (SCS), Tesco TLL (HACCP), Sustainably produced	Product certification goes beyond the private standards set out by retailers. Product certification may serve as a means for product differentiation in terms markets or serve certain socio-economic precepts giving consumers the assurance that the product was produced under fair conditions.	Third party	Civil action
4	**Private standards** Private standards relate to the agricultural practices producers need to comply with to be eligible for certain markets. Private standards can be local, such as LOCALG.A.P and equivalents, or international such as GlobalG.A.P or BRC.	Private standards, especially in food safety, emerged to verify compliance with government-mandated requirements or to address the perception in areas where public standards/regulatory frameworks fail to achieve the desired result. They often serve as a means to assure buyers of a product's quality conformance with production and processing methods.	FoodPLUS GmbH and GLOBALG.A.P. approved Certification Bodies	Civil action
5	**Public standards – Importing market** This includes the basic statutory requirements a product must adhere to in order to enter specific markets. For the European market, the basic statutory requirements for table grapes include: Council Regulation (EC) No 2200/96 Of 28 October 1996 On the common organization of the market in fruit and vegetables Commission Regulation (EC) No 2789/1999 of 22 December 1999, laying down the marketing standard for table grapes.	Importing country's statutory requirements are often the equivalent of the exporting country's basic statutory requirements that an export product must meet. These statutory requirements are often harmonised as agreed upon by the WTO agreements between countries.		Public action

Level	Institutional tool	Level summary	Monitoring	Enforcement
6	**Public standards – Exporting market** Agricultural Product Standard Act, 1990 (Act No 119 of 1990) - No. R. 748 of 2014 **Importing market** Agricultural Product Standard Act, 1990 - R. 422 of 2012 Foodstuff, Cosmetics and Disinfectants Act, 1972 (Act No 54 of 1972) No. R. 989 of 2016	This section relates to the statutory requirements table grape producers have to adhere to in terms of food safety and quality, regardless of whether the product is exported or imported into the country. These pertain to standards and regulations regarding the grading, packing and marking of table grapes, the control of export table grapes, and the maximum prescribed levels of biological or chemical contaminants.	DAFF, DOH	
7	**Regulatory measures in the marketing of agricultural products** Marketing of Agricultural Products Act, 1996 (Act No 47 of 1996) - No. R. 891 of 2012 - No. R51 of 2015 - No. R. 52 of 2015		DAFF	Public action

Source: DAFF (2012b; 2014; 2015); DoH (2016); EC (2001; 2005)

3.4.2 Governance in the table grape supply chain

Governance structures comprise the institutional arrangements that govern the rights over resources, goods and services, and, particularly, the terms of exchange and access to resources. The nature of governance structures is determined by the institutional environment (Kirsten, Karaan & Dorward, 2009), as discussed earlier. The governance structure is ultimately a transaction-cost reducing arrangement that determines the "the Nature of the Firm" and the boundaries within which the firm operates (Kirsten, Karaan & Dorward, 2009).

In the context of quality management in chains, and comparable to the losses and waste question, the governance of chains is an important dimension in ensuring chain performance. It is specifically highlighted that the appropriate alignment of inter-firm governance structures is essential to ensure quality management, and that a failure to align quality management systems with governance structures may lead to inefficiencies in quality management because of high transaction-costs (Wever et al. 2010). Equally, by abstraction, the efficient management of losses and waste depends on the appropriate alignment of chain governance with losses and waste management systems.

Cognisant of the importance of the governance mechanism in the management of losses and waste in the value chain, it is important to consider the governance of the South African table grape value chain. A review of the governance of the chain also completes the analysis of the action domain (Dorward, Kirsten, Omamo, Poulton & Vink, 2009) of the value chain as discussed earlier. The generic South African export table grape chain is largely characterised by a sequence of low coordination intensity exchanges, typically spot market- or contract-based exchanges (Table 3.5 below), as typically described (Peterson et al., 2001). Conversely, the specific export chain that was studied in this dissertation was a producer–exporter chain. This chain is characterised by high levels of coordination intensity in the initial stages of the value chain in the form of vertically integrated exchanges and by low levels of coordination intensity in the final links of the chain through a combination of contracts or spot market transactions that govern the exchanges.

Table 3.5: Level of control intensity throughout the supply chain

Chain	Producer-pack house exchange	Pack house-exporter exchange	Exporter-importer exchange	Importer-repack exchange	Importer-retailer exchange
Traditional exporting chain	S/C	S/C	S/C	S/C	S/C
Producer exporter chain	VI	VI	C	S	S/C

S = Spot Market; C = Contract; VI = Vertical Integration

These chain configurations with different governance arrangements (Figure 3.8 below and Figure 3.9 below) provide the foundation for the analysis of losses and waste in the chain that follows in subsequent chapters. Evidently, the significance of the coordination mechanism within the action domain framework is that the efficacy of quality safeguards and management relate directly to the coordination of the particular chains. Particular emphasis is placed on the notion that the quality of the final products, and by implication the extent of losses and waste, strongly depend on the behaviour of actors at the different stages of the chain (Raynaud, Sauvee & Valceschini, 2005). Cognisant of the probable role of governance structures in dealing with losses and waste, Raynaud et al. (2005) specifically note that alignment between quality enforcement mechanisms and the governance of the exchanges in chains is expected. These authors (Raynaud et al., 2005) also note "One can expect to observe that the more 'important' a transaction is for the final quality outcomes of the chain; the more control the owner of the label should have on that transaction". Collectively these observations reinforce the link between quality outcomes and the governance mechanisms of a chain. Subsequent sections of this dissertation will highlight this assertion in relation to the generation of losses and waste in the chain, and to where in the chain such losses and waste are more prominent.

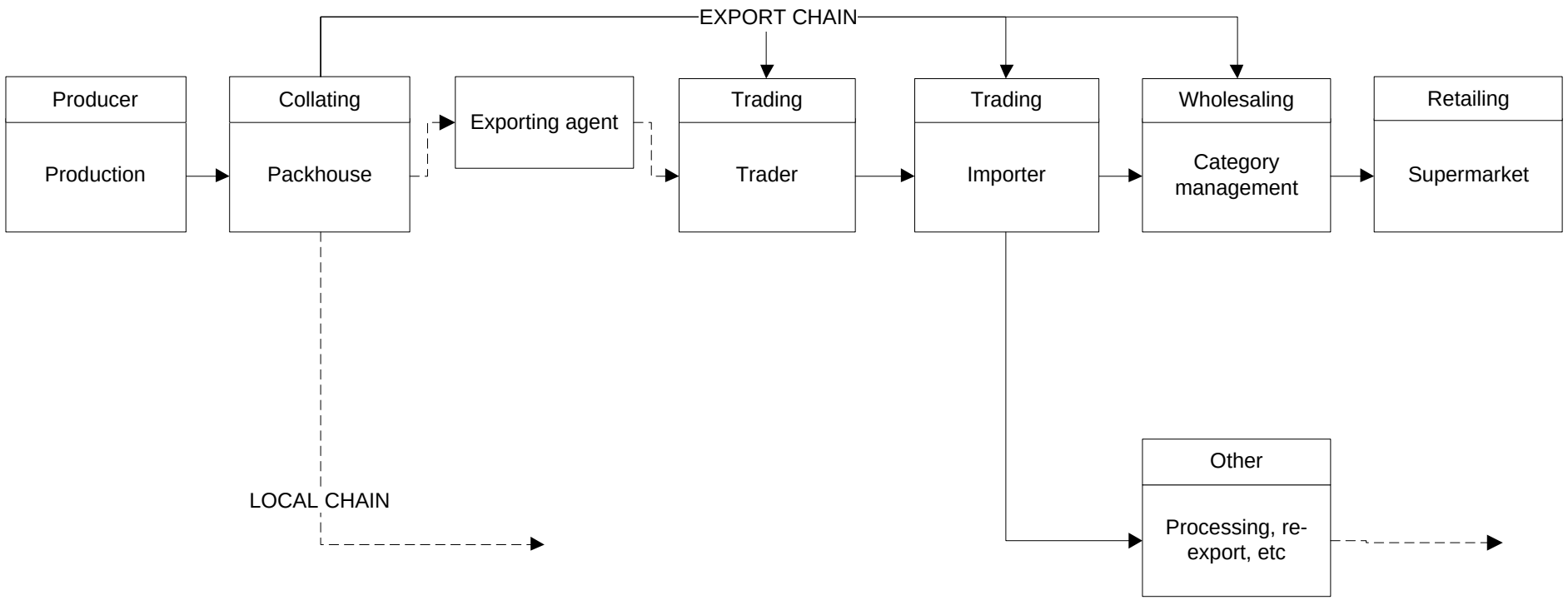


Figure 3.8: Generic table grape supply chain (spot or contract coordination)
Source: Author's own adaptation

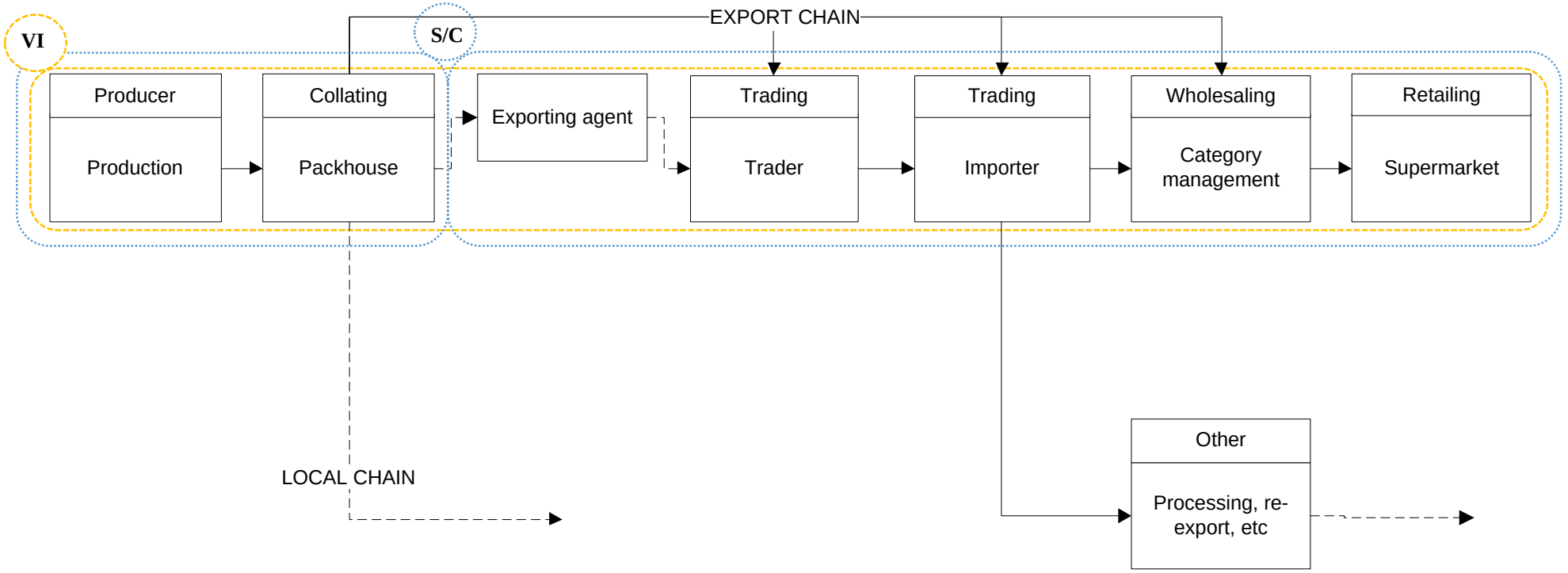


Figure 3.9: Producer–exporter table grape supply chain (vertical integration and spot or contract coordination)
Source: Author's own adaptation

3.5 CONCLUSION

A clear understanding of the nature of the TGSC and its action domain is argued to be essential to the analysis of FLW in the particular chain. Given SATGI institutional environment within which the role players functions, it inherently determines the different types of coordination mechanism within the industry. Role player's behaviour is also influenced based on the different types of coordination mechanism that govern that particular chain. Hence, more coordinated chains exert greater control measures throughout the chain to ensure the alignment of quality control measures than less coordinated chains influencing the occurrence of FLW.

The chapter argues that the inherent characteristics of the product, actors, activities and the governance of the chain inadvertently has an influence on FLW outcomes from the chain. Moreover, the interactions between the actors, activities and the governance mechanism theoretically influence FLW due to the incentives created by, amongst others, voluntary and mandatory rules and regulations that are applicable in the chain. The functioning of the chain inherently depends on the institutional environment of the chain and the underlying incentives influencing the decision making at both industry and operator levels which lead to FLW outcomes. Arguably the current alignment of incentives within the institutional environment warrants adjustment to, for example, the governance of some exchanges to align incentives with outcomes of the chain with a view to reduce the levels of FLW. In conclusion, this chapter provides the background for the operational analysis of an export supply chain in the chapter that follows.

CHAPTER 4
OPERATIONAL ANALYSIS OF FOOD LOSSES AND WASTE IN THE TABLE GRAPE EXPORT SUPPLY CHAIN

4.1 INTRODUCTION

The overview of the SATGI provided in Chapter 3 indicated that various actors and/or activities are responsible for the formation of FLW; however, very little is known of the economic extent thereof. The operational analysis explored in this chapter used both operational/financial and perceptual techniques to identify the main activities responsible for FLW and the extent thereof. The operational analysis was conducted on a specific United Kingdom (UK) export supply chain which exhibited partially integrated characteristics. The UK market is also an important export market for South African table grape producers. Focusing on one specific chain allowed for a more detailed analysis to be undertaken of the activities and coordination in terms of communication and information sharing.

The methodology of Kirezieva et al. (2013) and De Boeck et al. (2015) will be used to firstly identify the activities responsible for FLW, which factors within the activities should receive attention in order to reduce FLW, and to approximate the economic extent of FLW within the respective activities. The analysis within this chapter is merely done to highlight the trends within the particular supply chain and is not intended to portray the results as a statistical analysis, although it can be used as a basis from which future statistical analysis can be conducted.

4.2 METHODOLOGY

This section outlines the overall methodology used to investigate FLW in the SATGI. The different components within the mixed-method methodology will be discussed, given the requirements within both the quantitative and qualitative approaches. These two complementary approaches were followed as this enables the researcher to collect complementary data and to conduct counterpart analysis. Mixed methods thus enable the researcher to define and collect a richer array of evidence (Yin, 2014) in understanding FLW in the context of the South African TGSC.

Figure 4.1 below illustrates the segments in which the data was collected in order to satisfy the methodology requirements as discussed in Chapter 1. The Perceptual analysis represented by section 1 in Figure 4.1 involved the development of a questionnaire to determine the relevance and importance of certain activities and their impacts on FLW. Section 2 in Figure 4.1 represented the operational/financial analysis of activities, data on which was collected for volume and/or monetary values throughout the TGSC. Hence, the two complementary approaches formed the basis upon which comparisons and recommendations will be made regarding FLW in the UK table grape supply chain. The results are a representation of FLW in the UK TGSC and cannot be generalised to the SATGI as a whole, although certain trends observed in the qualitative and quantitative data can be generalised based on SATGI's institutional environment.

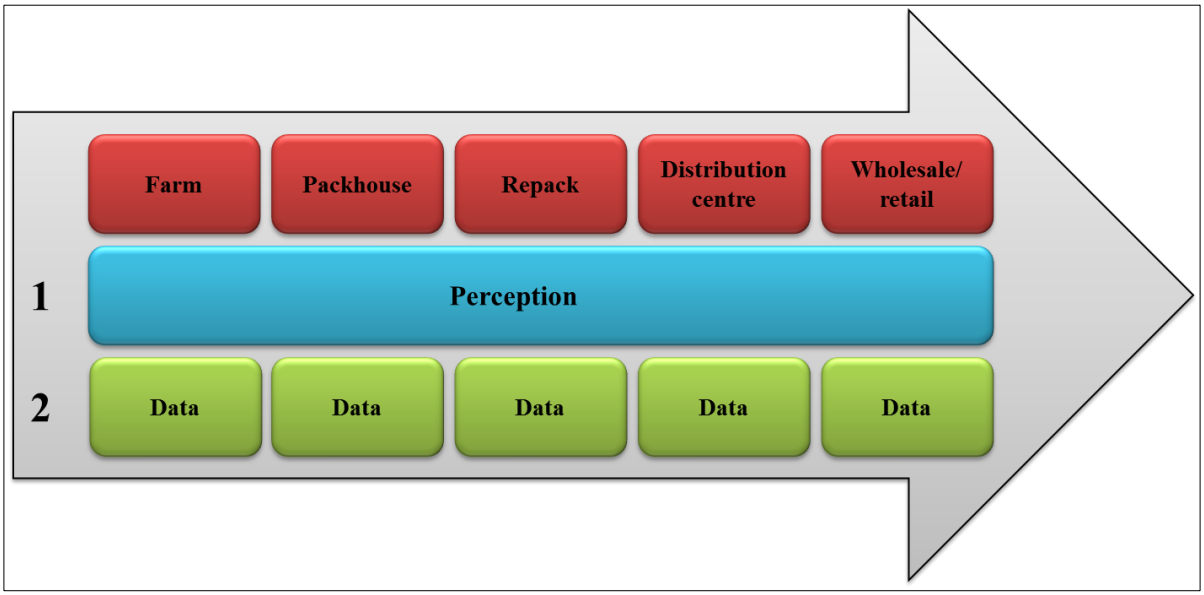


Figure 4.1: Complimentary approaches in the research methodology

Source: Author's elaboration

4.2.1 Developing the framework for collecting operational information

Data was collected from the key points throughout the TGSC to construct a meaningful analysis of the occurrence of losses and waste (Table 4.1 below) in the chain. Data collection was severely constrained by the unavailability of data. Moreover, the data collection and reporting strategies in the TGSC that was analysed were found to be fragmented, non-standardised and lacking in transparency. The data that was available had to be standardised before any

meaningful analysis could be conducted. Table 4.1 below reflects the data collection map, with the various stakeholders involved in the process.

Table 4.1: Different data collection points

Data collection point	Data description

Farm	• Total production volume
	  o Local and export market volumes
	  o Waste

Pack house	• Total production received
	• Total packed
	  o Export market volume
	  o Local market volume
	• Total pack house waste

Exporter	• Total export volume inspected • Total rejections o Reason for rejections
Importer	• Total volume received • Total volume rejected (write-offs) • Total volume rejected for repacking

Repack	• Total repack volume received
	• Total volume repacked
	  o Reasons for repacking
	  o Waste
	• Total volume distributed to distribution centres

Distribution centre	• Total volume received • Total volume that failed inspection o Reasons why it failed inspection • Total volume distributed to retailers
Wholesale/Retail	• Total volume received at retail • Potential losses and waste that occurred at retail o Reasons for losses and waste

Source: Author's elaboration

4.2.2 Developing the questionnaire for the perceptual analysis

The methodology used in collecting the perceptual data was inspired by that of Kirezieva et al. (2013) and De Boeck et al. (2015). A questionnaire was developed and e-mailed to selected participants within the pre-harvest/harvest, pack house, transport, repack and wholesale/retail segments of the TGSC. Participants were asked to evaluate the occurrence of losses and waste, based on their perceptions. As a result, each segment within the TGSC (pre-harvest/harvest, pack house, transport, repack and wholesale/retail) served as the embedded unit of analysis within the case study. The units of analysis were identified through previous studies (FAO, 2011; Segrè, et al., 2014; HLPE, 2014). The probability and the importance/impact of the embedded units/indicators were evaluated by means of a four-point Likert-scale (not

probable/important, slightly probable/important, probable/ important, very probable/important; 1→4). It was therefore decided that the top 3 indicators, under each supply chain segment, would be deemed as the important indicators and that these would be used in the framework in measuring losses and waste. This approach allowed for the capturing of the nuances of the complexity surrounding losses and waste in the TGSC (Kirezieva et al. 2013; De Boeck et al., 2015). See Annexure A for the delineation of the full questionnaire.

4.3 DISCUSSION ON CHARACTERISTICS OF THE LOSSES AND WASTE IN THE SOUTH AFRICAN TABLE GRAPE SUPPLY CHAIN

Given the controversy surrounding FLW literature, two major groups have emerged, endeavouring to differentiate losses and waste, first those surveying along the food supply chain (volume or nutritional intake), and second, those making a distinction between edible and inedible waste (Lipinski et al., 2013; Segrè et al., 2014, HLPE, 2014). As previously mentioned, this dissertation follows the first approach in endeavouring to differentiate and/or allocate where losses and waste occur along the South African TGSC. The operational data will be discussed first, followed by the perceptual data.

4.3.1 Operational and financial analysis

- **Farm to Pack house data**

Sourcing operational data from stakeholders in this section of the chain proved to be severely challenging. Those stakeholders who were willing to participate in the research often lacked adequate data with regard to the classification of different types of losses and waste. Interviews revealed that the industry has a 'short memory' in terms of FLW and that sensitivity regarding information disclosure, attributable to the competitive nature of the industry and political instability, have combined to negatively influence the availability of information at the production level.

This section will make use of Frudata's information since it gives a proper delineation of the regions' total production in terms of the local and export market split and processing facilities. The shortcoming of Frudata's information is that it only covers three production regions and has the information of stakeholders (± 90 %) who are members of the institute. Hence, the information is only representative of the three production regions. However, SATI does provide information in its statistical booklet on all the producing regions, but unfortunately, it

is not delineated based on the total percentage destined for the export market, local market and juicing facilities rendering it incomparable.

Based on Frudata's information illustrated in Figure 4.2 below, it is evident that the largest share of table grape production is destined for the export market, followed by the juicing and local market segments. Stakeholder interviews also revealed that, despite the lower price they receive from juicing facilities, it is often less trouble to sell to the juicing segment than to lobby for market space at fresh produce markets (FPM), when competing against established relationships and bearing in mind the risk of spoilage.

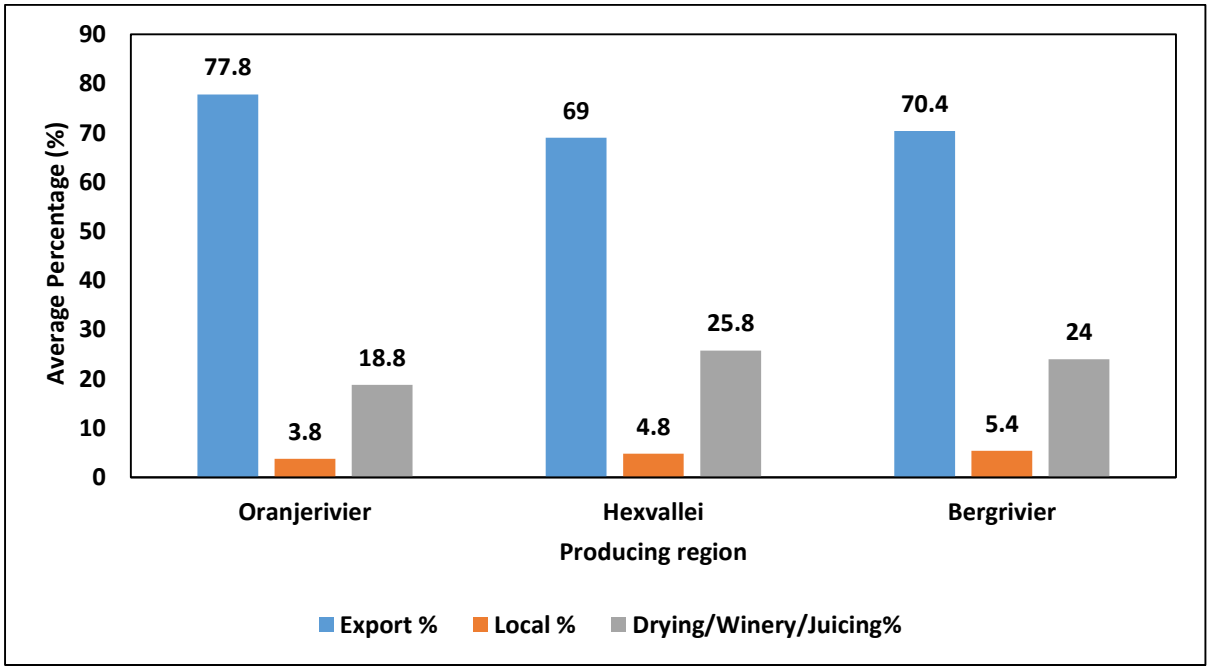


Figure 4.2: Cape producing regions, 5-year average

Source: Frudata (2016)

Some producers may have a relationship with a 'hawker'[1] who buys the lower-quality class fruit at a minimum price and sells it at the FPM, on the condition that there is no connection made between the producer and the quality of fruit sold. This kind of produce often ends up on the market in jumbled boxes, containing mixed quality fruit and sometimes even mixed cultivars. Despite the low profit margin in this market segment, the hawkers operate on the principle of economies of scale, which makes it worth their while to pursue this market (NAMC, 2000; Banda, 2013). However, the local retail market segment requires stricter rules

1 A person who travels about, buying goods from the farmers and selling goods at either informal or formal markets.

and regulations than the FPM does, in the form of certifications and buyer regulations. The economic returns are also greater in the local retail market segment, compared with that of the FPM (Gow et al., 2000; Henson et al., 2005; Henson & Jaffee, 2006; Henson & Blandon, 2007)

- **Pack house to Importer**

A few of the concerns raised in stakeholder interviews relate to the consistency with which the certifying body rejects volumes, based on the supply/availability of table grapes in the market. This phenomenon is referred to as 'thin' or 'thick' markets. Interviews revealed that, at times when thin market (supply of table grapes is limited) conditions prevail, the certifying body is less stringent when conducting inspections, and the opposite occurs when thick market conditions prevail, hence influencing the levels of FLW. Another concern raised by an interviewee was that the inspection criteria according to which the certifying body base their rejections are too broad, especially in the case of disease incidence. An interviewee, well acquainted with the regulation and concerns regarding it, indicated that although it is important to distinguish between different types of disease incidence, it would require Regulation Number 422 of Marketing of Agricultural Products Act (MAP) to be revised, together with significant capital expenditure to establish proper identification procedures, along with the necessary well-trained personnel. Moreover, the rejection criteria were open to rejection biasedness, depending on the person's experience/knowledge and personality traits, i.e. whether the person is very specific and strict, or less so. The broad rejection categories also resulted in information being lost, as it was not specific enough to address the types of FLW that occurred. For example, rejections were often just indicated as 'rot', irrespective of the cause, whether it was *Penicllium* or *Botrytis cinerea*, hence information for identifying the exact cause and for introducing appropriate mitigation strategies were insufficient.

Table 4.2 below shows the inspection and rejection volumes, over a period of six seasons. It is evident from the table that the 2011/2012 to 2012/2013 production seasons had the highest percentage of losses and waste, equating to 1.33 % and 1.08 %, respectively. Both these harvesting seasons were characterised by adverse weather conditions which caused visible damage on the table grape bunches, thus affecting the rejection volumes and/or losses and waste, based on PPECB's inspection criteria.

Table 4.2: PPECB's inspection and rejection volumes

Season	Inspection Volume 4.5 Kg	Rejected volume 4.5 Kg	Losses/Waste
2010/2011	46 380 229	24 035	0.05 %
2011/2012	51 263 110	682 269	1.33 %
2012/2013	50 138 109	539 346	1.08 %
2013/2014	46 886 254	300 948	0.64 %
2014/2015	54 242 677	186 195	0.34 %
2015/2016	51 342 339	115 000	0.22 %

Source: PPECB (2015)

The criteria for table grape losses and waste were categorised in Table 4.3 below in an attempt to simplify analysis. The PPECB rejection data had to be analysed and delineated according to Regulation 422 of MAP (hereafter referred to as Regulation 422) (PPECB, 2015; DAFF, 2012a). Tables 2 to 5 in Regulation 422 served as the basis according to which the rejections were categorised in Table 4.3. Due to the multifaceted nature of the categories, the basis was further categorised into five main categories that represent specific characteristics related to a particular category. The physiological category grouped all the components together that related to the aesthetic appearance of the fruit. Physiological rejections are based on the aesthetic appearance and taste of produce that is deemed to be an inferior quality product which fails to meet export specifications. The Hazardous/Foreign matter category groups all substances together that might cause potential immediate or long-term harm to a consumer when consumed. The third category relates to packing and marking, which relates to the visual appearance of the packaging in which the produce is packed. Failure to adhere to proper packing and marking requirements induces rejections which could be avoided. The Pathology category refers to any organisms, microbial presence, and insects that cause the fruit to spoil. Pathology losses and waste could be decreased if proper care is taken during pre-harvest and post-harvest practices. The Unspecified category is self-explanatory, as no definite rejection reason was given for why such losses and waste occurred.

Table 4.3: Categorisation of losses and waste

Category	Description
Physiological	Appearance of the bunch (Sound and attractive with a percentage bloom of at least 15 %
	General appearance of berries (fresh and firm, soft berry appearance)
	Uniformity of colour in the same container
	Shape of bunch (Uniformity of berry size, mature and fully developed, small berries)
	Blemishes on berries
	Stem inspections (dry foliage, stem end browning)
	Blush
	Straggliness
	Sunburn
	Fruit maturity (TSS, Brix, Acid-to-TSS ratio, fruit maturity)
	Seeds in seedless cultivars
	Loose berries
	Temperature damage (Cold store burn, cold damage, thermofilic waste, wilted/heat damage)
	Vascular Browning
	Berry Defects
	Brown Fleck
	Slip Skin
Hazardous/ Foreign matter	Chemical residues (Chemical substances, MRL exceedance)
	Visible chemical residue
	Dust deposits (dirty produce)
	Other (if termed foreign matter)
	Washed or wet bunches, excluding bunches that are wet due to condensation
	Bruised berries or berries burned with sulphur (injury)
	Dispersed Blood
Packing & Marking	Packing requirements for table grapes (Packing requirements, packing material, stacking of containers on pallets, strapping of pallet loads)
	Marking requirements (Faulty labels, faulty cultivar)
Pathology	Decay, Botrytis, vinegar fly or other larvae
	Arthropoda (mealy bug infestation)
	Oidium
	Insect damage (codling moth, fruitfly infestation)
	Cracked, cut, split, watery, raisin, pedical girdling/ downy mildew
	Mold Growth
	Sooty Mold
Unspecified	Collective deviations
	Unspecified Factors

Source: Author's elaboration of PPECB data DAFF (2016)

Figure 4.3 below indicate the percentage of losses and waste, according to the categories discussed above. On average, the physiological category contributes 63.9 % of total rejections, followed by pathology, packing and marking, hazardous/foreign matter and unspecified factors, each accounting for 31.6 %, 2.6 %, 1.6 % and 0.3 %, respectively. Physiological and pathology factors alone contribute to 95.5 % of total rejections. The high percentage of losses and waste due to physiological factors can be ascribed to the extremity of the weather

conditions (Hodges, Buzby & Bennett, 2010) experienced during that particular harvesting. Pathological causes of FLW, hence rejections, have decreased due to improved post-harvest practices and management, such as better cold chain management, 'just-in-time' production, and computerised stock control, all which have reduced costs and FLW (Kader, 2005; Hodges et al., 2010; Palou, serrano, Martínez_Romero & Valero, 2010).

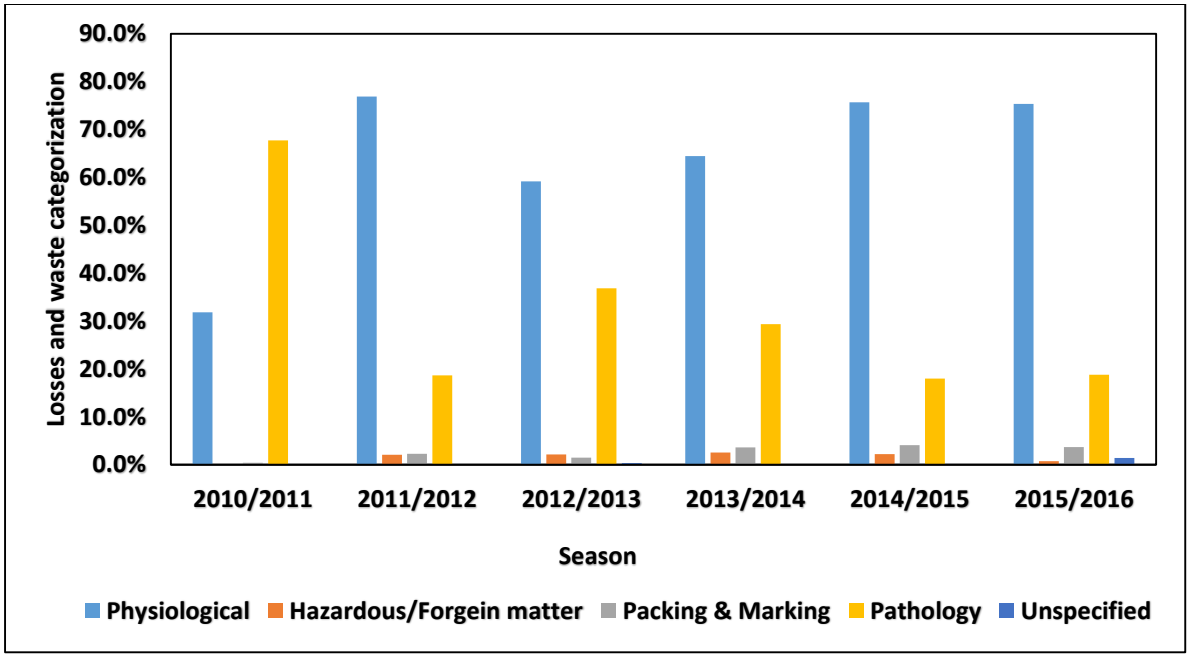


Figure 4.3: Percentage losses and waste according to categorisation
Source: PPECB (2015)

The goal of adequate post-harvest handling, especially in non-climacteric fruit such as grapes, is to maintain a range of quality attributes, such as appearance, colour, texture, flavour and aroma, for as long as possible to delay fruit senescence (Palou et al., 2010) which goal will inevitably reduce the formation of FLW. Retail specifications and growing customer intolerances to substandard foods (aesthetic appearance, size, etc.) are inherently responsible for the high levels of FLW, especially in developed countries (Hodges et al., 2010; Palou et al., 2010). A UK table grape buyer has revealed that certain retailers have established a new product line at a lower cost to compensate for physiological discrepancies, as being their contribution to sustainable supply chain practices, and in so doing, to reduce avoidable losses and waste.

- **Importer to retailer**

The reluctance to disclose information, and to generally participate, by role players in this section of the supply chain hindered the research objectives severely. The time series of available data was constrained by numerous factors, such as the implementation of new data capturing systems, system upgrades which resulted in information being lost.

Figure 4.4 represents the volumes importer handled for the retailer. The total volumes sent from the exporter did not correlate with the volumes received by the importer as a result of market diversion attributable to differences in market specifications. The volumes were diverted to the importers, who are the preferred suppliers for the specific retailers hence the distortion in volumes. As a result, FLW were only traceable from the importers up to the retailers' distribution centres. The retailers were reluctant to share information due to the competitiveness in the retail industry. Very low levels of FLW were seen at the importer's packhouse due to the time frame the fruit spend in importer's holding facilities before it is transported to the retailer's distribution centre. The FLW that however occurred were due to mechanical and handling damage during off load process.

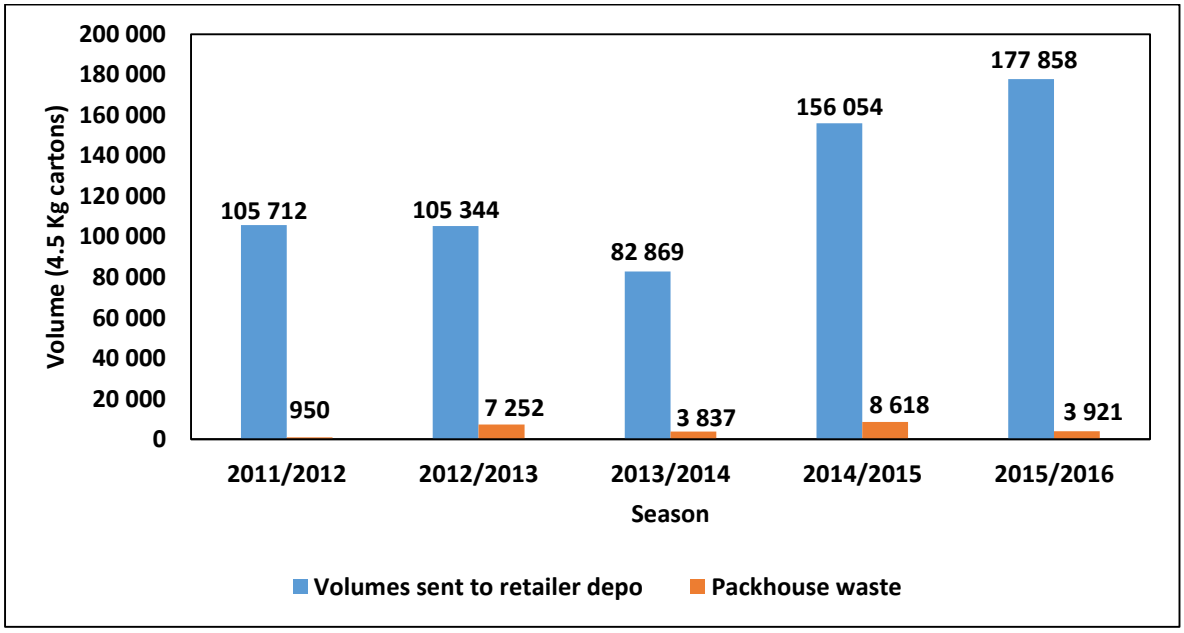


Figure 4.4: Importers' volumes handled for retailer
Source: Anonymous (2016)

- **Quantitative analysis across the supply chain**

This section aims at consolidating the various data sources, based on two sections: Section A represents macro-level information and Section B represents micro-level information.

Although not comprehensive, it gives an indication of the magnitude of FLW in the South African TGSC due to the industry's information availability.

The percentages of FLW across the TGSC are delineated in Table 4.4. It is evident that the majority of FLW occurs during the early stages (from production up to export), followed by the second half of the chain (importer up to retail). These trends are in line with other studies conducted on fruit and vegetable supply chains (FAO, 2011; HLPE, 2014) as well as with the other quantitative data. On average, 9.5 % of FLW occurs between production and intakes, and this is primarily attributable to production practices and market diversification (FAO, 2011). The percentage of FLW that occurs between intakes and export, 2.2 %, can primarily be attributed to physiological/aesthetic factors which fall beyond the producers' control (FAO, 2011), whereas the percentage of FLW that occur after export, 3.8 %, is primarily due to pathological factors and mechanical damage during handling (FAO, 2011). These factors can, to some extent, be controlled by means of better accountability structures throughout the institutional environment.

The postulated monetary value for FLW was calculated in Table 4.5 based on the assumption that all table grapes were produced for the export market, since the majority of table grapes are exported. The net realisation value for exports was used to calculate the monetary value of the FLW between the various functions. However, it is important to note that these values can differ, based on market diversification and buying contracts. This does, however, give an indication of the monetary value of FLW, given the trends observed throughout the TGSC, especially for the UK export market.

Table 4.6 refers to the monetary value of FLW based on a local and export market split. Based on the assumptions that all producers produce for the export market, the volume difference between production and intakes was diverted to the local market because of the product's failure to adhere to export market specifications. The average fresh produce market prices were then used to calculate the financial 'loss' in the TGSC, up to when it was exported. These two scenarios depict the difference in the financial 'loss' in terms of market specification and the assumptions that were used. It is important to note that these values are not comprehensive due to the fragmented nature of the data and serve as a mere indication of the potential magnitude of the financial implications of FLW.

Table 4.4: Percentage of losses and waste between functions in the TGSC

Section	Waste between functions	2011/2012	2012/2013	2013/2014	2014/2015	2015/2016	Average
A	Production – Intakes	13,9 %	7,4 %	9,5 %	8,3 %	8,4 %	9,5 %
	Intakes – Exports	2,9 %	4,2 %	0,5 %	1,4 %	2,3 %	2,2 %
B	Importer – Retailer Depot	0,9 %	6,4 %	4,4 %	5,2 %	2,2 %	3,8 %
	Total	17,8 %	18,0 %	14,4 %	15,0 %	12,8 %	15,6 %

Source: SATI (2016) and authors own elaborations (2016)

Table 4.5: Postulated monetary value of FLW between functions in the TGSC

Section	Season	2011/2012	2012/2013	2013/2014	2014/2015	2015/2016	Average
A	Export net realisation value per 4,5 Kg	R59,68	R67,61	R81,31	R83,08	R99,39	R78,21
	Production – Intakes	R528 498 001,62	R291 848 054,84	R433 792 413,43	R447 415 482,79	R526 348 866,27	R445 580 563,79
	Intakes – Exports	R95 259 921,69	R151 215 288,94	R19 311 902,62	R69 309 356,57	R131 161 056,15	R93 251 505,19
B	Importer – Depot	R56 693,38	R490 324,86	R312 018,25	R715 931,54	R389 708,19	R392 935,25
	Total net realisation value of FLW	R623 814 616,69	R443 553 668,64	R453 416 334,30	R517 440 770,91	R657 899 630,61	R539 225 004,23

Source: SATI (2016), DAFF (2016) and authors own elaborations (2016)

Table 4.6: Postulated monetary value of FLW between functions in the TGSC based on average fresh produce market prices and export net realisation values

Section	Season	2011/2012	2012/2013	2013/2014	2014/2015	2015/2016	Average
	Average price on Fresh produce markets	R35,72	R41,11	R47,71	R54,12	R59,10	R47,55
A	Production – Intakes	R316 303 121,48	R177 434 654,51	R254 525 786,87	R291 477 226,57	R312 981 366,30	R270 544 431,15
	Export net realisation value per 4,5 Kg	R59,68	R67,61	R81,31	R83,08	R99,39	R78,21
	Intakes – Exports	R95 259 921,69	R151 215 288,94	R19 311 902,62	R69 309 356,57	R131 161 056,15	R93 251 505,19
B	Importer – Depot	R56 693,38	R490 324,86	R312 018,25	R715 931,54	R389 708,19	R392 935,25
	Total net realisation value of FLW	R411 619 736,55	R329 140 268,31	R274 149 707,75	R361 502 514,69	R444 532 130,64	R364 188 871,59

Source: SATI (2016), DAFF (2016) and authors own elaborations (2016)

4.3.2 Perceptual analysis

A total of 330 potential respondents were contacted via email, out of which only 40 (12 %) participated as respondents across the various TGSC stages. The questionnaire at first focused on general overview questions (respondent's profile/function), after which it moved into more specific SC segment questions, based on the respondent's profile/function. These SC specific questions were categorised into three main categories: 1. Farm to pack house, 2. Pack house to importer, 3. Importer to retailer. Hence, this section will first discuss the findings of the general overview questions, followed by the questions on farm to pack house, pack house to importer, and importer to retailer.

- **General overview questions**

The general overview questions focused on aspects such as a respondent's profile/function within the particular chain, marketing models used to distribute the products, their perception as to where the most FLW occurred, and recourse methods should FLW occur. The majority of the participants indicated that they utilised the market agent model to distribute their product, followed by some form of vertical coordination. This was in line with our expectations regarding SATGI's vertical coordination continuum, as elaborated by the work of Peterson et al. (2001): higher levels of FLW are prevalent in chains with lower levels of coordination, and vice versa. The respondents also indicated that the majority of FLW occurred at the retail level, followed by the repacking and pack houses facilities. Recourse methods utilised in the event of FLW were predominantly claims, immediate price penalties, and insurance. This brings to mind a question whether these trends indicate that the responsibility was diverted back to the producers, which highlights the institutional failures that are brought about by unstructured rules and regulations and the lack of coordination and accountability among institutional bodies, as explained by Williamson's (1999) institutional framework.

- **Validation of indicators across the three main categories**

In order to establish a framework for measuring FLW, indicators had to be validated based on the methodology of Kirezieva et al. (2013) and De Boeck et al. (2015), as discussed earlier. The top three indicators under each category were chosen based on the respondents' ratings which indicated the likelihood and the impact thereof should it occur at the relevant SC stages.

The most important indicators in terms of FLW under each supply chain segment were calculated by multiplying the probability rating with the importance/impact rating to obtain an impact factor. The top three indicators with the highest scalar ratings were chosen under each segment. In the first category, farm to pack house, respondents revealed that extreme weather conditions (13.43), fungal diseases (10.48) and bird damage (10.56) contributed the most to FLW during pre-harvest and harvest. Aesthetic factors, such as colour (10.77), general appearance (10.56) and uniformity in colour (9.97), had the highest impact factors among pack house indicators. The second category, pack house to importer, revealed that containerised transport (78.3 %) was the most frequently used mode of transport, followed by refrigerated (25.0 %) and non-refrigerated road transport (7.5 %). Hence, it is logical to assume that there would be a greater FLW incidence associated with containerised transport, based on the frequency at which it is used. Factors that contributed the most to FLW during transport were quality deterioration (13.32), product damage (12.00), and container loss (7.34). It seems that containerised shipping is the preferred transportation method used in the SATGI export market. Products destined for the export market are deemed to be superior in terms of quality, packaging material, and economic value in terms of value addition. Hence, should the cold chain break or mechanical damage occur, the resulting poor quality and aesthetic appearance of the product has a significant impact on the monetary value of containerised FLW, based purely on the frequency with which containerised shipping is used in the export market and the value thereof.

4.4 COMPARISON BETWEEN OPERATIONAL, FINANCIAL AND PERCEPTUAL ANALYSIS

Mixed method research designs enabled the researcher to compare operational, financial and perceptual techniques in order to gain a better understanding of FLW in the SATGI context. Hence, in order to attempt to triangulate the results, both the quantitative and qualitative methods have to share the same research questions in order to draw comprehensive conclusions regarding the nature and extent of FLW in SATGI. This approach was necessary because of the nature and (un)availability of information from the various activities and stakeholders in the particular chain.

Figure 4.5 below indicates the average response rate as to where respondents believed the most FLW occurred at the various functions throughout the chain. The perceptual analysis trends are in line with the operational analysis trends assembled in Table 4.4 above and Table 4.5 above.

The respondents' views are that the majority of FLW in the TGSC chain occurs at the early stages (production) in the chain, and then again at the end (retail) of the supply chain. It is therefore clear that the respondents have a good sense of where the most FLW occurs in the chain. In general, there is a coherence between the perceptual and operational analysis data in terms of the respondents' rating regarding the perceived levels of FLW and the possible factors that contribute the most to the formation of FLW.

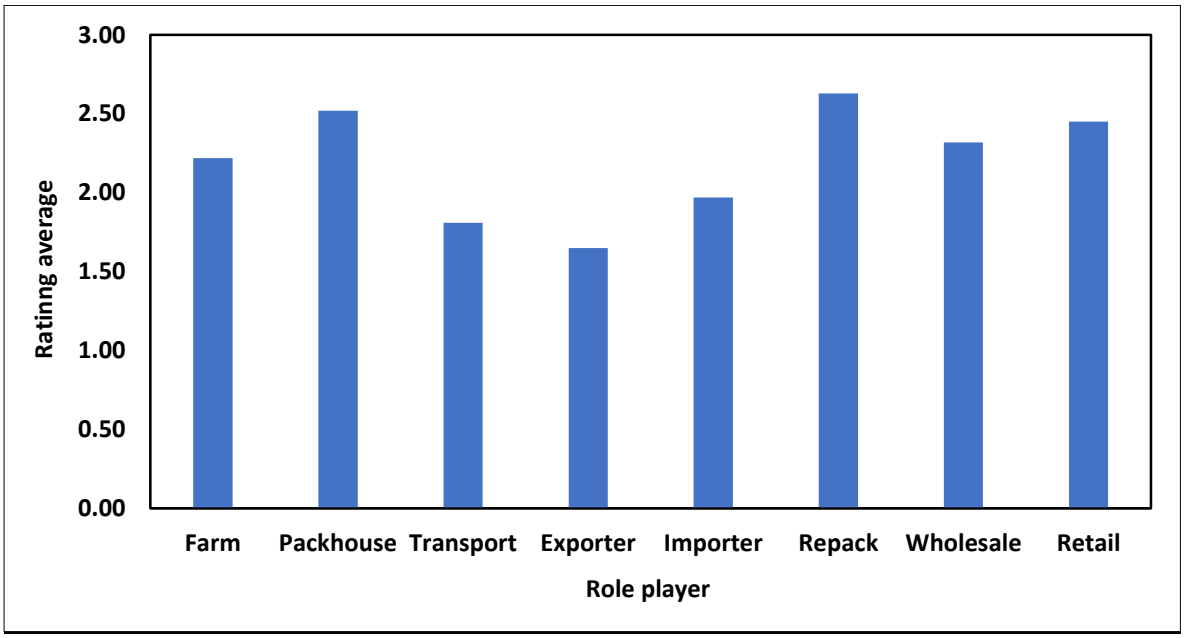


Figure 4.5: Perceived level of FLW at various supply chain functions
Source: Author's own elaborations (2016)

4.5 CHALLENGES AND SHORTCOMINGS EXPERIENCED IN THE OPERATIONAL, FINANCIAL AND PERCEPTUAL ANALYSES

Challenges surrounding information sharing and quality were a topical issue throughout the course of the research. Actors were often unable to share information among themselves due to the (un)availability of information, or they refrained from sharing the information that would otherwise have enriched the findings of the research due to the industry's competitive nature. Various literature studies have indicated the importance of information sharing and information quality as being crucial factors for adequate supply chain performance (Cachon & Fisher, 2000; Moberg, Cutler, Gross & Speh, 2002; Li & Lin, 2006). There is, therefore, a correlation between the level of information sharing/quality and the degree of supply chain integration and FLW in the SATGI (Cachon & Fisher, 2000; Moberg et al., 2002; Li & Lin, 2006). Marinagia, Trivellas, Reklitis (2015) have found that the main implication of information sharing is that it not only enhances overall supply chain performance, but also elevates information quality and

reliability through enforced supply chain management practices. Hence, the low levels of information and the quality thereof, on both macro- and micro-levels, have been a cause of concern throughout the course of this research. Macro-level information often could not be validated through various sources because of measurement discrepancies between the institutions. As a result, reliable and accurate information was often fragmented and lacked credibility when validated through various sources. As a consequence, certain assumption-based calculations had to be made in order to determine the degree of FLW between supply chain functions. Fortunately, these assumptions were verified by key industry role players. The mixed-method design also assisted in validating the trends observed in both the perceptual and operational data that were available.

Researchers have suggested that making up-to-date marketing and undistorted data available at every node in the supply chain facilitates better information flow, and improves supply chain efficiency and effectiveness, which also enables better responses to be made to changing customer needs. The importance/impact of information sharing depends on what information is shared, with whom, and how and when it is shared. The dysfunctional effects of inaccurate information, the opportunistic behaviour of supply chain role players, and their divergent interests all have a negative impact on the SC performance (Mason-Jones & Towill, 1997; Holmberg, 2000) and on the occurrence of FLW within SATGI as a whole. In general, there appears to be a general reluctance in sharing information, as it is seen as relinquishing power to competitors (Boddy, MacBeth & Wagner, 2000). However, various studies have indicated the advantages of sharing undistorted information throughout the supply chain. Back in 1998, Lalonde considered information sharing in supply chains as being one of the five building blocks that characterised solid supply chain relationships. Hence, future research can focus on the importance and/or impact of information sharing and the quality thereof in SATGI, the formation of FLW, and the level of supply chain integration.

4.6 CONCLUSION

The results from both operational and perceptual data revealed that the majority of FLW occur during the early stages of the supply chain, before the table grapes are exported. The operational analysis revealed that an approximate 9.5 % (R270.5 m) of losses and waste occurred between the production and intake stages, and that 2.2 % (R93.2 m) and 3.8 % (R0.4 m) occurred between intakes and exports, and between the importer to retail depot, respectively. Volume ‘losses’ at the early stages of production can be attributed to legislation regarding marketing

and product standards, and more specifically to the aesthetic appearance of the table grapes. The perceptual analysis indicated the same trends in that rejections are often based on the aesthetic appearance of the grapes, and not necessarily on pathological or hazardous factors which are harmful when consumed. Moreover, retailers also set private standards above those which are required by governmental legislation, hence contributing to volume 'losses' earlier on in the supply chain. Rejection volumes could be reduced, should legislation provide for market diversification based on the physiological/aesthetic appearance of the fruit. Further research into how the institutional environment in terms of rules and regulations and supply chain relationships contribute to the formation of FLW should be conducted in how it can be managed to reduce FLW.

CHAPTER 5
DISCUSSION AND CONCLUSION

5.1 INTRODUCTION

The dissertation took an economic approach in analysing FLW in the South African TGSC. Contemporary literature addresses the issue of FLW, based on two premises, namely food security and hunger perspectives, and environmental concerns (HLPE, 2014). Both premises neglect the complicated nature of the economic drivers that bring about FLW and the impacts thereof. The premise of this dissertation was to provide greater awareness of the economic importance of understanding and mitigating FLW throughout the chain and to emphasise the need for the flow of readily available and accurate information for providing a means to measure and assess FLW in an economic context. In light of the need for sustainable and sovereign global food systems, the management of food losses and waste is an obvious priority, given the economic, social and environmental consequences thereof.

The goal of this dissertation was to develop a framework to identify, describe and quantify FLW in SATGI, with specific emphasis on the UK export chain. This goal was addressed through two main chapters. The first chapter (Chapter 3) analysed the TGSC to determine the significance of the macro-, meso- and micro-factors within specific supply chain activities that contribute to FLW. An operational, financial and perceptual analysis was conducted in the second chapter (Chapter 4) to determine which activities are more prone to the formation of FLW and the extent thereof.

5.2 DISCUSSION OF RESEARCH PROPOSITIONS

This dissertation explored the concept of FLW within the SATGI, with specific emphasis on the UK export chain. The premise was to gain a better understanding of how specific activities and actors, together with the institutional environment in terms of rules and regulations, all have an influence on FLW. The purpose was specifically to (1) identify areas prone to FLW and to determine the kinds of FLW; (2) develop a method to quantify FLW; (3) determine why FLW occur; (4) identify, where possible, what activities are responsible for the formation of FLW; (5) determine the approximate economic extent of FLW; and (6) suggest measures and policies that can be taken to improve the management of FLW and to enhance accountability among actors.

5.2.1 Factors influencing FLW in SATGI

The first research proposition indicated that the macro-, meso- and micro-factors causing FLW vary in their significance and impact on FLW in the SATGI. The different macro-, meso- and micro-factors were prioritised in Chapter 2 and applied in Chapter 3 in terms of the institutional and perceptual analysis. In order to recognise the different level causes, it is important to have a thorough understanding on how the rules and relationships within a typical TGSC affects the transactions and also its outcome (FLW.) The findings suggest that the institutional environment of SATGI guides the behaviour of actors (Scott, 2001) and that the implementation of these regulations influences the level of FLW (Smith, 2009; FAO, 2011; Waarts et al., 2011).

5.2.2 Supply chain activities influencing the levels of FLW

The second research proposition suggests that various supply chain activities influence the levels of FLW and that certain activities play a more prominent role than others do. This proposition was partly explored in Chapter 3. The interaction between supply chain activities, actors and institutions (rules and regulations) has an effect on the levels of FLW.

Farm to pack house and pack house to importer activities seem to the largest contributors to FLW levels because of the statutory requirements that have to be complied with. However, losses and waste that occur between these activities are predominantly attributable to the physiological factors (colour, uniformity and size) of table grapes and are more often a financial ‘loss’ and not a volume ‘loss’, as these volumes are diverted to the local market.

Importer to retailer activities are simultaneously governed by statutory and ‘de facto mandatory’ certifications and private standards. Instances of FLW that occur between these activities can be either a financial and/or volume ‘loss’. Failure to meet retailer specifications often results in a financial ‘loss’ since consignments may have to be diverted to another market at a lower price. Financial and volume ‘losses and waste’ occur when the table grapes are damaged during the handling processes or infected with pathogens. Depending on the grading received by the inspector, these table grapes are repacked at a lower cost or are completely destroyed.

5.2.3 Determining the economic extent of FLW

The third proposition proposed that FLW within SATGI can be evaluated based on an operational, financial and perceptual analysis. Chapter 4 revealed a coherent trend in the operational and perceptual analysis in that the majority of FLW occurred between production and export. An approximate R363.7 m worth of losses and waste occurred between production and exports. These losses and waste can be attributed to the statutory regulations regarding the marketing and product standards that govern the marketing of table grapes. The rejections are based, in order of importance, on physiology (63.9%), pathology (31.6%), packing and marking (2.6%), hazardous/foreign substances (1.6%), and unspecified factors (0.3%). Approximately R0.4 m losses and waste occurred between the importer and retailer, which according to expert opinion, can be attributed to retailer specifications or product damage.

5.3 IMPLICATIONS FOR RESEARCH

FLW generators (the macro-, meso- and micro-drivers discussed in Chapter 2), as well as their financial implications on the supply chain's welfare, go unnoticed due to the lack of the measurement thereof. Ironically, it is argued that managerial action in the management of supply chains is primarily driven by economic factors, and as such, the economic dimensions of FLW in the chain should not remain unquestioned. This observation in itself creates ample opportunity for future research in the context of time series analysis and scenario simulations (i.e. food safety concerns such as *Listeria* contaminations, and their impact on the percentage of FLW and on the financial returns of the entire supply chain). This study aimed at setting the theoretical background for statistical and simulation purposes to validate the trends observed throughout the course of the research.

Trends observed throughout the course of the research indicate that institutional arrangements within SATGI create an environment that is conducive to the generation of FLW (Smith, 2009; FAO, 2011; Waarts et al., 2011). Williamson's (1999) framework for institutional analysis indicates that social embeddedness (informal institutions, traditions, norms, etc.) has an influence on the institutional environment (formal rules of the game) and the governance thereof (playing the game). These findings correlate with Dorward & Omamo's (2009) framework for analysing institutions, in that the only way to change outcomes (FLW) is to facilitate changes in the institutions (rules of the game and the management thereof) (Waarts et al., 2011). Does the embedded social environment within SATGI lead to issues pertaining to

the measurement of FLW, the comprehension of FLW generators, and the appropriate mitigation strategies. Hence, liberal research opportunities are presented by questions as to whether actors became desensitised to traditions, such as the lack of supply chain transparency and accountability.

5.4 SHORTCOMINGS OF THE RESEARCH

Conducting research has never been undertaken without encountering shortcomings. The quote of William Pollard (undated) remains applicable in today's society, where we live in an ever-changing environment with continuous enhancements in 'old ways', and this dissertation is no exception to it.

> *'Without change there is no innovation, creativity, or incentive for improvement. Those who initiate change will have a better opportunity to manage the change that is inevitable.' (Pollard, undated).*

Notwithstanding the appropriateness of the mixed-method design (Doyer and van Rooyen, 2001; Johnson and Onwuegbuzie 2004; Kirsten, 2004; Yin, 2014) and the exploratory nature of this dissertation in analysing FLW in SATGI, the research is not without shortcomings.

The foremost constraint experienced throughout the dissertation's time frame in the operational, financial and perceptual analysis was the willingness or ability of the actors (institutional organisations and private role players) to participate in the research. The limited willingness of stakeholders to engage concerning the phenomenon of FLW in the chain. This raises questions as to whether there is a general lack of information and analysis thereof on the part of the stakeholders, whether there is poor communication and flow of information between stakeholders related to FLW, and whether there is lethargy and reluctance among stakeholders for interrogating the phenomenon. As a result, the findings and the conclusions flowing from these findings are limited by the availability of operational and financial data and participation in the perceptual analysis.

In general, the operational shortcomings experienced throughout the course of this research concerned the availability of accurate secondary information. Information was not readily available or accessible due to issues surrounding protecting competitive advantage, despite confidentiality agreements being signed. On the other hand, the data that was available is plagued with discrepancies, such as in reversed engineering, and in consistent measurement

across time, or the lack thereof. Hence, the data available did not satisfy the requirements to construct a feasible time series analysis. Accordingly, it was decided to make use of qualitative data to extrapolate and approximate the linkages between actors and their exchanges to create a better understanding of FLW in SATGI. Although perceptual data provided a more detailed understanding of FLW, the significance of the findings is constrained by the sample size of the participants. It was a lengthy process to establish collaboration among various stakeholders, and the collection of data was time consuming. A total of 330 actors were contacted via email, out of which only 40 (12 %) participated as respondents.

In terms of the generalisability of the results of this dissertation, it is noted that although certain concepts, such as the degree and measurement of FLW, can be extrapolated to other value chains, the findings reported in this dissertation are very specific to the supply chain studied and cannot be generalised across the SATGI (Polit & Beck, 2010).

Typical concerns raised in FLW literature regarding the scope and extent of FLW were seen in the SATGI case study. The phenomenon of FLW should, therefore, be viewed in terms of supply chain sustainability and not only as affecting individual actors in the chain. Matters related to social embeddedness and behavioural economics might reveal more details regarding FLW in SATGI and thus assist in developing the appropriate mitigation strategies.

5.5 CLOSING REMARKS

Food losses and waste are an inevitable part of food supply chains. However, notwithstanding this phenomenon, the need for ‘acceptable’ levels of FLW has to be determined within the respective chains, given the various forces that drive these chains and their goals. This dissertation has highlighted the point that the nature of the product and the institutional environment plays a tremendous role in determining the extent of FLW in any given chain. Moreover, cognisant of the major flows in value chains – goods and services, the distribution of value added, and intelligence – the importance of information and its management in the performance of chains is clearly illustrated and reiterated.

Inevitably, the alignment of a number of sequential activities into a supply chain, and the governance of the exchanges within the chain, determine the outcomes that the chain is able to deliver. This dissertation has specifically highlighted the importance of the informational dimension of chains in managing losses and waste in an export table grape chain and of the interaction with a range of institutional factors that require coordination to ensure specific

performance from the chain that was studied. However, as insightful as these findings are, they are equally informative to the particular chains and the actors involved in for developing future strategies in an environment that can ill-afford losses and waste. As a consequence, a more considered approach to the management of losses and waste seems to be appropriate, and the stakeholders in the chain, SATGI and the statutory entities linked to the chain, may well guide their strategies and policies cognisant of the phenomenon and the need to manage it in the interest of a sustainable future.

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Appendix

Table grape losses and waste research

INTRODUCTION

Dear Respondent,

Thank you for your time. You are invited to participate in a research study about food losses and waste in the South African Table Grape Supply Chain. This research is funded by the Postharvest Innovation Programme (PHI) and the South African Table Grape Industry (SATI) in collaboration with the Department of Agricultural Economics, Extension and Rural Development at the University of Pretoria in South Africa.

Thank you for your willingness to participate in this survey. Your highly valued inputs are important to the success of the research, the dissertation and in advancing the field of agribusiness value chain research.

Please send any queries to:
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As an expert resource person the information you provide in this questionnaire will be used to develop a framework to measure food losses and waste along with an economic definition of food losses and waste. You will be asked to adjudicate the relevance/probability and importance/impact of a number of factors influencing losses and waste within the table grape supply chain.

The questionnaire should take no more than about 10 minutes to complete.

There are no known risks if you decide to participate in this research study. There are also no costs to you for participating in the study. No personal or commercial harm is foreseen as a result of participating in the study.

Personal information asked will only be used to clarify certain aspects should the enumerator be required to do so.

Your participation in this study is voluntary. By completing and submitting the web based survey you are voluntarily agreeing to participate. You are free to decline to complete the questionnaire for any reason.

INSTRUCTIONS
Please complete all the relevant questions, in the context of definitions provided, by considering the relevance/probability and the importance/impact of each of these factors affecting the degree of losses and waste.

Relevance/probability: Refers to the likelihood of the occurrence of a certain type of loss and waste at a specific level in the supply chain.

Importance/impact: Refers to the impact of the occurrence of a certain type of loss and waste at a specific level in the supply chain.

RESPONDENT'S PROFILE

1. Profile information

Name	
Company	
Address	
Address 2	
City/Town	
State/Province	
ZIP/Postal Code	
Country	
Email Address	
Phone Number	

2. Please define what you understand as losses and waste in the table grape industry:

Loss:	
Waste:	

For the purpose of this questionnaire we will use the following definitions for food losses and waste. Bearing these definitions in mind, please fill out the questionnaire based on the definitions given.

A generalised definition of FLW, currently comprises of the following dimensions (Codex Alimentarius, 1985; FAO, 2011; HLPE, 2014):

Food loss refers to food that spills, spoils or is lost before it reaches the consumer which are mainly caused by the institutional and legal framework of the food production and supply system, the unintended result of agricultural process or technical limitation in supply chain infrastructure.

Food waste is the removal of food fit for human consumption as a result of a conscience decision or negligence on the actors part – this predominantly occurs at the final consumption stage, but not limited to it.

GENERAL QUESTIONS

3. Please select the appropriate chains you utilise to distribute your product?

- ◯ Vertically integrated (centrally managed or owning different stages throughout the supply chain)
- ◯ Marketing Agent (sells the product on behalf of the producer)
- ◯ Other (please specify)

4. Based on your perception, please indicate for each level in the value chain, the extent of losses and waste.

	Very low	Low	High	Very high
Farm	◯	◯	◯	◯
Packhouse	◯	◯	◯	◯
Transport	◯	◯	◯	◯
Exporter	◯	◯	◯	◯
Importer	◯	◯	◯	◯
Repack	◯	◯	◯	◯
Wholesale	◯	◯	◯	◯
Retail	◯	◯	◯	◯

5. What recourse options do you use in the event of losses and waste?

- ☐ Claims
- ☐ Insurance
- ☐ Immediate price penalty
- ☐ Future price penalty
- ☐ Future volume penalty
- ☐ Write-off
- ☐ None

6. Please indicate your, your company or your business unit's function in the value chain (More than one option is available for vertically integrated operations)

- ☐ Producer/farmer
- ☐ Producer-exporter
- ☐ Market Agent
- ☐ Exporter
- ☐ Transporter
- ☐ Repacker
- ☐ Wholesaler/Distributer
- ☐ Retailer

PRE-HARVEST/HARVEST QUESTIONS

7. Indicate the probability of the following factors pertaining losses and waste during the pre-harvest/harvest period.

	Not probable	Slightly probable	Probable	Very probable
Extreme weather conditions	○	○	○	○
Insect damage	○	○	○	○
Bird damage	○	○	○	○
Fungal diseases	○	○	○	○
Infield waste (sorting and grading)	○	○	○	○

8. Indicate the importance/impact of the following factors pertaining losses and waste.

	Not important	Slightly important	Important	Very important
Extreme weather conditions	○	○	○	○
Insect damage	○	○	○	○
Bird damage	○	○	○	○
Fungal diseases	○	○	○	○
Infield waste (sorting and grading)	○	○	○	○

PACKHOUSE QUESTIONS

9. Please indicate the importance/impact of the following quality factors affecting the extent of your business' losses and waste.

	Not important	Slightly important	Important	Very important
Appearance of the bunch	○	○	○	○
General appearance of berries	○	○	○	○
Colour (minimum) in the case of cultivars	○	○	○	○
Uniformity of colour in the same container	○	○	○	○
Shape of bunch (Uniformity of berry size)	○	○	○	○
Blemishes on berries	○	○	○	○
Minimum mass of individual bunches (small berry cultivars)	○	○	○	○
Minimum mass of individual bunches (large berry cultivars)	○	○	○	○
Minimum mass of individual bunches (late harvest berry cultivars)	○	○	○	○
Minimum mass of individual bunches (prepacked units)	○	○	○	○
Unspecified internal or external quality defects (berry or bunch) not specified above	○	○	○	○

10. Please indicate the importance/impact of the following quality factors pertaining losses and waste.

	Not important	Slightly important	Important	Very important
Appearance of the bunch	○	○	○	○
General appearance of berries	○	○	○	○
Colour (minimum) in the case of cultivars	○	○	○	○
Uniformity of colour in the same container	○	○	○	○
Shape of bunch (Uniformity of berry size)	○	○	○	○
Blemishes on berries	○	○	○	○
Minimum mass of individual bunches (small berry cultivars)	○	○	○	○
Minimum mass of individual bunches (large berry cultivars)	○	○	○	○
Minimum mass of individual bunches (late harvest berry cultivars)	○	○	○	○
Minimum mass of individual bunches (prepacked units)	○	○	○	○
Minimum mass of individual bunches	○	○	○	○
Unspecified internal or external quality defects (berry or bunch) not specified above	○	○	○	○

11. Indicate the probability of the following MRL (Minimum Residue Limits) pertaining losses and waste.

	Not probable	Slightly probable	Probable	Very probable
Exceedance of registered pesticides (S.A. standards)	○	○	○	○
Exceedance of registered pesticides (EU standards)	○	○	○	○
Exceedance of unregistered pesticides (S.A. standards)	○	○	○	○
Exceedance of unregistered pesticides (EU standards)	○	○	○	○

12. Indicate the importance/impact of the following MRL (Minimum Residue Limits) pertaining losses and waste.

	Not important	Slightly important	Important	Very important
Exceedance of registered pesticides (S.A. standards)	○	○	○	○
Exceedance of registered pesticides (EU standards)	○	○	○	○
Exceedance of unregistered pesticides (S.A. standards)	○	○	○	○
Exceedance of unregistered pesticides (EU standards)	○	○	○	○

13. Please select the certifications you have.

- ☐ GlobalGAP
- ☐ BRC (British Retail Consortium)
- ☐ Certified organic
- ☐ SEDEX (Supplier Ethical Data Exchange)
- ☐ Ethical trade or equivalent audits
- ☐ Environmental sustainability or equivalent audits
- ☐ CSR (Corporate Social Responsibility) or equivalent audits
- ☐ Certificate of conformity (UK market)
- ☐ Nature's Choice
- ☐ Field to Fork
- ☐ Tesco NURTURE
- ☐ None
- ☐ Other (please specify)

TRANSPORT QUESTIONS

7. Please indicate, as a percentage, the different modes of transport you use to transport your product.

Container transport	
Refrigerated road transport	
Non-refrigerated transport	

8. Please indicate, as a percentage, the losses and waste that occur with the different modes of transport you use.

Container transport	
Refrigerated road transport	
Non-refrigerated transport	

9. Indicate the probability of the following factors pertaining losses and waste during transportation.

	Not probable	Slightly probable	Probable	Very probable
Container loss	○	○	○	○
Wrong delivery address/destination	○	○	○	○
Theft	○	○	○	○
Product damage	○	○	○	○
Quality deterioration	○	○	○	○

10. Indicate the importance/impact of the following factors pertaining losses and waste during transportation.

	Not important	Slightly important	Important	Very important
Container loss	○	○	○	○
Wrong delivery address/destination	○	○	○	○
Theft	○	○	○	○
Product damage	○	○	○	○
Quality deterioration	○	○	○	○

REPACK QUESTIONS

7. Do you repack your products (specifically table grapes)?

- ◯ Yes
- ◯ No

8. Please indicate, as a percentage, the proportional split why your product is generally repacked.

Repacked because of quality factors (bunch and/or berry appearance)	
Repacked because of damaged packaging	
Repacked because of market diversification (product repacked into different packaging sizes)	

9. With whom does the decision lay to repack the product?

- ☐ Producer/Farmer
- ☐ Market Agent
- ☐ Retailer
- ☐ Other (please specify)

10. Who pays for the cost of repacking?

- ☐ Producer/Farmer
- ☐ Exporter
- ☐ Importer
- ☐ Repacker
- ☐ Wholesaler
- ☐ Retailer

11. Who pays for the cost associated with losses and waste as a result of repacking?

- ☐ Producer/farmer
- ☐ Exporter
- ☐ Importer
- ☐ Repacker
- ☐ Wholesaler
- ☐ Retailer

12. Indicate the probability of the following factors pertaining losses and waste during repack.

	Not probable	Slightly probable	Probable	Very probable
Quality factors (bunch/berry appearance and colour)	○	○	○	○
Damaged packaging	○	○	○	○

13. Indicate the importance/impact of the following factors pertaining losses and waste during repack.

	Not important	Slightly important	Important	Very important
Quality factors (bunch/berry appearance and colour)	○	○	○	○
Damaged packaging	○	○	○	○

RETAIL QUESTIONS

8. Indicate the probability of the following factors pertaining losses and waste at retail level.

	Not Probable	Slightly probable	Probable	Very probable
Expiry date	○	○	○	○
Customer returns	○	○	○	○
Holding/cycle inventory	○	○	○	○
Sale on holding/cycling inventory	○	○	○	○
Defaults on buying programmes (Procurement losses and waste)	○	○	○	○

9. Indicate the importance/impact of the following factors pertaining losses and waste at retail level.

	Not important	Slightly important	Important	Very important
Expiry date	○	○	○	○
Customer returns	○	○	○	○
Holding/cycle inventory	○	○	○	○
Sale on holding/cycling inventory	○	○	○	○
Defaults on buying programmes (Procurement losses and waste)	○	○	○	○


THE END


thank you
danke
謝謝
gracias
merci
obrigado
teşekkür ederim
go raibh maith agat
dziękuję
sukriya
kop khun krap
mochchakkeram
terima kasih
ngiyabonga
спасибо
bedankt
dank je
arigatō
dakujem
grazie
감사합니다
ありがとう
мерси
хвала
рахмат
Баярлалаа
tapadh leat
sagolun
takk
taiku
hvala
mauruuru
faafetai lava
vinaka
blagodaram
misaotra
matondo
paldies
grazzi
mahalo
asante
manana
obrigada
tenki
murakoze
mamnun
chokrane
djiere dieuf
tau
дякую
chnorakaloutioun
gratias ago
gràcies
sulpáy
akun dankon
kiitos
dankie
dhanyavad
nanni
nandri
gràcie
bayarlalaa
köszönöm
enkosi
sobodi
dekuji
mèsi
didi madloba
najis tuke
kam sah hamnida
rahmat
rahmet
tanemirt
trugarez
dhanyavadagalu
shukriya
mercé
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ευχαριστώ
mersi
kia ora
barka
welalin
tack
spas
спасибі