Enhancing food security through the integration of DRR and the food chain value: The case of the Listeriosis outbreak, South Africa

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ABSTRACT

Disasters tend to negatively influence the activities and functions of the entire food chain which ultimately affect food security. South Africa is considered to be food secure at a national level, however over 6,8 million citizens experienced hunger in 2017 (Stats SA, 2019). The government established food security policies to address this however, disaster risk along with poverty continue to threaten food security. Therefore, it is important to protect livelihoods and make food systems more capable of absorbing disaster risks through sustainable food chains.

The food chain has been facing a continuous crisis and disaster risk due to complex interactions between socio-economic and environmental factors. However, the rapid increase of disaster risk in terms of frequency and extent along with socio-economic issues have made it challenging for food chains to continue absorbing these risks. Therefore, the aim of this study was to explore how the integration of the Food Chain Value (FCV) and Disaster Risk Reduction (DRR) can enhance food security in South Africa. To achieve this aim, six research objectives were established and addressed in the chapters (1-6) of the study. Firstly, a literature review explored the relationship between the FCV, food security, and DRR, followed by a legislative analysis to identify and analyse the policy gaps towards addressing food security (FSNP, IFSS, and ZHP) and disaster risks (NDMC, NDMAF, NDMF, and DMA) in South Africa. A qualitative research design was applied through the use of a questionnaire that was used to conduct semi-structured interviews and for self-administration in order to explore how the integration of the FCV and DRR can enhance food security in South Africa. Thematic analysis was used to develop five themes that were predetermined based on the research objectives with others emerging from the participants' responses.

The research findings revealed that there is a knowledge gap about DRR among the respondents which is concerning because climate change and disaster risk were recognised as key dynamics that disrupt the FCV and threaten food security. Furthermore, the current national policy structures of South Africa offer limited policy integration of the FCV and DRR where the food chain stakeholders and DRR officials work separately. This was further accentuated by using the Listeriosis outbreak as an example which resulted in 1, 060 cases and 216 mortalities. This outbreak exposed the loopholes in food safety regulations and the need for better preparedness. The Listeriosis outbreak in South Africa (2017/18) emphasised the significance and need for proper risk assessment. According to respondents, the household food security become distorted during and after the outbreak in the sense that consumers lost their preference and convenience; anxiety about processed food; disrupted household budget; loss of income for those who were laid-off from Enterprise; disruption of small local businesses; changed consumption patterns; and increased food waste. The respondents noted DRR as an approach that can contribute towards reducing and preventing risks within the FCV. The findings of the study are significant towards policymaking and

understanding areas that require further attention in terms of integrating DRR into the FCV. The study recommends that a forum which is specifically focused on integrating DRR into the FCV should be established with clear roles and responsibilities to avoid confusion and duplication of initiatives/strategies.

Keywords: Disaster Risk Reduction (DRR); food chain value (FCV); food security; Listeriosis; policy integration; South Africa.

LIST OF ACCRONYMS AND ABBREVIATIONS

ACDS	African Centre for Disaster Studies
COOPI	Cooperazione Internazionale
DMA	Disaster Management Act
DFID	Department for International Development
EAGER	Engaging African G.I.R.R.Ls in Gender Enriched Risk Reduction
FAO	Food Agricultural Organisation
FCV	Food Chain Value
FSNP	Food Security and Nutrition Policy
GEF	Global Environment Facility
GFDRR	Global Facility for Disaster Reduction and Recovery
GIRRL	Girls in Risk Reduction Leadership
HFA	Hyogo Framework for Action
IFAD	International Fund for Agricultural Development
IFSS	Integrated Food Security Strategy
ISDR	International Strategy for Disaster Reduction
MDGs	Millennium Development Goals
NDMAF	National Disaster Management Advisory Forum
NDMC	National Disaster Management Centre
NDMF	National Disaster Management Framework
RSA	Republic of South Africa
SFDRR	Sendai Framework for disaster risk reduction
WFP	World Food Programme
YSPA	Yokohama Strategy and Plan of Action
ZHP	Zero Hunger Programme

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CHAPTER 1: INTRODUCTION AND ORIENTATION

1.1 Introduction

Disasters threaten peoples' lives, livelihoods, and the environment (Tirivangasi, 2018). In addition, the higher the population growth the higher the demand for resources which includes water, land, and food (Barrett, 2010). Godfray *et al.* (2010) illustrates that such a high competition for resources will lead to the exploitation and degradation of several resources, with climate change as an additional catalyst. Thus, the urgent need to reduce the adverse impacts of disasters on the environment and food systems (Caldecott *et al*., 2013; Carter & Gulati, 2014). Food security is achieved when every person has adequate and healthy food at all times. In addition, the food must be of the individual's preference (Matuschke, 2009). Moreover, it is worth noting that food security is not only about adequate food but also the safety, cultural acceptability and quality of the food (Ericksen *et al*., 2009). Research shows that food security can be significantly influenced by the activities of food chains. For instance, household food production can increase due to cultivation of cash crops, while the nutritional value can reduce due to processing and storage techniques (Deloitte, 2015).

Chapter 1 introduces the key concepts of this research which are food security, the food chain value (FCV), and disaster risk reduction (DRR). In addition, the chapter introduces the key terms that are essential for understanding food security, namely; food accessibility, availability, utilisation, and stabilisation. This chapter highlights the connection between food security, the FCV and DRR, which forms the basis for this study. The problem statement indicates the research gap that the study aims to address. Additionally, the objectives and methodology of this study are discussed to indicate the approaches that were followed in this study. The ethical considerations are highlighted in order to indicate the measures taken to minimise harm and prohibit misrepresenting research data.

1.2 Background to the study

There is increasing evidence demonstrating the connection between disasters and food insecurity (De Lange, 2015; FAO, 2013; Israel & Briones, 2013; WFP, 2012). For instance, the drought event in Australia in 2006 caused severe crop failure of 85%, which led to increased food prices that saw people unable to afford or purchase essential food such as fruits and vegetables (Heberger, 2012). A study conducted in Mozambique revealed that the flood disaster in 2007

affected 500 000 people whereby the food productions dropped drastically, hence, the World Food Programme (WFP)'s provision of food aids to 33 500 people (WFP, 2012). In 2011, South Africa experienced great flooding within seven provinces and 20 000 people were affected. These floods caused an outbreak of diseases including diarrhoea, malaria, and the Rift Valley Fever on livestock and the government and the Red Cross assisted the affected people with tents and food aids (Smith *et al.,* 2016).

The incidence of disasters has long-term consequences that have serious impacts on critical dimensions of human welfare such as education, poverty, and food security (Mercer *et al*., 2010; Nellemann *et al*., 2009). Poor communities are highly susceptible to suffer from disaster losses which include loss of lives, assets and livelihoods. This is because underprivileged people tend to live-in disaster-prone areas which are fragile to hazards and such people lack resources to cope with disruptions (Heberger, 2012; Noy, 2009; Schipper & Pelling, 2006). The level of exposure and lack of coping capacity accompanied by other dynamics like unemployment and poor access to basic services (i.e. water and sanitation) tend to result in a vicious cycle of poverty and food insecurity (Swartzendruber, 2014). Often, food insecure households' resort to coping mechanisms that are harmful and risky when faced with stress or shock. This includes reducing food quality and quantity, child labour, selling valuable assets at cheap prices and distress migration. Ultimately, these communities are confronted with food crisis when a disaster strikes (Hill & Pittman, 2012; Israel & Briones, 2013). The value of food chains is the ability to continue delivering value-added food regardless of disaster events (Hawkes & Ruel, 2012).

A disaster event affects the entire food chain i.e. food producers, manufacturers, distributors, and consumers (FAO, 2013). These effects can range from food decay, crop and livestock loss, damaged food processing infrastructure and reduced production capacity. Additionally, they disrupt market access, trade and food supply, reduce income, deplete savings and erode livelihoods; all of which reduce the value of food chains (Hawkes & Ruel, 2012; Hill & Pittman, 2012). Thus, the urgent need to reduce the adverse impacts of disasters on food systems and the environment. Moreover, this places emphasis on the need for integrated and multifaceted strategies that promote equitable and sustainable food security (FAO, 2019).

The complexity of food security highlights the need for multiple approaches and research from multiple disciplines (Ericksen *et al*., 2009). This will help to create an in-depth and holistic understanding of food security, which will result in effective policies and strategies to address food insecurity (FAO, 2019). The FAO, IFAD and WFP (2006) as well as Godfray (2010) indicate that no single profession or author can take accountability for addressing food insecurity, especially with the rapidly increasing population and food demands. With the global population being

predicted to reach 10 billion by the end of the century, it is without a doubt that sustainable and value-added food production is essential (Deloitte, 2015). Sustainable food chains reduce adverse environmental and economic impacts, while promoting sustainable food and nutrition security (Caldecott *et al*., 2013). The International Strategy for Disaster Reduction (ISDR) pointed out that food systems are threatened by various factors, with disasters as one of the biggest threats (Israel & Briones, 2013).

Recognising the impacts and the relationship between disasters and food chains is the first step towards developing sustainable food systems (Hill & Pittman, 2012). The level of consciousness by related role-players is vital to encourage the transition to practices that are based on a sustainable FCV for multiple benefits (Bolwig *et al*., 2010). The FCV offers an in-depth analysis of the strengths, weaknesses, opportunities and threats in relations to sustainability within the food system. In addition, the FCV analysis further explores strategies that improve food accessibility and affordability at local levels while ensuring revenue (Deloitte, 2015; Israel & Briones, 2013). The central idea of FCVs is to enhance food security through the sustainable use and management of natural resources which will contribute to strengthening livelihoods, maintaining healthy ecosystems and improving equity throughout the food supply chain (Bolwig *et al*., 2010).

1.3 The concepts of this study

The following section offers a discussion about the prominent concepts that will be used throughout this study, i.e. Food security, food chain value (FCV), and disaster risk reduction (DRR).

1.3.1 Food security

Food security is a major priority within all countries around the globe, especially developing countries (Altman *et al*., 2009; FAO, 2019). More than one in eight people globally have inadequate access to nutrients and proteins with micronutrient malnourishment as a concern (Godfray, 2010). In the year 2017, 821 million people globally were undernourished (FAO, 2017). Asia and Africa have the highest number of hunger and undernourishment with 515 million people in Asia and 256.5 million in Africa, respectively (FAO, 2017). Lack of nutrition results in more than 45% of deaths in children who are under the age of five years, while 66 million children in primary schools go hungry each year. Additionally, the World Food Programme (WFP) revealed that 3.2

billion dollars is needed each year to feed 66 million children in schools (WFP, 2012). Godfray *et al.* (2010) propose that the key is to transform the way that food is produced, processed, stored, and distributed in order to ensure that malnutrition is addressed. On the contrary, Hamann *et al.* (2009) posit that establishing an understanding regarding the components and dynamics of food security should be the first step to tackle issues of undernourishment and food insecurity. In order to understand what food security comprises of, the four pillars of food security must be unpacked, namely; availability, utilisation, access, and stabilisation (Berry *et al*., 2015). Altman *et al.* (2009) indicate that these pillars can serve as guidance to determine the state of food security.

The first pillar, i.e. *food availability*, is dependent on food production and the distribution thereof—it is about having adequate nutritious food (Berry *et al*., 2015). On a national level, the availability of food is based on domestic food production, imports and exports of food, domestic food stocks and food aids (Matuschke, 2009). At a household level, food availability is mainly based on food purchased at local markets or own household food production (Altman *et al*., 2009). For example, in most rural areas such as Lanao del Sur in the Philippines the local shops sell cheap but not necessarily nutritious food, and the residents purchase such products because of financial insecurities (Israel & Briones, 2013).

Food utilisation is the second pillar and it is about the amount, type and reasons why people eat a certain food (Barrett, 2010). Food utilisation is mainly focused on the concerns about the use of food acquired by households or individuals. This is determined by the knowledge concerning nutritional intake, consumption habits adopted by households, safety food handling and preparing, and socio-economic factors (Hamann *et al*., 2009). Households have different ways of preparing, consuming, and allocating food. In African households, it is common that women dish up for men first and the children after since men are perceived as the household heads. This is because most African women believe that men should not go hungry because they are providers and fear that men would stop providing should they (men) go hungry (Botlhoko & Oladele, 2013). This tends to increase food insecurity for women and children in such households. A positive food utilisation is linked to a healthy environment and proper sanitary facilities with awareness and understanding of healthcare, food preparations and storage processes (Ericksen *et al*., 2009). The manner in which households utilise food or resources is closely linked to the level of accessibility. For example, poor households tend to reduce meal portions or skip meals in order to stretch the food for a longer period or until the time of the next source of income (Matuschke, 2009).

The third pillar to determine the state of food security is *food accessibility*. Food accessibility means that all household members are able to acquire sufficient and nutritious food or produce

their own food based on their preference through appropriate resources (Mohamed Sayeed & Pillay, 2011). This is highly dependent on the prices, resources, household income, household size, and geographical distance to food outlets. Changes in these aspects may cause disruptions in food production and access strategies (Barrett, 2010). For instance, food access is threatened when droughts occur, whereby the harvest volume decreases and food prices increase significantly (Berry *et al*., 2015). According to the Crop Estimates Committee (CEC) in South Africa, the sorghum production is expected to reduce from 139, 000 million tons (2019/20) to 120, 000 million tons in 2020/21 (Esterhuizen, 2020). Gomez and Ricketts (2013) point out that food insecurity is not merely the result of failure to produce sufficient food on a national level, however, it is caused by failure to develop livelihoods that stimulate adequate food access at a household level. Hamann *et al.* (2009) emphasised that multiple livelihood strategies help households to have a long-term and stable food supply.

Lastly, *food stability* is the pillar that relates to the state of food and nutrition within households (Caldecott *et al*., 2013). When households have a constant level of food supply throughout the year and in the long-term, only then is stability achieved. This includes the ability of food, resources and income to withstand the effects of external factors such as disaster risk, price volatility and conflicts (Israel & Briones, 2013). Research conducted by the United Nations Standing Committee on Nutrition indicated that food insecurity is mostly a consequence of having limited or no access to food and resources that are available (UNSCN, 2013). It is worth noting that the food security pillars are inherently hierarchical whereby the availability of food is necessary, however, not sufficient to ensure accessibility, which in turn is essential but not necessary leading to effective utilisation (Hamann *et al*., 2009). Understanding these pillars will help us gain a better understanding of food security. This will assist researchers and communities to create effective strategies against hunger and other factors influencing food insecurity (Tirivangasi, 2018).

There are two types of food insecurity, i.e. chronic and acute food insecurity. *Chronic food insecurity* according to the FAO (2017) is about having inadequate food for a long period because of certain socio-economic or environmental issues, whereas *acute food insecurity* is the sudden unprecedented reduction of food access because of inevitable changes such as inflations, recessions, sickness, disability or death of the breadwinner. De Lange (2015:50) adds that “the prevalence of HIV/AIDS is a major cause of household acute food insecurity in Africa”. This is mainly because HIV/AIDS reduces the physical and emotional strength for food access or production and this destroys livelihoods. There is a high prevalence of chronic food insecurity in South Africa (Altman *et al*., 2009; De Lange, 2015). This is mainly due to lack of employment, poor integration of public and private food production sectors, high food prices, chronic diseases

like HIV/AIDS, complex trade environment and technical barriers (De Lange, 2015; Pereira, 2014).

Deloitte (2015) indicate that food systems are an umbrella for food security, therefore, it is important to understand the three elements of food systems. The first element is the ability to meet people's food needs through production, distribution or import. Secondly, the ability of food markets, inflations and politics to withstand adverse condition such as climate change in order to minimize vulnerability. Lastly, people must be able to attain and have access to food throughout seasonal changes without having cyclical food access.

1.3.2 Food chain value (FCV)

The world population is rapidly growing, and research predicts that the population will reach 10 billion by the end of the century (Deloitte, 2015). In effect, this will increase the strain on the global food supply and emerging food markets (Pereira, 2014). The demands of the population are ever changing and influenced by a variety of factors such as urbanisation, changing food consumption patterns, income instability as well as environmental and nutritional concerns (Godfray, 2010). Research shows that the consumption per capita of cereal is steady, however, the total quantities of cereals and meat need to double by the year 2050 in order to feed the population worldwide (Wood *et al*., 2010).

The United Nations Secretary-General pointed out that food productions need to increase by half by the year 2030 in order to feed the rapidly growing population (Israel & Briones, 2013). Although this is perceived as an effective approach to fight hunger, several scholars are worried about the food chain constraints and the environmental impacts (Canal, 2018). Deloitte (2015:6) state that "intensifying food productions may cause producers to make decisions based on short-term gains rather than long-term ecosystem loss and impacts". Moreover, high productions can lead to intensive irrigation, increased use of fertilizers and pesticides, mono-cropping and the use of transgenic crops (FAO, 2013). Sustainable food chains will therefore be a key factor in addressing food insecurity given the relationship between food security and the ecosystem (Deloitte, 2015).

Food chains are complex networks that link different stakeholders who produce, process, sell food and those who consume the food, through non-linear interactions (Pereira, 2014). A food chain is value-added when it is sustainable in a way that it considers social, economic and environmental impacts (Abecassis *et al*., 2018). The FCV must promote evenly distributed socio-economic benefits and growth to individuals. However, this may be difficult to achieve since the FCV involves a variety of people and factors (FAO, 2014). It is important to acknowledge that the

value of food chains are market-driven systems where vertical coordination (governance) plays a major role and that value-added cannot be viewed as separate from sustainability (Gomez & Ricketts, 2013; Hawkes & Ruel, 2012).

The FCV approach involves analysing the structure, role-players, and underlying forces of value chains; exploring the locations and typologies of role-players; the relationship between such factors; and the factors which facilitate or hinder participation (Gomez & Ricketts, 2013; Deloitte, 2015). Furthermore, the approach entails understanding the operational labour within a food chain and its continuous evolvement, the distribution of value-added products and the structure of rewards or threats (Bolwig *et al*., 2010).

The FCV offers diversity, whereby the Western/modern firms (e.g. agribusinesses, modern food markets, multinational food manufacturers) create their own chain or/and integrate with the traditional FCV firms (e.g. smallholder farmers, street vendors, mom and pop stores) (Gomez & Ricketts, 2013). The analysis of these chains specifically gained more attention when publications were mainly focused on improving the food production environments (Bolwig *et al*., 2010). The vast literature about different approaches and definitions on the FCV has made it challenging to grasp the bigger picture. Furthermore, the potential and limitations of practice-based learning regarding the development of the FCV are still limited (Hawkes & Ruel, 2012).

Achieving value-added food is essential because it directly affects business environments where FCV stakeholders operate (FAO, 2014). Thus, it is important to be able to understand the different internal and external factors influencing the value of food chains, which can be done by assessing the socio-economic dynamics, environmental deliverables and the future possibilities (FAO, 2017). This will help to create a better image of the gap between the current/actual performances of the FCV and the desired FCV performances while addressing the root causes that hinder its potential (Abecassis *et al*., 2018). Deloitte (2015) posits that this can be done by taking into account the following aspects: the link between the stakeholders and their activities with their socio-economics and the environments; individual factors that drive the stakeholder's behaviours within their businesses; and interactions and the manner in which value is determined at the end markets.

The FCV creates collaboration between the different enterprises as they work towards the production and marketing of products and services (De Lange, 2015). This collaboration is important and holds a significant impact on food security and safety (Scholtz & Von Bormann, 2016). Exchanging knowledge and expertise such as consumer trends, inventory levels and best practices for food storage helps to strengthen the FCV. On the contrary, interdependencies among enterprises are no longer closely linked within the chain since food safety and traceability

are becoming key issues (Pereira, 2014). Enterprises are responsible and must be held accountable for the handling, sourcing, safety, and quality of food in order to deal with any negativity or defaults in the products or services provided to consumers (FAO, 2013). The food chain stakeholders have been coping with climate change throughout the millennium, however, the frequency and extent of these changes are rapidly increasing and this means that the food chain stakeholders need to keep up with these changes (Candel, 2018).

1.3.3 Disaster risk reduction (DRR)

Disasters and food security are closely correlated because conflicts, disasters, and crisis can disrupt livelihoods, cause death, reduce productivity, increase food prices and cause displacement; all of which increase food shortages (Caldecott *et al*., 2013). Israel and Briones (2013) argue that disasters can promote food security. For example, the Vietnam floods in 2007 that occurred in the Mekong River Delta improved soil fertility, larger habitat for aquatic animals and fresh water for irrigation. Nonetheless, research shows that the adverse impacts prevail over the positive effects caused by disasters. Disasters tend to deprive people of the fundamental right to adequate and healthy food access. The meeting of COP21 United Nations Framework Convention on Climate Change (UNFCCC) held in Paris in 2015 revealed that food shortages are commonly caused by severe climate-change hazards, and this influence different dimensions of food security such as physical and economic access to food, availability and stability (FAO, 2017). Therefore, it goes without saying that the prevention and reduction of disaster risk is imperative to ensure resilient food systems that will in turn ensure food security (FAO, 2013).

Disaster risk reduction (DRR) is the application and implementation of policies, frameworks and practices that aim to reduce vulnerabilities, avoid and mitigate adverse impacts through planning and preparedness in order to protect lives and create resilience against disasters (Baas *et al*., 2008). The UNISDR (2004) defines DRR as a conceptual framework that focuses on minimising vulnerabilities and creating prevention, mitigation, and preparedness against adverse impacts of disaster events within the context of sustainable development. These definitions indicate that disaster risk is a combination of various factors (environmental, socio-economic, political and technological factors) together with human activities that create conditions of vulnerability (Baas *et al*., 2008; De Lange, 2015). The various researchers, agencies, and organisations contributed to the development of DRR with disaster preparedness, mitigation, response and resilience as core factors in defining DRR (Schipper & Pelling, 2006; UNISDR, 2015; Van Niekerk, 2008). The

focus area of DRR is eliminating risk through prevention and minimising the adverse hazard impacts rather than providing disaster relief (UNISDR, 2004).

Disaster risk management (DRM), on the other hand, focuses on implementing coping capabilities, policies and strategies by using administrative decisions, organisation, operational skills and capacities that reduce adverse impacts of hazards (Holloway, 2009). In addition, it is focused on the need for definitive facts whereby information sharing and communication flows are structured in a fixed manner rather than exercising flexibility and multi-sectorial communication with different points of view (Schipper & Pelling, 2006). DRM also constitutes of risk identification and risk mitigation intending to reduce risks and vulnerabilities. However, the downside of DRM as a discipline is that it tends to focus on applying the disaster management cycle (continuum) that illustrate a sequential cycle of how disasters occur and how implementation activities must be set to mitigate adverse impacts (UNISDR, 2004). This sequential cycle is illustrated in the figure below whereby flexibility is limited.

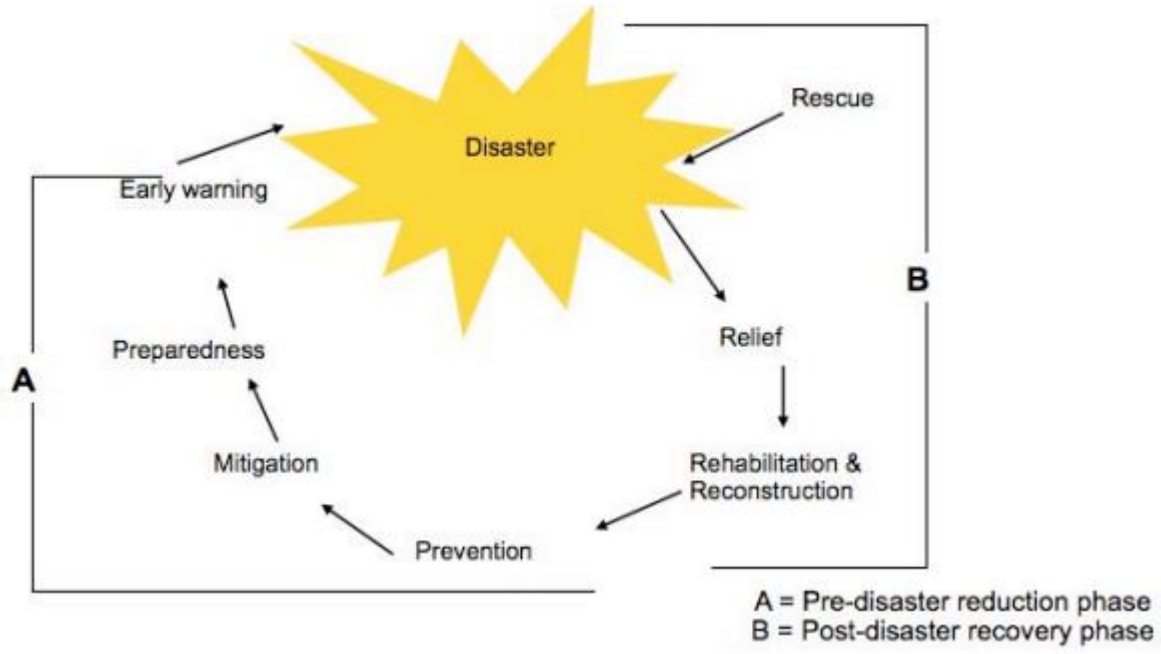


Figure 1-1: Disaster management cycle (Van Niekerk, 2011)

In DRR, flexibility, multidisciplinary and situational specificity form core building blocks (Van Niekerk, 2008). Several authors emphasise that more attention and focus should be placed on moving from disaster management to DRR (Baas *et al*., 2008; De Lange, 2015; UNISDR, 2004; Van Niekerk, 2008). DRR encourages governments, departments and businesses to integrate

risk reduction with sustainable development. Nonetheless, the costs and budget may cause constraints on developing countries that have poor resources (Holloway, 2009).

The definitions of DRR and DRM therefore indicate that DRM is the application of DRR in a way that DRM applies various coping capacities with the aim to reduce or eliminate adverse hazard impacts and place emphasis on the reduction of disaster risk (Schipper & Pelling, 2006). Van Niekerk (2008) pointed out that the success and effectiveness of these two approaches depend on the coordination and partnership of different spheres such as government, research units, private organisations and civil society to create a cornerstone towards the reduction of disaster risk and resilience building.

1.4 Problem statement

There is vast research conducted based on food security and DRR, however, only limited research focuses specifically on the integration of DRR and the FCV in South Africa (Scholtz & Von Bormann, 2016). Although there is growing evidence of the socio-economic and environmental benefits of the integration of DRR and the FCV and its potential towards securing a resilient future, the current policy structures and frameworks of South Africa offer limited support of the greater uptake of this integration (Scholtz & Von Bormann, 2016; Tirivangasi, 2018). Moreover, the progress stakeholders along the food chain are slow to apply integrative approaches that would promote resilience and sustainability of food chains. Furthermore, the food industry stakeholders (i.e. producers, manufacturers and distributors) and Disaster Risk Management officials tend to work separately, which indicates the lack of interaction between different but related departments (De Lange, 2015; Hamann *et al*., 2009). Consequently, the occurrence of disasters (floods, drought, earthquake etc.) threaten the functions of food chains, which can lead to food shortages (FAO, 2008; FAO, 2019). The FAO (2013) indicated that the food systems are becoming more fragile to disaster risk and disruptions. Therefore, it is important to protect livelihoods and make food systems more capable of absorbing the disaster risks while creating value-added products (Hill & Pittman, 2012).

The fact that there are no specifications and accepted approaches for measuring food security in South Africa nor regulations for monitoring it is a call for multi-sectorial interaction (Mohamed Sayeed & Pillay, 2011; Swartzendruber, 2014). In South Africa, researchers apply different methods in assessing food security, which depends on the purpose and goals of the study and this includes Food Insecurity and Vulnerability Information and Mapping System (FIVIMS); General Household Survey (GHS); National Food Consumption Survey (NFCS); and Community

Survey (CS). Although these approaches are effective, they tend to cover only a limited or certain aspects of food security rather than offering a holistic research coverage (Johnston, 2019; Koch, 2011; Mohamed Sayeed & Pillay, 2011).

The South African government has established several national policies to ensure food security, however, these policies fail to recognise and integrate disaster risk management as a core factor in ensuring food security (De Lange, 2015; Koch, 2011). The national food security includes the Food security and Nutrition Policy (FSNP), the Integrated Food Security Strategy (IFSS) and the Zero Hunger Programme (ZHP). Despite these strategies, several South African citizens go hungry on a daily basis. The Statistics South Africa (2019) revealed that 6,8 million South Africans experienced hunger in 2017. The FAO (2014) indicate that the lack of communication between various sectors and the public hampers the effectiveness of food security initiatives globally, including South Africa. Therefore, this study emphasises on the need for a holistic approach to enhance food security, given the dynamics and uncertainties in the FCVs.

The context of DRR is multidisciplinary and offers a holistic approach because it is grounded on risk identification and analysis before establishing mitigation strategies, consequently, food security can be enhanced by identifying the potential risks, exposure and factors contributing to the vulnerability of the value chain (De Lange; Mercer, 2010). Food producers face many uncertainties, especially when it comes to weather-related hazards, climate change and food safety (contaminations) (Drimie & Pereira, 2016). Although most food producers have an interest in moving towards sustainability and resilience, often core strategies are not aligned with sustainability but are an “add-on” factor (Deloitte, 2015; FAO, 2013). Risk management is a major issue in the food production sector; this includes internal risk factors within the sector and external environmental factors. The problem is that disaster risk management is poorly practiced within the South African food production sector (Scholtz & Von Bormann, 2016). This can be observed in the South African Listeriosis outbreak which disrupted the food chain, particularly the manufacturer who as the food chain stakeholders compromised the health and lives of consumers (Tambo *et al*., 2018). Overall, the outbreak put emphasis on the need for an integrated approach towards preventing, reducing and facilitating risks early in the stages of food chains. This Listeriosis outbreak is used as an example to emphasise the importance of risk reduction within the FCV.

The main research question that this study will therefore aim to answer is how the integration of the food chain and DRR can enhance food security in South Africa, focusing on the recent South African Listeriosis outbreak as an example to highlight the extent of disaster impacts in the food chain.

1.5 Research objectives

This research study aims to explore the integration of the FCV and DRR for enhancing food security, while focusing on the Listeriosis outbreak in South Africa. To reach this aim this study is based on six (6) research objectives that will be used to address the research problem.

The research objectives are as follows:

- To explore the relationship between the FCV and DRR;
- To investigate how the underlying factors of the FCV influence food security;
- To explore how DRR legislation and statutory frameworks integrate the FCV for improved food security in South Africa;
- To investigate the impacts of the Listeriosis outbreak on food security in South Africa;
- To explore how the integration of the FCV and DRR can enhance food security; and
- To make recommendations for enhancing food security through the integration of DRR and the FCV.

1.6 Research methodology

Research methodology is a process that indicates the manner in which a research is or/and was undertaken (De Vos *et al*., 2012). This section provides a detailed discussion of the research methodology that will be utilised for the purpose of this study. A detailed discussion on the literature review, empirical study, research design, sampling, data collection, data analysis, validity and reliability, and ethical consideration is provided below.

1.6.1 Literature Review

A literature review is a process of reviewing existing data including theoretical frameworks, hypothesis, methodologies, and substantial findings on a certain topic (Hart, 2018). This serves as secondary data since it does not provide new work, but rather a body of knowledge that can be linked to the research under investigation (Braun *et al*., 2014). Hart (2018) highlight that reviewing literature helps the researcher to identify gaps, inconsistencies, and contradiction that may exist within a certain subject. The purpose of conducting a literature review for this study is to identify the relationship between ideas and practice while rationalising the theoretical and practical significance of the FCV and DRR. This creates a rich understanding that forms the foundation for this study by exploring the current trends in the FCV, DRR and food security.

A literature review guides the researcher in terms of finding relevant and meaningful sources (Hart, 2018). Various sources used for the literature review such as academic journals, books, government and department publications, internet sources and published thesis/dissertations relating to the FCV and DRR. For the most part, South African sources were used since the study area is in South Africa, nonetheless, international papers were also used as supporting literature. A desktop study was conducted (see Chapter 2) in order to build an extensive literature investigation that addresses the first and second research objectives i.e. (1) to explore the relationship between the FCV and DRR, and (2) to investigate how the underlying factors of the FCV influence food security. Thereafter, the study investigated the legislative and statutory provisions pertaining to DRR and food security to address the third research objective i.e. to explore how DRR legislation and statutory frameworks integrate the FCV for improved food security in South Africa (see Chapter 3). Chapter 4 focused on the Listeriosis outbreak to address the fourth research objective i.e. to investigate the impacts of the Listeriosis outbreak on food security in South Africa. The following section focuses on the empirical investigation of the study.

1.6.2 Empirical study

The empirical study is grounded in acquiring information using experiences or observations (Braun *et al*., 2014). The main factor in empirical studies is that observations or experiences can be properly operationalised using research questions. It uses actual experiences or observations to create or enhance knowledge (Hart, 2018). This can be done by applying a qualitative or quantitative research design depending on the researcher's questions and aim (De Vos, 2012). The discussion of data analysis and interpretations is presented in Chapter 5 to address the fifth research objective i.e. to explore how the integration of the FCV and DRR can enhance food security.

1.6.3 Research design

This study utilises a qualitative research design. A qualitative research design will be used because the study aims to understand and explore the relationship between the food chains, DRR and food security. This research design is fruitful for explaining the in-depth mechanisms and linkages within DRR and value chains, while a quantitative research design would not stimulate this in-depth analysis. Moreover, this design provides flexibility in terms of data collection as opposed to quantitative, which is more structured in nature (Hart, 2018). A qualitative research design is used for conducting research based on social phenomena through observations and

human experiences (De Vos, 2012). This design helps a researcher to evaluate the subject matter with deeper detail due to focus on the details of the collected data and less attention on speculative data (Hart, 2018).

1.6.4 Data collection

Data collection is a process of gathering information from different sources whether through a literature review or empirical studies in order to evaluate outcomes or answer questions (Hart, 2018). There are various qualitative data collection methods which include semi-structured and unstructured techniques including, interviews, participation or observation (Braun *et al*., 2014). Theoretical data is collected through scientific journals, books, internet and other academic sources, while empirical data will be collected using questionnaires.

The researcher had initially planned to conduct face-to-face interviews with all participants, however, due to the Coronavirus pandemic and the restrictive regulations thereof, the data collection approach was reformed. A questionnaire was then developed with 22 open and close-ended questions and this questionnaire is included in Annexure A at the end of the dissertation. The questionnaires were sent to participants via email for them to self-administrate and return once completed. However, very little response was received using this approach. Nonetheless, there were slight improvements after several reminder messages were sent to participants. The number of the received responses was still inadequate. In light of this, the researcher opted for telephone interviews which resulted in higher but also inadequate responses particularly from the food chain stakeholders. After numerous attempts, the food chain stakeholders revealed that they preferred face-to-face interviews because this closes the gap of clarity seeking questions that may not be understood through self-administration. As a result, face-to-face interviews were conducted with these stakeholders (particularly from retail stores) after seeing that these participants were reluctant to self-administrative questionnaires and telephone interviews. The Coronavirus lockdown was then at level 3 and the regulations and restrictions were adhered to, which included but was not limited to the wearing of mask, sanitising, avoiding physical contact, and maintaining social distancing of 1.5 meter. The application of the three abovementioned data collection approaches resulted in sufficient responses/data. The semi-structured questions were used because they give the interviewee a platform to elaborate on other things that the researcher might be missing while having less bias from the researcher. Furthermore, the questions were predetermined based on the research objectives while some of the questions emerged during the pilot study that was conducted with three respondents (a disaster management official and two

food chain stakeholders). The empirical investigations were conducted within the province of Gauteng in South Africa since it was revealed that this province had the most reported cases of Listeriosis with 581 (61%) people infected (NICD, 2018).

1.6.5 Research sample

A research population is the large target of participants that assist to develop generalized findings for a research study. This large target usually shares common characteristics that are of interest for data collection (Hart, 2018). Often, the population size is too large which presents challenges for the research to entirely cover this size, hence a sample is developed from the population group. The population of this study is based on the food chain stakeholders (i.e. producers, manufacturers, distributors) and the disaster risk management actors who are located in the Gauteng Province of South Africa because this area had the highest number of reported cases (581) according to the National Institute for Communicable Diseases (NICD) (NICD, 2018).

Sampling is defined as the approach to narrow down the target group to represent the total population group (De Vos, 2012). A non-probability sampling method was utilised because with this method participants are selected based on the research aim and objectives. None-probability was used because the researcher wants to select sector units from the interested population that is being studied and it is not feasible to do random sampling since the research question require specific knowledge or experience to achieve the research aim and objectives. Purposive and snowballing are the types of non-probability sampling techniques that were used because they enable a fruitful selection of participants that are appropriate for the purposes of the research. Purposive sampling is a non-random sampling approach to recruit the relevant participants who have variables that are connected to the research aim and questions (De Vos *et al*., 2012). Firstly, the purposive sampling technique was used to recruit personnel in the National Disaster Management Centre (NDMC), Department of Agriculture Forestry and Fisheries (DAFF), Enterprise Company, and major food retailers (Shoprite, Pick ‘n Pay, and Spar). Major food retailers such as Spar, Pick ‘n Pay and Shoprite are of great importance since they provide food access and are responsible for distributing food to consumers as in the case of the Listeriosis outbreak where the contaminated products had to be removed from the stores and recalled from consumers. The DAFF is focused on establishing food security policies and food safety regulation, specifically on agricultural productions, while the NDMC coordinates the promotion and integration of disaster management and risk reduction approaches across the three spheres of government and state entities in South Africa.

Secondly, snowball sampling is a non-probability sampling technique that is utilised when the researcher begins with a small group of participants who then recommend other relevant participants to expand on the sample size (Hart, 2018). This technique was used for recruiting participants who acted as substitutes for purposive participants who were unable to participate and to recruit those who were able to contribute valuable information of which they were not known by the researcher. For instance, the managing director of Enterprise, Chief Directors from the NDMC, and a Spar store manager, were not available and the relevant representatives were recommended.

The researcher aimed to initially recruit thirty (30) participants where 35 people were sent invitations to participate in this study. The researcher had planned to distribute self-administrative questionnaires and conduct interviews. A total of 15 self-administrative questionnaires were sent out to participants where only five (5) participants completed and returned the questionnaires. Telephone interviews were initially arranged with 10 participants, but only eight (8) were interviewed at the end. Due to the Coronavirus pandemic and the restriction regulations thereof, most departments were not fully operational whereby several employees were not reporting to their offices. This meant that the researcher was unable to conduct physical interviews nor telephone interviews with those who were out of office at that period. Nonetheless, major retail stores were operating whereby 10 participants within the food chain were interviewed face-to-face. Overall, the pandemic had major impacts on data collection methods and the sample size. Nonetheless, the final sample size was a total of twenty-three (23) participants. Specifically, six-teen (16) participants were food chain stakeholders (managers or supervisors from Shoprite, Spar, Pick ‘n Pay, farmers, and Enterprise); five (5) participants from the NDMC (disaster risk management officials within various directorates); one (1) participant from Enterprise (quality risk manager) and one (1) participant from the DAFF. Guidelines criteria for sampling participants was developed to ensure that relevant and appropriate participants were recruited. Participants were recruited based on these criteria relevant occupation; all gender types and adult age groups; and located within the study area which the Gauteng province. Consumers were excluded from participating in this study due to the adverse impacts and sensitivity of the Listeriosis on the infected or affected.

1.6.6 Ethical considerations

This research study acknowledges the importance of sensitivity and ethical deliberations when commencing in cross-cutting research subjects. Therefore, an ethical approval letter was

obtained from the researcher's study institution (North-West University) which indicated that this study is categorised under minimum risk impacts towards participants (see Annexure B). The following ethical considerations were considered while carrying out the data collection and the research study as a whole (Braun *et al*., 2014):

- Assured participants of their privacy, anonymity and confidentiality regarding information gathered during the study.
- Informed participants about the aim, purpose and procedures of the study without deceiving anyone.
- Participation took place on a voluntary basis, with the consent of the participant and without any form of pressure.
- Ensured that there are no physical and/or psychological harm on participants.
- Ensured free-will of participants in taking part in this study to withdraw from the research at any time when one feels uncomfortable.
- Analysis and reporting of data were conducted based on an ethical research method. The researcher has acknowledged the participants and sources that are constituted in this study.
- This study is not based on anonymity because the researcher personally identified the participants through purposive sampling with the aim to acquire the right information from the right people. Telephone and emails are included in the data collection methods which means this is not an anonymous study.
- The participants were identified by the researcher however, they will not be exposed to people outside this study. All the participants remained anonymous which means that no personal information was revealed. This includes, but is not limited to names, home address, telephone contacts, photographs, and identity number. The confidentiality of these participants was further accentuated in the consent form to ensure that their discretion is protected.

1.6.7 Rigour / Validity & reliability

The aspects of validity and reliability influence a research study in a way that can increase or decrease the value and quality of a study. Validity is the extent to which a concept or approach is accurate and realistically while reliability is the extent of consistency in a research study (Hart, 2018). The research methods used for this study are reliable i.e. the researcher has applied the qualitative research techniques throughout the study and if another person were to use the same methodology to collect data then the results would be similar to that of this study. In terms of validity, the study aimed to investigate the relationship between DRR and the FCV and how this

contributed to food security. According to the literature review it was revealed that DRR and the FCV are interlinked and there are multiple benefits of integrating the two in order to enhance food security (see Chapter 2). This is aligned with the results obtained from the participants who have emphasised the need for integration and the challenges for the integration gap. The desktop study and the literature review has assisted the researcher to gain a theoretical foundation for guidance on how to approach the research study. The researcher focused on the study aim and objectives while refraining from being bias when collecting and analysing data.

1.7 Significance of the study

The purpose of this study is to promote the policy integration towards improving food security. This research is influenced by the fact that there are poor partnership and collaborations between various sectors, professions, and policy structures when it comes to addressing humanitarian issues in South Africa (Llosa and Zodrow, 2011; Manyena, 2013; Van Riet, 2016). Each sector is merely focused on its function line while ignoring other focus areas that may have an indirect influence on the sector (De Lange, 2015). This has also increased policy duplication that in turn leads to a waste of resources (e.g. financial, infrastructural and human resources) and capacity building. This is a problem because food security is shaped by multiple factors which makes it complex, therefore, integration is key (Berry *et al*., 2015; Bolwig *et al*., 2010; Caldecott *et al*., 2013). One of the biggest challenges that threaten food security are disaster events. The increasing frequency and extent of disasters and their adverse impacts on food systems tend to threaten food security (Ashley, 2018). This study emphasises the inseparableness of food security, FCVs and DRR and the benefits of their integration. Furthermore, the multidisciplinary and multidimensional context of this paper serves to create sustainable development growth.

1.8 Chapter division

This study is divided into six (6) chapters that were predetermined based on the research objectives. The following section provides a summary of the essence of each chapter.

Chapter 1: Introduction and orientation

This chapter consist of an introduction to the study with a brief background on food security, the FCV and DRR. Chapter 1 also offers a discussion of the problem statement that leads to the need of this study, which is lack of integration towards ensuring food security in South Africa. The researcher indicates the objectives of the study and the proposed methodology to show the approach that was followed to address the research problem.

Chapter 2: The relationship between food security, FCV and DRR

Chapter 2 provides the theoretical ground with extensive literature on food security and DRR and the relationship between food security and DRR, while aiming to attain Research Objectives 1 and 2 i.e. (1) to explore the relationship between the FCV and DRR, and (2) to investigate how the underlying factors of the FCV influence food security. It reveals that disaster risk and food chains are closely correlated whereby food chains have become fragile towards disasters, thus, the need for capacity and resilience building. The key challenges and constraints of food security and the food systems in South Africa are to be discussed in this chapter; this includes a multidisciplinary approach, culture, changing patterns and agricultural practices. This is noted as important because these challenges serve as barriers towards ensuring sustainable food security.

Chapter 3: Legislative and statutory integration for food security

Chapter 3 aims to address Research Objective 3, i.e. to investigate the prevailing DRR legislations and frameworks that consider and incorporate the FCV in South Africa. This chapter offers sections on the leading international and national DRR legislation, as well as food security policies. The national DRR legislation and structures include the Disaster Management Act (DMA), the National Disaster Management Framework (NDMF), the National Disaster Management Advisory Forum (NDMAF), and the NDMC, while the food security policies include the IFSS, ZHP, and FSNP. Furthermore, policy integration challenges and benefits are discussed whereby international and national integrated food security and DRR policies are also conversed (i.e. FAO, WFP, Group-Global Environment Facility etc.).

Chapter 4: Listeriosis and its impact on food security

This chapter is focused on the Listeriosis outbreak to address the fourth research objective i.e. to investigate the impacts of the Listeriosis outbreak on food security in South Africa; and the effectiveness of emergency response for this outbreak. It was revealed that the outbreak influenced households' food security in the sense that their food accessibility (e.g. inability to purchase product due to recall), availability (e.g. stopped production of product), and stability (e.g. changes in budget and daily diets) was compromised when the popular ready-to-eat products became contaminated and later recalled.

Chapter 5: Data analysis and interpretation.

Chapter 5 is focused on addressing the fifth research objective i.e. to explore how the integration of the FCV and DRR can enhance food security. The data collected through interviews and questionnaires were analysed and interpret to represent the findings. The thematic analysis was used to create five themes were used to discuss the results from the respondents while aligning this with the literature from the previous chapters (1, 2, 3, and 4). All the respondents indicated that disasters threatened the functions within food chains which ultimately has negative influence on the state of food security.

Chapter 6: Conclusion and recommendations

The final chapter concludes this study and aim to reach the last research objective, i.e. to make recommendations for enhancing food security through the integration of DRR and the FCV.

CHAPTER 2: THE RELATIONSHIP BETWEEN FOOD SECURITY, FCV, AND DRR

2.1 Introduction

The previous chapter (Chapter 1) provided the background study, problem statement, and research objectives which have laid the foundation for this study. Chapter 2 offers a literature review on food security, FCV, and DRR in order to identify the knowledge gap from previous studies, while identifying windows of opportunities that need to be explored. This chapter aims to address research objectives one and two, i.e. (1) to explore the relationship between the FCV and DRR, and (2) to investigate how the underlying factors of the FCV influence food security. This chapter begins with discussing the state of food security in South Africa to understand the underlying factors and challenges of establishing effective approaches that address the issues related to food insecurity. Secondly, the relationship between the FCV and DRR are discussed to show the influence of disaster risks within the entire FCV (i.e. producers, manufacturers, distributors, and consumers). The third section is focused on indicating the benefits of integrating DRR into the FCV which includes practical cases of such benefits from international examples.

The fourth section discusses the influence of disasters on food security (i.e. availability, accessibility, utilisation, and stability). Lastly, this chapter concludes by providing a brief discussion of the key challenges towards sustainable food systems which serves as barriers to ensure food security. These challenges cannot be effectively addressed through a single sectorial approach due to the complexity of the underlying dynamics (Caldecott *et al*., 2013). Godfray (2010) says that each country has distinctive characteristics or conditions which means that international strategies need to be altered according to the conditions of a specific region. Therefore, the first section of this chapter begins with a focus on the state of food security in South Africa.

2.2 The state of food security in South Africa

Research indicates that South Africa is food secure on a national level however, on household level it is food insecure (Ngandu *et al.,* 2010). Food security on a household level refers to when all family members have adequate food daily without threatening their food accessibility (Altman *et al*., 2009). Food security is further characterized as being able to acquire food acceptably, being able to eat balanced daily meals, and the ability to eat enough food without having to stress that

food would run out (Shiferaw *et al*., 2014). On a household level, food access is mainly dependent on markets and distribution systems, while on a national level the Gross Domestic Product (GDP) is the major factor in shaping food access (Altman *et al*., 2009).

The General Household Survey of 2016 illustrated that hunger rates for individuals in South Africa declined from 29.3% to 13.4% from the year 2002 to 2016 (Stats SA, 2016). This indicates positive efforts by the government, the food industry and other humanitarian organisations (e.g. The World Wide Fund for Nature, World Food Programme, Oxfam, and the International Federation of Red Cross and Red Crescent Societies) in fighting against hunger and undernourishment in South Africa. Nonetheless, the presence of hunger and undernourishment is still a serious concern in the country (Pereira, 2013). Hunger is a sensation experienced in the stomach with the need to eat, while undernourishment involves insufficient intake of micronutrients such as iron, vitamins, and proteins (Nellemann, 2009). Undernourishment is a condition where an individual consumes insufficient food or nutrients according to the required for dietary energy and the condition usually lasts for a year or longer (Shiferaw *et al*., 2014). Undernourishment and hunger have long-term effects on human health and development such as malnutrition, stunting, impaired cognitive development, a weakened immune system, low labour productivity, and poor school performance (Pereira, 2014). A healthy and balanced regular diet can assist in fighting against undernourishment, but this requires having adequate income for purchasing a variety of healthy food. Therefore, the prevalence of undernourishment in this country highlights that research and strategies aiming to combat household food insecurity need to be intensified (Abecassis *et al*., 2018).

The National Food Self-sufficient index indicated that the country produces enough food and is nearly self-sufficient in some major food products, and therefore is a net exporter of some agricultural products like corn, fruits and wool (Altman *et al*., 2009; Von Bormann, 2017). The Constitution of the Republic of South Africa of 1996 under Section 27 (1) (b) states that every citizen has the right to adequate food and water (RSA, 1996). This entails that food should be available, accessible and sufficient for all citizens without any discrimination. However, in 2016 research indicated that 22.3% of South Africans had severely inadequate access to food (Stats SA, 2016). This indicates that although sufficient food is produced at a national level, it does not necessarily mean it is also translated to household food security (Altman *et al*., 2009).

Previously, the South African Census (2011) indicated that 20% of South African households were involved in agricultural practices. Nonetheless, due to the lack of agricultural equipment, skills, and finances, most of these households still struggle to survive on agricultural productions alone (De Cock *et al*., 2013). In 2019, only 15.3% households were practicing agricultural activities (Kamer, 2020). Households that produce their food have the advantage over food

insecurity however, this does not necessarily make them food secure (Botai *et al*., 2016). Vulnerability to food insecurity in South Africa is mostly due to high poverty rates, especially in rural and informal settlements (Altman *et al*., 2009). Vulnerability occurs when people have a lack of resources or when resources are poorly managed (Ngandu *et al.,* 2010). In 2016, an estimated number of 26.6% of people in South Africa were unemployed, inhibiting these households from producing or buying enough healthy food to feed themselves (Botai *et al*., 2016). Since many South African households are vulnerable to food insecurity, the food industry must understand various influencers which include the increase of climate change-related hazards such as floods, drought and veld fires. This is important because climate change has increased the stress on food chains, which intensifies the vulnerability to food insecurity (Pereira, 2013). Caldecott *et al.* (2013) indicates that comprehensive effects that modify the FCV are a result of collective factors emerging from environmental risk. To overcome these challenges, strong food chain systems are needed to mitigate risk dynamics and meet the pressure demands. In this regard, various risk management and coping capacity strategies assist to protect food chains that are at risk, while strengthening the ones that are regarded as safe to a certain degree (Hill & Pittman, 2012).

2.3 The relationship between FCV and DRR

There are several studies based on the relationship between environmental risk factors (e.g. water scarcity, climate change, and land degradation) and agriculture due to the high dependency on agricultural productions for food and income (Caldecott *et al*., 2013; Canal, 2018; Hill & Pittman, 2012; Israel & Briones, 2013; Lobell *et al*., 2008; Scholtz & Von Bormann, 2016). The negative impacts of disasters experienced in Africa, including South Africa, and the high dependency on agriculture for food security and livelihoods pose serious challenges on the FCV (Deloitte, 2015). Nonetheless, it is important to note that environmental risks influence the entire FCV and not just agriculture (Pereira, 2013).

The integration of DRR into FCVs assists to minimise and/or prevent adverse impacts of hazards while reducing the risks that hinder the optimal function of the FCV. This approach applies risk analysis within the FCV and prioritise DRR interventions (Hill & Pittman, 2012). The following section discusses the relationship between the FCV and DRR by breaking down the FCV (producers, processors, distributors, and consumers) to optimally understand the underlying challenges and the connection between the FCV and DRR (Canal, 2018). Figure 2-1 below illustrates how the FCV stakeholders and the related activities are connected and influenced by DRR. KPMG (2012) indicates that the food sector is one of the least prepared for future megatrends, such as natural disasters and climate change. Thus, analysing the FCV from the

perspective of DRR is crucial for addressing the threats in the food chain, promoting sustainable value-added products and ensuring resilience (Hill & Pittman, 2012).

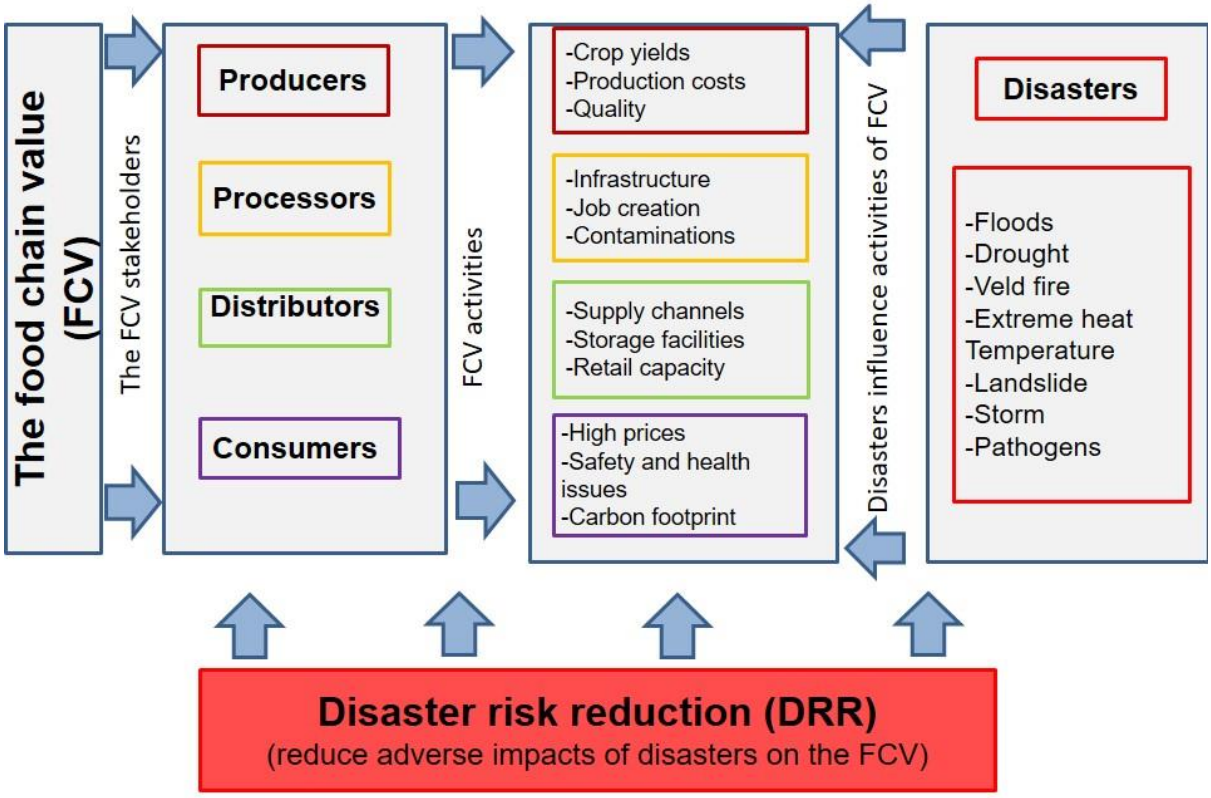


Figure 2-1: The relationship between the FCV and DRR (Adapted from: Deloitte (2015) and FAO (2019))

2.3.1 Food producers

Each year livelihoods and agricultural productions are destroyed due to disaster events and this contributes to the risk of food insecurity (FAO, 2019). Some disaster events occur in isolation, in simultaneous combination, or with mutually magnifying effects. Even so, food producers need to deliver a large amount of food that is of good quality (according to standard requirements) despite unfavourable conditions such as climate change and competition for resources like water and land (Abecassis *et al*., 2018). For instance, the 2007/8 Eastern Cape and Free-State drought in South Africa caused an increase in food production costs by 25% for smallholder farmers and 22% for large-scale farmers, which reduced the availability of locally produced food within these provinces (Ngaka, 2012). The FAO (2017) revealed that the food system is likely to continue suffering if proper measures are not implemented. Pereira (2014) went on to say that farmers

have changed their focal point from focusing on things they can produce to focusing on producing things they know will sell. This is important because the consumers' needs evolve with time, and it is the producers' responsibility to deliver on those needs (Pereira, 2013). The following subsections discuss how key aspects of food producers (crop yields, production costs, and produce quality) are influenced by DRR.

2.3.1.1 *Reduced crop yields*

The natural environment along with the ecosystem, provides value which cannot be quantified because it makes it possible for all biotic organisms to live (FAO, 2017). The state of the environment can influence the food chain through the provision or non-provision of resources such as water, soil, and climate conditions. Furthermore, the environmental state and the ecosystem affect the occurrence of pathogens, pests, and weeds, all of which influence the availability, quality, and quantity of food (Von Bormann, 2017). It is therefore crucial to note that promoting healthy ecosystems enhances sustainable food productions.

Water is one of the key components limiting crop yields and food productions (FAO, 2017; Kwasek, 2012). A study conducted by FAO (2017) revealed that 40% of the world's food is produced on land that uses irrigation systems. In addition, Scholtz and Von Bormann (2016) publicised that irrigation increases crop yields with two to three times higher than rain-fed crop yields. In South Africa, water availability differs across provinces with the eastern side of the country receiving more rainfall compared to the western side of the country. South Africa is a water-stressed region whereby more than 60% of the country's water is used for crop irrigation (Carter & Gulati, 2014; Scholtz & Von Bormann, 2016). Therefore, when water sources become stressed crops turn out to be exposed to significant risks. This includes crops such as maize and wheat which significantly contribute to food security, while other crops such as grapes and oranges are exported which contribute towards income that is used for importing other crops not grown in South Africa (e.g. rice) (Pereira, 2013). Due to the high demand of water in the agricultural industry and the impacts of disaster events in South Africa, the legislation regarding food systems and food security need to consider the issues around water sources in this country (De Lange, 2015).

The fact that the agricultural sector is mainly dependent on weather and climate conditions, land and water, makes it highly vulnerable to disasters and climate change (FAO, 2017). Hot temperatures and high precipitation lead to increased evapotranspiration and reduced soil moisture profile (Scholtz & Von Bormann, 2016). Crops require certain temperatures to grow and

this differs according to plant variety. A crop will not reproduce given that the temperature is outside the required range. For instance, soybean will not reproduce in temperature above 38.8 Celsius degrees while maize must not be planted at more than 35 Celsius degrees (Carter & Gulati, 2014). KPMG (2013) points out that fluctuating crop gains and shortfalls in supply is mainly shaped by harsh climate conditions. Disasters are harmful to livestock health, crop growth, fisheries and aquaculture productions which reduces animal productivity, fertility and weakened immune systems, leading to susceptibility to diseases (FAO, 2017). Drought and heat waves result in long-term water shortages that cause stress to crops which reduces the number of yields, particularly when these occur at the initial stage of the plant life-cycle (Israel & Briones, 2013). In Southern Africa, most rain-fed crops are most likely to decrease in yields because of the maximum capacity to tolerate high temperatures (Carter & Gulati, 2014). Research conducted by the Crop Estimates Committee (CEC) shows that 30% of maize will be lost due to climate change in Southern Africa by the year 2030. The agricultural industry absorbs more than 80% of the damage and loss caused by drought. Nearly half (49%) of these damages become absorbed by crops, while 36% damage become absorbed by livestock (FAO, 2017).

Pereira (2013) acknowledges the rapid reduction of staple crops due to climate change and disasters, and proposes that food producers and manufacturers need to work together to produce high nutrient food using traditional crops (e.g. sorghum) that are more tolerant to climate change as compared to rain-fed crops (e.g. maize). Furthermore, diversification of agriculture is a method that can be used to cope with the shocks of exposed to crops (Kwasek, 2012). The greater the variety of species in an ecosystem the higher the chances that most of the species will cope with the unpredicted environmental changes. The diversification of crops reduces the development of organism-hosts that cause diseases and pests (FAO, 2014). Ultimately, this promotes adequate food production and food security. For those who have limited resources, monotonous diets seem to be a common option however, this causes a low metabolism due to lack of micronutrients in a monotonous diet. Finance and farming resources such as adequate land and water can help transform monotonous diets into diversified diets (Kwasek, 2012). Food availability in South Africa differs in all nine provinces; households in the Western Cape Province have the highest diverse food consumption as compared to all other provinces (Labadarios *et al*., 2011; Shisana *et al*., 2013). Poverty and income are key issues that shape food accessibility for South Africans (De Lange, 2015).

The Labour Force Survey (2016) indicate that the agricultural sector is responsible for employing 876 000 people in South Africa, which is important because those households can use salaries to purchase food and other goods that will promote food security (Abecassis *et al*., 2018). In addition, workers develop technical skills that may be used to start small farming businesses or

home gardens (Kwasek, 2012). Therefore, the decline of production flows poses serious threats to household income and food security (FAO, 2017). Research and innovation are needed to help producers to enhance crop yields, production efficiency, and keep up with the consumers' demands (Pereira, 2013). This requires close cooperation with other food chain stakeholders, especially the retailers since they have close connections with consumers (Deloitte, 2015). This collaboration is linked to better quality and increased yields which strengthen food security through enhancing food availability, access, and stability (Abecassis *et al*., 2018; Pereira, 2014).

2.3.1.2 *Increase production costs*

Capital has become an issue for producers in the 21st century due to the unstable markets and harsh weather conditions as mentioned above (Pereira, 2014). Globally, the majority of food producers are smallholder farmers and they produce nearly 70% of the food however, they face difficulty in terms of economic limitations (Deloitte, 2015). This is mainly due to the intense resources and capital investment required to successfully operate a farming business. Consequently, it is not easy for small producers to enter and participate in national or international market channels (Pereira, 2014).

According to the Crop Estimate Committee (CEC), the damage caused by disasters in the agricultural sector cost millions (FAO, 2017). Damages caused by disasters might include facilities, machinery, tools, strategic inputs of water and electricity, temporary labour issues, lack of capital, and other key infrastructure which may cause deprived farmers to be unable to resume production systems and activities after a disaster event (Deloitte, 2015). After or during a disaster, the damage in the processing sector is determined by calculating the cost of restoring or enhancing assets and facilities to the state of quality that existed before a disaster (Scholtz & Von Bormann, 2016). These costs include replacing or fixing various things such as the production facility, equipment, and crops or livestock. Furthermore, the number of employees and working overtime may have to be increased (depending on the damage severity) to address the damage in the facility (Kwasek, 2012). In February 2011, South Africa experienced floods that led to severe crop and equipment damage which caused R2.8 billion damage in agriculture where the Northern Cape sustained high impacts that amounted to R1.8 billion and other provinces shared the remaining R1 billion (Reuters, 2011).

The unstable weather patterns and disaster risk may force farmers to find alternative or rental space while restoring the damaged site (Hill & Pittman, 2012). The farmer then has to pay for both the rental space and reconstruction costs. In addition, the temporary supply of water and electricity will be required for production activities at the alternative site and this increases

production costs for the farmer (Caldecott *et al*., 2013). The distribution of produce to the targeted consumers or suppliers may be disrupted of which the alternative site may be located far from the target market (Hill & Pittman, 2012). In some cases, producers decide to change what they farm in response to climate change and disaster risk. The high temperatures and drought conditions experienced in the Western Cape led farmers to change apple orchards into wine vineyards, which are more tolerant in warmer temperatures (Pereira, 2014).

The demand for food usually increases prior to or post a disaster event which means higher production costs (Hill & Pittman, 2012). For instance, in a situation where existing agricultural produce becomes insufficient then farmers would need to increase the amount of produce and this requires more input resources to feed the affected community. Furthermore, prices of inputs such as fertilisers, irrigation systems, herbicides, fuel, labour wages, and electricity are ever-increasing and these influence the production methods and costs (Walker *et al*., 2011). Irrigation systems have become a need in agricultural productions as an approach to cope with the changing climate conditions i.e. drought (Botai *et al*., 2016; Pereira, 2014). The challenge is that setting up proper irrigation systems is costly. According to Pereira (2014), only 10% of South African farms have irrigation systems. Commercial farmers are likely to afford these systems however, most subsistence farmers cannot afford these systems (Botai *et al*., 2016). Most farmers also rely on diesel to plough fields and this diesel is also used as the fuel to transport products to the markets and to distribute these products within the food market (Tadesse *et al*., 2014). Moreover, transporting fresh food is costly since it requires refrigeration or urgency as opposed to preserved foods that can endure long-distance trips without refrigeration (Nassirou, 2016). Although these issues put a strain on the affected stakeholders, it is necessary to ensure that productions return to normal without compromising on the quality of delivery (Caldecott *et al*., 2013).

2.3.1.3 *The quality of food*

Disasters and climate change reduce the quality of food and jeopardize the quality of food supply chains by increasing the risk for pests, reducing the soil nutrients, reducing the size and appearance of crops and livestock (Lobell *et al*., 2008). Hot weather conditions such as heat waves and drought result in higher metabolic rates and increase the number of breeding cycles for insects. For example, the Armyworm is an alien species that thrives in warm humid conditions and intensifies after a drought. The Armyworm was identified in South Africa in 2017 where it initially appeared in the North-West and Limpopo provinces, but later spread across the country. The wind acted as a catalyst in spreading this worm to feed on crops; mainly maize and sweet

potato (Day *et al*., 2017). In the case of floods, water can be powerful to transport sewage waste, pollutants or manure from roads, and lawns which can result in more pathogens and toxins in food (Bruinsma, 2017). This leads to a widespread over-use of pesticides however, most insects are developing a strong immunity against pesticides. The over-use of pesticides causes the bacterial cell of pests to become conditioned to survive in harsh conditions and increase the number of pests. These pests reduce the quality of livestock and crops such as soybean and maize (Israel & Briones, 2013). Parasites that attack livestock tend to thrive in moist and warmer conditions causing farmers to resort to chemical medicine treatment which can spread throughout the food chain and to consumers (Rosenzweig *et al*., 2001). This means that extreme environmental conditions have a significant influence on the development of pests and pathogens (Day *et al*., 2017).

Research indicates that the benefits of the rising carbon dioxide on plant growth are enhanced by extreme weather conditions (Lobell *et al*., 2008). According to Rosenzweig *et al.* (2001) the protein content in plants declines when the level of carbon dioxide is between 540 to 960 parts per million. The protein content of wheat, rice and potatoes can decline by 6 to 15% when planted at areas with 540 to 960 parts per million of carbon dioxide (Lobell *et al*., 2008). Furthermore, extreme weather conditions can reduce the water content and minerals in the soil and that can cause a decline of vitamins in plants (Lobell & Field, 2007). This highlights that extreme weather conditions tend to alter agricultural production and reduce the nutritional value of food (Bruinsma, 2017).

Cyclones and veld fires can hamper growth stages, root development, disturb the pollination processes and lead to the premature death of vegetation (Lobell & Field, 2007). Prolonged drought causes developmental stress in crops which can alter the appearance, texture, and taste of crops. In addition, dry conditions are detrimental to plants in a way that they may be unable to set fruits, flowers, or seeds (Genard *et al*., 2007). Apart from crops, livestock is also affected by disasters which can cause infertility and susceptibility to infections and diseases. For instance, the dairy from the cows is sensitive to hot temperatures which means milk productions are likely to reduce (Rosenzweig *et al*., 2001). This has led to an increase in highly processed food that usually includes high levels of chemical additives such as salt, sugar, sodium, and fat which leads to life-threatening health issues (Deloitte, 2015). Fieldhouse (2013) concluded that urgent responsibility and actions are needed to move the food system from high chemical additives to healthier production methods.

2.3.2 Food processors or manufacturers

Although agriculture is an important source of food supply, agriculture in Southern Africa is mostly subsistence productions and reliant on rain with low output. Furthermore, most food products require further processing before consumption (Hawkes & Ruel, 2012). This has paved a way for the processed food industry worldwide, including in South Africa (Pereira, 2014). The food processors are important stakeholders within the FCV who need to feed the global population of nine billion as mentioned earlier (Godfray, 2010). To achieve this, significant changes are required within the processing industry. Moreover, the underlying factors that delay the optimal function of manufacturers need to be addressed holistically through up- and down-stream collaboration (Deloitte, 2015). The following subsections discuss the impacts of disasters within the food processor's activities. The activities of the food processors range from preparing fresh food for markets to producing prepared food products for retailers. For instance, meat slaughtering and processing, seafood product preparation, fruit and vegetable preserving, sugar and sweets, bakery, dairy and other manufactured products are activities of the food processors (Pereira, 2013). For this study, the key issues identified for further discussion in the food processors section are narrowed down to employment, processing facilities, pathogens, and food waste.

2.3.2.1 *Employment and growth*

Food processors are central stakeholders of the food chain therefore, up and downstream cooperation is essential for sustainable productions. The food processing industry employs numerous people and it is known as the largest employer within the FCV (Pereira, 2014). This is important because in South Africa, poverty and unemployment are some of the biggest barriers to achieving household food security (Botai *et al*., 2016; De Lange, 2015). The food and beverage manufacturing sector were second categorised as main motivations that increased the annual growth rate with 1.2%. This was the highest growth recorded over the past five years which significantly contributed to lifting South Africa out of recession (Mabotja, 2019). The manufacturing sector in this country plays an essential role in economic development and employment opportunities (Scholtz & Von Bormann, 2016). Thus, whenever this sector grows the number of jobs also increases (at 1.7 million people in 2019) (Stats SA, 2019). This emphasises the need and importance of this industry.

The occurrence of disasters affects the potential of labour in a sense that employees may lose their jobs due to temporary or permanent business closure, suffer from several diseases caused by a disaster, and become unable to travel to work due to damaged infrastructure (e.g. obstructed railways and flooding roads) (Noy, 2009). The 2011 floods in the Northern Cape Province of South

Africa left 24 000 employees without salaries, because livestock and crops were eroded and productions could no longer proceed (Scholtz & Von Bormann, 2016). Incidences such as these affects both the employees and the employer where the loss of income becomes a challenge for employees and loss of production for employers (Wagner & Bode, 2009).

Research conducted by Israel and Briones (2013) indicated that the level of household food access and stability becomes shaken during periods of disasters due to low or absent income. Thus, when a household member becomes sick then household functions and their livelihoods become adversely influenced (Botai *et al*., 2016). In the United States, there is funding specifically set aside for addressing employment implications caused by disaster events called the Disaster Unemployment Assistance. This programme is established to assist workers who may lose their jobs due to disaster events. The programme provides unemployment funds until the affected people find other employment opportunities (Noy, 2009). In South Africa however, no programme specifically tackles unemployment loss as a result of disaster events however, the UIF a form of financial relief programme that assist workers during distress. The Unemployment Insurance Fund (UIF) provides temporary or short-term financial relief to employees when faced with various situations such as illness, leave and maternity, which result in the inability to work. The Coronavirus pandemic of 2020 (COVID-19) and its negative influence on jobs and income, caused the South African government to consider a Disaster Unemployment Assistance programme that would partner with the UIF to provide relief for the affected households during this pandemic and other disaster to occur in future (Voigt, 2020).

The occurrence of contagious outbreaks is often unpredictable (FAO, 2013). The vulnerable group in the labour market are the low-income workers due to the socio-economic pressure and damage caused by a disaster (Caldecott *et al*., 2013). This was observed in South Africa when a national lockdown was implemented as a measure to contain the spread of COVID-19. In this regard, non-essential (e.g. restaurants, entertainment avenues, schools, and clothing retails) businesses were temporarily closed which meant that most people could not go to work or/and make income (Voigt, 2020). The South African government has indicated that R500 million would be distributed among small, medium and micro-enterprises that are adversely impacted by the pandemic. However, the money has been used up without achieving the said goals and most informal businesses (e.g. street vendors) continue to suffer because they are not registered taxpayers (Voigt, 2020). Moreover, these businesses cannot afford insurance policies and are already struggling to thrive in the weak economy of South Africa. In addition, most of small business owners do not qualify for a financial loan which can provide financial relief in tough times (Mabotja, 2019). South Africa needs to focus on creating a connection between the uncertainties

and markets that promote income opportunities for the underprivileged (Scholtz & Von Bormann, 2016; Mabotja, 2019).

The risk of processing error becomes significantly high when workers have to perform daily tasks during disasters (Noy, 2009). This is mainly due to changes in the environment which put pressure on workers to carry out their daily functions in a normal manner despite a disaster event. The workers affected by disasters can be expected to develop stress and tiredness which can influence their state of mind and performance in the chaos of disasters (Wagner & Bode, 2009). Therefore, adequate DRR staff training before disasters is necessary to avoid poor employee performance should a disaster occur. This training will assist food processors to analyse, prevent, prepare, and manage various hazards within a processing facility (KPMG, 2013).

2.3.2.2 *Processing facilities*

Food processing facilities are an essential component in food processing and the structure or set-up of such facilities plays a huge role in improving the coping capacity aimed at minimising risks (Rosenzweig *et al*., 2001). The processing methods used for processing, packaging and storing food are commonly influenced by weather and climate conditions and disaster risk has detrimental effects on the processing facilities and processed products (Caldecott *et al*., 2013). Furthermore, the damage to food processing facilities is likely to result in food contaminations through the exposure of food ingredients to unusual temperatures that can stimulate the emergence of harmful microbes (Rosenzweig *et al*., 2001).

Stocks of raw materials and manufactured goods tend to be lost after a disaster (FAO, 2017). Thus, changes in the production flow may be observed with declining productions and higher production costs. Furthermore, a business that was not directly hit by a disaster may experience declining production flow when a reliant sector of raw materials (e.g. water and ingredient supplier) is adversely impacted (Rosenzweig *et al*., 2001).

The occurrence of extreme weather conditions may cause certain food producers and processors to relocate to areas with suitable conditions (Von Bormann, 2017). This is most likely to occur when a processing facility cannot cope with some type of disaster incidence or due to weather preferences (Noy, 2009). This relocation is more likely to result in higher transportation, distribution networks, and firm/facility construction costs. Pereira (2013) points out that relocation forces facilities to adapt to a new situational arrangement that is different from the familiar situation which can take time to return to optimal operations.

Disasters can impact the production flow which can significantly degrade the value of products and services delivered to consumers (FAO, 2017). For example, hurricanes usually lead to compromised quality of products whereby electricity supply and the facility structure become exposed to large water and water-pathogens which delay productions. Food processing facilities and warehouse units situated near the ocean or sea site are at high risk of rising sea levels, cyclones, and flooding. The 2019 (April) flood in South Africa at Ballito destroyed several businesses that suffered a lot of financial loss in terms of replacing damaged equipment and recovering profit lost through the shutdown period. In this regard, the total infrastructure damage of this flood was estimated to be over R650 000 000 where fishermen suffered great loss and damage to port and landing facilities, storage facilities, and processing sites (Singh, 2019).

Despite the negative impacts of disasters on processing facilities, there are some positive impacts such as the development of effective infrastructure through the disaster response and rehabilitation (Caldecott *et al*., 2013; Noy, 2009). Israel and Briones (2013) revealed that communication and the level of responsiveness become better after experiencing disaster events. This is mainly because the producer or processor will ensure that future prevention or management strategies are implemented to avoid the reoccurrence of the previous experiences while improving safety standards in a processing facility (Hill & Pittman, 2012).

2.3.2.3 *Pathogens and contaminations*

Global studies show that consumers are developing a sense of anxiety when it comes to food safety (Abecassis *et al*., 2018; Deloitte, 2015; Pereira, 2014). This is acceptable given that there are more than 300 food recalls reported annually, leading to over 75 million foodborne illnesses, 325,000 hospitalisations, and 5,000 mortalities globally (Lobell & Field, 2007). In South Africa, a number of 327 food-borne disease outbreaks were reported from January 2013 to December 2017. As a result, 11 155 people became ill, with 8 680 hospital cases, where 494 people were admitted to hospital for a long period, and 49 deaths cases recorded (Shonhiwa *et al*., 2019). Most food companies work to minimise these statistics by tightening the safety protocols because they depend on the consumer's trust for success. Thus, compliance with all regulatory regimes is essential for minimising food-borne illnesses and improving traceability (NICD, 2018). The food processors need to work closely with all other food chain members to ensure that everyone understands the risks and impacts thereof (Abecassis *et al*., 2018).

Processing (e.g. manufacturing equipment and food handing), packaging (e.g. pack-house, and hygiene), and storage (e.g. cold rooms and refrigerated transport) have the power to influence and alter temperature that can in turn increase the risk for spoilage and contaminations (Lobell &

Field, 2007). Microbiological contaminations tend to inhabit the absorption of nutrients and usually causes diarrhoea. These food-borne hazards can occur naturally or introduced through contaminations (NICD, 2018). The impacts of disasters on livelihoods and economies are increasing in magnitude and number at the local and national levels in South Africa (Tirivangasi, 2018). These include outbreaks of food-related diseases as a result of pathogens such as Salmonella species, Clostridium perfringens, Bacillus cereus, Shigella species, E. coli, and Listeria monocytogenes (Shonhiwa *et al*., 2019).

In the Kwa-Zulu Natal Province of South Africa, 216 people were hospitalised after consuming contaminated food at a school event that contained the Salmonella Enteritidis bacterium (Niehaus *et al*., 2011). The West Point Processors announced that processed canned pilchards products had a canning default which could lead to health implications hence, a recall was announced to the public in February 2020. As a result, all the formal and informal retailers were ordered to stop selling the 400g pilchards in tomato sauce and the pilchards in chili sauce, while consumers were advised to check for the following in the barcode ZST-2, ZSC-2, ZST29, or ZSC 29 and return the product if the mentioned code appeared on the canned product (Meyer, 2020). Although the consumers and retailers get refunded during the recall period, the products will be disposed which contributes to the issue of food waste (Oelofse & Nahman, 2013).

2.3.2.4 *Food waste*

The FAO (2013), Nellemann *et al.* (2009) and Von Bormann (2017) revealed that most food waste is lost in the production stage before even reaching the retail shelves. Food waste implies the food that is lost because of various aspects such as adverse environmental conditions, over-production, and rapid inflation rates that occurs throughout the food chain i.e. at production, processing, and post-harvest stage (Nahman *et al*., 2012). The global food loss or waste in a food system is 1.3 billion tonnes and this is unacceptable because 800 million people go hungry each day (Von Bormann, 2017). Furthermore, more than 30% of the global food waste is caused by processors which show that better attention is needed in the manufacturing stage (Deloitte, 2015). Food waste is a serious problem because the wasted products could have fed those in need. Moreover, the resources (e.g. water and energy) used to produce the wasted food could have been saved or used for producing something else (Oelofse & Nahman, 2013). According to Von Bormann (2017) more than 43% of fruits and vegetables become wasted annually in South Africa.

Food waste is enhanced by three main dimensions, namely: increased urbanisation with rapidly growing food demands and agriculture; changing consumption patterns to resource-intensive

foods such as meat; increased processed foods; and retail competition driven by global trade and globalisation (Oelofse & Nahman, 2013). The occurrence of food waste may differ according to regions whereby food waste in developing regions usually occurs at the early stages of the FCV while in developed regions, waste usually occurs at the later stage of the FCV (Nahman & De Lange, 2013). In developing regions, food waste is primarily caused by environmental risks, inefficient planning, the attitude and behavioural patterns of retailers and consumers, lack of processing resources and expertise (Nahman *et al*., 2012).

Research conducted by the World Wide Fund for Nature (WWF-SA) revealed that 10 million tonnes of food are wasted each year in South Africa, which accounts for a third of 31 million tonnes of food produced each year (Von Bormann, 2017). An estimated 70% of this waste results from fruits, vegetables and cereals and this occurs early within the FCV (Oelofse & Nahman, 2013). According to the Council for Scientific and Industrial Research (CSIR cited by Nahman & De Lange, 2013) the total food waste costs R61.5 billion annually which accounts for 2.1% of the national GDP. On the other hand, food waste also contributes to environmental degradation and climate change because waste deposited in landfills produces methane gas and carbon dioxide (Pereira, 2014). Methane is detrimental to the environment because it traps a significant amount of heat which is 30% more than Carbon dioxide (Oelofse & Nahman, 2013). In South Africa, 90% of the food waste gets deposited in landfills (Von Bormann, 2017). More information and data based on disaster and food waste is needed to understand this relationship in depth and thus addressing the issues (Oelofse & Nahman, 2013). Reducing this waste can provide an opportunity for the South African food industry to deliver sufficient value-added food while reducing input resources and environmental degradation, which may promote evenly distributed food to all (Nahman *et al*., 2012; Von Bormann, 2017).

2.3.3 Food distributors

Food distributors are the intermediaries of the FCV who ensure that food travels from producers and processors to reach consumers at safe conditions (Deloitte, 2015). This can be influenced by several factors such as transportation channels, storage facilities, and trade issues. It is important to note that risk can creep up in the phase of food storage and distribution (Israel & Briones, 2013).

2.3.3.1 *Storage facilities*

The rate of food spoilage is influenced by various factors such as the type of food product, the temperature where the food is stored, humidity, and the duration of exposure to harsh conditions (Altizer *et al*., 2013). The temperature has the power to inhibit or enhance microbial growth in food. In general, warm temperatures enhance the development and growth rate of microbial species (such as the disease-causing Salmonella spp), while cold temperature reduces development and growth (Tirado *et al*., 2010). Thus, cold storage is commonly used to increase the shelf life of processed and fresh products by retailers and consumers (Altizer *et al*., 2013). Food processors spend more money on cold storage due to the heat increase. The Coca Cola Company revealed that 71% of its carbon footprint is a result of refrigeration used for marketing and sales equipment (Tirado *et al*., 2010).

Although there are several studies on food storage and spoilage, only a limited amount integrates the context of climate change and disasters (Altizer *et al*., 2013). Bacteria, viruses and parasites can develop at any stage of the FCV where climate change facilitates the contamination. According to Tirado *et al.* (2010) extreme temperatures can lead to hygiene risks, especially within the storage and distribution in the FCV.

Humidity is one of the core influencers of food spoilage since microbial favours the presence of moisture around food products (Altizer *et al*., 2013). In addition, moisture also serves as a catalyst for microscopic fungi in food. Low environmental moisture slows down the growth of microbial, especially in perishable food such as fruits, vegetables, and fresh meat. This means that food producers lose a lot of profit during seasons of high-frequent rainfall, storm surge, floods, etc. since their produce cannot be stored for a longer period (Tirado *et al*., 2010). The emergence and re-emergence of pathogens are further influenced by climate change where new infectious agents may develop (Altizer *et al*., 2013).

During or after a disaster event, unsafe food storage and contaminations usually become high due to lack of essential resources such as water and electricity which may lead to poor sanitation during food handling and preparations (Scholtz & Von Bormann, 2016). This is particularly worse in the informal food sectors where insurance and investment is lacking (Mabotja, 2019).

2.3.3.2 *Multiple channels and formats*

In South Africa, the retail industry is divided into two sections: the formal sector and the informal sector (Pereira, 2013). The formal sector consists of large format hyper- and supermarkets,

smaller superettes, “non-major” stores such as convenience stores, and self-serve stores while the informal sector consists of local street vendors/hawkers, small stands and spaza shops (Pereira, 2013; Weatherspoon & Reardon, 2003). The informal sector provides citizens with opportunities for self-employment, local economic growth, and skills development; all of which contribute to addressing household food insecurity (Pereira, 2014). The development of the formal sector transitioned from supermarkets to hypermarkets and later the establishment and growth of convenience stores. This development began in high-income areas, but then expanded to rural towns and townships intending to accommodate the middle-class group (Weatherspoon & Reardon, 2003). The growth of retailers has contributed to the expansion of the supply chain in the sense that a single retailer is most likely to have multiple suppliers for various products such as dairy, fruits and vegetables, bakery, wine, etc. (Pereira & Ruysenaar, 2012). For example, Woolworths has several suppliers including the Bliss brands, West Peak Specialty Meats, Little Cake Company, and the KWV wine producer (Pereira, 2013).

During extreme weather events, it becomes difficult to transport food due to damaged transport infrastructure (i.e. roads, railways, port terminals, and transport logistics) and transporting equipment (cars, van or trucks), which increases the transportation costs or inability to access suppliers in severe cases (Tschirley *et al*., 2015). Poor infrastructure limits the capabilities of food distribution systems which in turn affect the local supply chain (Walker *et al*., 2011). Ideally, consumers must be able to access food markets easily however, a disaster event can disrupt this convenient access whereby consumers may have to travel a long distance to supermarkets that are located outside their residing areas (Altman *et al*., 2009).

Iles (2005) proposes reducing “food miles” through the production of fresh food that is nearby urban markets. “Food miles” is the distance it takes for food products to travel from producers to consumers (Bryan *et al*., 2009; Iles, 2005). Transporting food to various suppliers and retails is not only costly, but it also contributes to high levels of carbon dioxide emission which in turn contributes to climate change and disaster risk (Hawkes & Ruel, 2012). Therefore, it is necessary to minimise importing or sourcing food from far sources to reduce the mileage distance and ultimately, the carbon footprint (Deloitte, 2015). Although some products can only be accessed through imports such as rice which is difficult to grow in the South African soil profile and climate conditions; it is important to reduce mileage for those products that can be produced in South Africa (Bryan *et al*., 2009). Iles (2005) recommends that household or community gardens (organic) are a good way towards healthy diets that cost less. In addition, trusted local supply chains promote good environmental sustainability.

The evolution of consumers along with an increase in adverse disaster impacts on food supply has contributed to the growing importance of the e-commerce channel (Deloitte, 2015). Online shopping has significantly grown over the past 10 years (Deloitte, 2015). Retailers that offer online grocery shopping tend to perform better in terms of physical shopping as well. This is because e-commerce requires innovation that ensures a balance between logistical costs and benefits (online sales) (Abecassis *et al*., 2018). Research shows that online grocery shopping is beneficial for people who have challenges in accessing physical stores. They include among others disabled people, those who are always on the go, those who want to purchase food from any location at any time, and those who hate doing physical grocery shopping. Therefore, online shopping promotes equal food accessibility and minimises any isolation or exclusion and this strengthens food security (Godfray, 2010).

Retailers are working with other food chain members through joint efforts to create better warehouse operations including inventory management, order management and fulfilment, creating and operating online stores and providing home delivery (Pereira & Ruysenaar, 2012). Furthermore, retailers are continuously investing in technologies that ensure consumer satisfaction (Pereira, 2013).

2.3.3.3 *Food retail capacity*

In the event of a disaster most local small to medium retail stores face challenges of having adequate products within retails (Van der Merwe *et al*., 2020). The food products are more likely to run out and the managers may not always have the ability to stock more products. This can be caused by several factors such as lack of finance, disrupted supply chain, and inability to reach supply networks (Voigt, 2020). For example, during the global Coronavirus (COVID-19) disaster, several local shops had to close because the store owners were unable to receive products from their local suppliers as a result of lockdown regulations. The rapid increase in the number of cases and mortalities caused by the Coronavirus disease led to lockdown implementation for many countries including South Africa (Van der Merwe *et al*., 2020). Although this was a necessary measure, food distribution became a major issue whereby citizens started engaging in panic buying. Furthermore, this meant unequal distribution patterns for the poor communities since they rely on informal markets (e.g. street vendors and spaza shops) which were ordered to close during the lockdown period. The restricted availability and use of public transport left many low-income households with limited access to food and other commodities, since people had to travel to major food outlets (e.g. Shoprite, Pick ‘n Pay, and Clicks) which were operational during the lockdown (Voigt, 2020).

Food distribution is an important way to ensure that food reaches people across different communities, regions and globally (Iles, 2005). Disaster events, especially food-borne and pandemic incidences tend to negatively influence the import and export systems. In some cases, import or export trade becomes banned during a disaster as a way to protect or prevent the spread of a disaster incidents. In South Africa, the Listeriosis outbreak led to a temporary export ban and some trust issues in other Southern African partners (WHO, 2018). Shonhiwa *et al.* (2019) reveal that it becomes challenging to retrieve all the distributed products that have been identified as contaminated in the event of a product recall. This shows that distribution patterns are not just mere linear network systems (Iles, 2005).

The flexibility of distribution channels paves the way towards capacity coping in the event of adjusting to unpredictable circumstances (Caldecott *et al*., 2013). FCV stakeholders face serious problems of producing and distributing adequate food when faced with a disaster (Chapagain & Raizada, 2017). For instance, food transportation logistics such as traveling routes may be inaccessible hence, the need to enforce alternative arrangement to avoid food shortage so that consumers receive sufficient food. This challenge can also limit the assistance offered by humanitarian organisations in the form of restricted food aids during emergency response and relief that result from lack of proper infrastructure (with poor quality) that cannot handle disaster impacts (Graef *et al*., 2014). In 2015, Nepal experienced earthquakes that caused serious damage. Relief aids reached many households in the city however, only a limited group in the rural areas were reached due to poor road connections that lead to mountain site communities (Caldecott *et al*., 2013). Similarly, the 2010 floods in Pakistan caused a higher food shortage and insecurity with 20 million displacements where the emergency assistance was delayed due to lack of communication that was caused by damaged infrastructure such as bridges, roads, electricity lines, network and telephone towers (Chapagain & Raizada, 2017).

The establishment of supply chains requires time and efforts which becomes difficult to change once established (Caldecott *et al*., 2013). As a result, it becomes challenging for these food chains to cope with rapid and unpredictable events. This needs to change because unforeseen conditions have huge impacts on the operational activities of food chains which include the behaviour of the consumer (Chapagain & Raizada, 2017).

2.3.4 Consumers

Consumers are the end-users within the FCV because they purchase and consume the products (Pereira, 2014). Consumers have so many concerns about food such as food safety, genetically

modified foods, massive food riots, global food recalls, the increasing demand for high-value, and sky-rocketing food prices. Although consumers show concerns, most of them tend to take food production for granted and expect the food sector and government to resolve all food issues (Gomez & Ricketts, 2013).

2.3.4.1 Food security and high prices

The aftermath of a disaster event requires rapid government and international response, and support to aid effective reconstruction (Chapagain & Raizada, 2017). Graef *et al.* (2013) points out that it is important to understand the relationship between disasters and the FCV's capacity to effectively distribute emergency and recovery funds. Moreover, the rapid growth of informal settlements serves as high-risk areas and this means it is of great importance to understand the human cost and impact of disaster events on different communities (Van Wyk & Dlamini, 2018).

Most individuals in low-income communities of rural areas are dependent on farming and rainwater, however households face low food productions during unfavourable weather conditions and this causes them to spend more than 70% of their income on food purchases (Bryan *et al*., 2009). The fluctuating food prices add more stress to these households. Market volatility is the velocity of the price changes, whereby the dispersion of returns is measured over a given period (Deloitte, 2015). Market volatility affects livelihoods and food security by reducing the available food commodities for local markets which also contributes to food inflation and a decline of farmers' income (Gomez & Ricketts, 2013). Such pressures hamper the households' purchasing capacity, deplete savings, restrict food access, and erode livelihoods. Consequently, the quality and quantity of the food reduce significantly which contributes to malnutrition and food insecurity (Deloitte, 2015).

The high demand for food and resources required for food production tends to add a burden to the supply chain performance which is restricted by inadequate water and land, poor harvest due to climate conditions, and the high demands for biofuel production (Deloitte, 2015). Candel (2018) indicates that emerging consumers from the middle-class group require resource-intensive and high-value foods, which add a strain on meat productions and crop yields. According to the FAO (2017), the increasing demand for meat harms the overall food system because livestock and meat productions require bigger land, more water, and energy as compared to the production of maize or rice. These high demands along with increasing prices influence food productions and distribution patterns (transportation) leads to higher retail prices (Abecassis *et al*., 2018).

The amount of water required for food production is rapidly becoming scarce as mentioned above with extreme weather events as core factors that facilitates low productions (De Lange, 2015). Due to the adverse environmental impacts of climate change and disasters, some areas have ended up with unsuitable agriculture which increases the competition for land and ultimately higher food prices (Hill & Pittman, 2012). All of these issues can occur at any stage of the food chain which threatens household food security (De Cock *et al*., 2013).

According to the FAO (2015) the poor spend two-thirds of their income on food purchases which means a change in food prices shakes household food security. High food prices cause people, especially the poor to depend on seasonal foods and cheap products rather than organic and high-priced imported foods (Godfray, 2010). Pereira (2014) points out that increasing the portion of maize meal is a common strategy to fight hunger for poor households with less diversity in meals. This means that poor households are unable to acquire sufficient nutrition and diversity within their diets. The risk of high prices can contribute to long-term detrimental effects on health, cognitive development, and stature such as malnutrition, diseases, and potential disabilities (e.g. blindness due to lack of vitamin A) (Hill & Pittman, 2012).

Although supermarkets sell healthier products as opposed to small stores, the prices are charged higher at 10% to 60% more than less nutritious products when compared in terms of weight (Van Wyk & Dlamini, 2018). Thus, there is a rising need for products that offer value and functionality at an affordable price (Candel, 2018). The FCV has a huge responsibility not only to ensure food availability, but also to ensure that the available food is affordable and safe. As a consequence, the producers and retailers try to create value-added products by creating functional foods, improved marketing, and product labelling to enforce the value of their products (Abecassis *et al*., 2018).

4.3.2.3 Food safety concerns

The emergence of risks in the food industry is increasing due to the rapid population growth and the pressure to meet the high demands and this can be observed in the series of recent food recalls (FAO, 2017). The contamination of maize by mycotoxins bacteria is a huge issue that contaminates a quarter of the global maize produce. This results in serious health impacts whereby a small dose can lead to death (Hattersley, 2013). These adverse effects usually occur during food shortages. In addition to health effects, the loss of the substantial harvest brings about an increased burden (FAO, 2019).

Moreover, consumers worry about farming practices that involve growth hormones and antibiotics in livestock, the use of pesticides on crops, and food additives and preservatives that are added in food processing (Pereira, 2014). Cleanliness and freshness of food is also a major concern (Abecassis *et al*., 2018). These concerns have prompted the widespread approach of sustainable food productions, which aim to maximise productivity while minimising environmental degradation and other negative impacts (KPMG, 2013).

Deloitte (2015) revealed that transparency is becoming a major need for consumers. Consumers are increasingly becoming interested in knowing about how food products are produced, the origin and contents of the food being purchased and the resulting environmental and social impacts. Increasingly, high-class consumers tend to examine food labels in detail and these consumers are not willing to settle for less (Lagerkvist *et al*., 2016). However, food safety can be threatened through the way food is prepared, cooked, and stored in the homes of the consumers (Pereira, 2014). This emphasises the need for education and knowledge sharing regarding techniques for safely handling food to minimise food contaminations and the health impacts thereof (Deloitte, 2015).

4.3.2.4 Carbon footprint of food

The production of food requires several resources however, the consumption of energy poses serious challenges (Deloitte, 2015). Agricultural production and distribution of produce use a high quantity of carbon-fuel while manufacturing requires a large electricity supply. A carbon footprint is defined as the total amount of greenhouse gases (GHGs) emitted by a product or activity through its life cycle- from raw material to consumption and disposal (Nahman & De Lange, 2013; Tirado *et al*., 2010). This includes all direct (e.g. crops and livestock) and indirect (e.g. electricity supply) emissions of carbon dioxide. Brenton *et al.* (2009) defines 'carbon footprint' as the quantity of GHGs which is expressed as the equivalent that is released within the supply chain of a product. The companies of meat and dairy are one of the biggest contributors to GHG emissions which highlights the need for better attention to the strategies that reduce the carbon footprint and build sustainable food chains (Nahman & De Lange, 2013).

Consumers influence the establishment of a sustainable food chain through the demands for environmentally friendly products which trigger positive changes in production processes (Iles, 2005). Therefore, consumer awareness regarding their choices and the consequence thereof are important for promoting sustainable food chains. This requires collaboration among the government and FCV stakeholders. Food producers can label the amount of GHG emissions

used to make products with the support of government support to ensure creditability (Brenton *et al*., 2009). In addition, consumers would have the opportunity to compare different brands and make choices based on reliable information. Moreover, this will promote a sense of transparency and competition for reducing the carbon footprint which stimulates sustainability along the food chains (Iles, 2005). The Carbon Reduction Label (by The Carbon Trust) in the United Kingdom is a good example of constructive partnership within the government and food industry to reduce GHG emissions and share information about carbon footprint with consumers (Brenton *et al*., 2009). The goal to reduce carbon footprints is in line with the DRR aims which are to enhance food production, reduce waste, and promote food security and sustainability (Lobell *et al*., 2008; Wagner & Bode, 2009). As such, this partnership would help avoid duplicated strategies or initiatives and reduce a financial loss (Wagner & Bode, 2009).

According to the FAO (2017), the occurrence of extreme temperatures and disasters is unlikely to stop, but it is rather becoming a norm. Despite the adverse impacts and concerns of disasters on the FCV as indicated above, risk assessments and effective preparedness within the FCV is still a developing field (KPMG, 2013). This is concerning because the impacts have already been felt, especially by the poor and this threatens their overall food accessibility and stability (De Lange, 2015). Given the relationship and issues caused by disasters on the FCV as discussed in the section above, this study further seeks to close this research gap by developing a conceptual foundation for integrating the FCV with DRR. This means that the FCV would be able to identify and deal with disaster risks (at each stage) optimally based on DRR practices which include early warning systems.

2.4 Multiple benefits of integrating DRR into the FCV

The connection between disasters and the FCV shows that effective DRR approaches or practices have the potential to bring about benefits while minimising losses (Chadburn *et al*., 2013). The opportunities for an integrated FCV and DRR system promote an enabling environment that enhances added value in food chains. These opportunities include: (1) environmental co-benefits; (2) the promotion of inclusive, accessible, sufficient food for all; (3) improvements of climate change adaptation; and (4) enhancement of resilience against disasters (FAO, 2019). Firstly, the contribution of DRR practices promotes multiple environmental co-benefits (e.g. positive soil health and water management) which further enhances the conservation of ecosystems and natural resources (Hill & Pittman, 2012). Moreover, the sustainable development of resources, along with climate change mitigation serves as incentives towards the FCV (FAO, 2019). Secondly, the adaptation of DRR approaches within the FCV

promotes nutritional value on a local and national level through inclusive, accessible, sufficient and healthy food for all communities. This enables low-cost and easily applicable practices that assist vulnerable communities and increase capacity for unsusceptible communities (IFRC, 2010). Thirdly, the implementation of the DRR approach presents an opportunity for climate change adaptation through the establishment and enhancement of risk-informed development, while preventing climatic disasters to ensure resilience within communities (IFRC, 2016). Lastly, the DRR approach leads to improved resilience among the FCV stakeholders in the face of disasters. Therefore, these stakeholders have the opportunity to communicate and engage in the design and implementation of strategies that benefit producers and consumers (FAO, 2019). Overall, the partnership between the FCV and DRR stakeholders emphasise on positive gains such as lower production costs and increased turnover (Chadburn *et al*., 2013).

Table 2-1 below demonstrates the cases of multiple benefits of integrating DRR into the FCV by showing evidence-based cases in developing countries. Furthermore, this integration is seen as a no-regret approach whereby profit is generated in a hazard or non-hazard context (FAO, 2019).

Table 2-1: Benefits of applying DRR in the FCV (FAO, 2019).

Country	DRR practice	Previously used practice	Season	Type of hazard addressed
Haiti	Bean cultivation with conservation agriculture and agroforestry	Bean cultivation with practices such as slash and burn, mounds	Dry season	Pest invasion
Jamaica	Tomato cultivation with rooftop rainwater harvesting and gravity drip irrigation	Tomato growing with manual watering using purchased water	Dry season	Drought
Lao People's Democratic Republic	Flood-tolerant rice varieties Indoor mushroom production for livelihood diversification	Local rice varieties No mushroom plantations	Wet season Dry seasons	Floods Drought
Pakistan	Vegetable and wheat cultivation using ridge sowing, farmyard manure (FYM), multi-cropping and Integrated Pest Management (IPM)	Vegetable and wheat cultivation using multi-cropping, but no ridge sowing, FYM, and IPM	Dry season	Dry spells

Uganda	Coffee cultivation with mulching, digging of trenches for water retention, organic composting and planting of shade trees Cattle raising with zero grazings, improved cattle breeds, and drought-tolerant fodder	Coffee cultivation with no mulching, no trenches, no organic composting and no shade trees Free-ranging cattle, a local breed	Dry seasons Dry seasons	Drought Drought
Haiti	Fish pots as passive fishing gear to prevent fish losses during extreme weather conditions Drought-tolerant aquaculture species	The bottom set long lines Local aquaculture approach	Dry seasons The wet and dry season	Typhoons Dry spell

Most of these DRR practices demonstrated above contribute to sustainability through various measures such as reduced GHG emissions, deforestation, and soil erosion (IFRC, 2016). A good example is of the shade trees planted on coffee crops in Uganda and in Bolivian silvopastoral systems where carbon sequestration was increased and forest degradation prevented. In the Philippines, the number of boat trips and diesel fuel was reduced by 33% in fish harvesting when fish pots were used (FAO, 2019). Furthermore, these practices improved household nutrition and food security. In Jamaica, the use of rainwater allowed farmers to plant and grow crops in dry conditions. The introduction of a micro-irrigation kit for crops and new production activities contributed to household dietary diversification (Chadburn *et al*., 2013). Additionally, in Uganda, the zero-grazing system in cattle breeding significantly enhanced nutrition and calcium acquisition, especially for children. Overall, the measures used to improve food chains have a positive influence on the performance of food systems and ultimately, food security.

2.5 The influence of the FCV on food security

The FCV has a substantial impact on the efficiency of food security initiatives and policies (FAO, 2014). According to Ashley (2018), the FCV is responsible for producing food and ensuring that food reaches consumers thereby, promoting food security. This means that the inability of the FCV to produce and deliver sufficient food tends to undermine food security policies, in such a way that food security policies become impractical when there is insufficient or no food to consume. Furthermore, the FCV influences the way households behave in terms of gaining food access and achieving stability thus, the success of food security (Rosegrant *et al*., 2009).

The FCV is important in assisting and ensuring that food security is achieved through several characteristics of the food chain (Hawkes & Ruel, 2012; Graef *et al*., 2014):

- The food chain is characterised as market-driven which helps to connect households to markets to assist households to generate income that can be used as an alternative for those producing their own food and to also add diversity to daily diets.
- The FCV approach is based on a system approach which means that it focuses on understanding the food system and its impact on food security holistically. This results in ensuring a balance between increasing food productions and enhancing food availability for the poor. In addition, emphasis is placed on the need for better attention on various activities of the FCV rather than merely focusing on agricultural productions.
- The FCV is centred on establishing long-term strategies for addressing the underlying constraints and causes of food insecurity.
- Emphasis on leverage is essential and provides opportunities for improving the involvement and investment of the private sector in improving household food security.
- The FCV helps to guide the food security frameworks and projects to identify and understand the impacts of various activities that influence food security, and thus establish strategies that bring positive outcomes on food insecurity.

Improving the FCV is crucial for addressing food insecurity. Altman *et al.* (2009) points out that functions of food markets, distribution systems, and household resources influence food security and this determines the level of food accessibility.

Pereira (2013) indicates that food chain activities are interlinked to food security, using the four pillars of food security to illustrate this relationship. *Food availability* involves food production, distribution, and exchange; *food accessibility* involves the affordability, preferences, and allocation of foods; *food utilisation* includes the adequate knowledge and application regarding nutrition, social value, and food safety; and *food stability* involves sudden or predictable disruption (Kwasek, 2012). These elements are the results of the activities and processes from the food chain. Pereira (2014:2) states that “there are multiple and at times contradicting institutions which govern the way that food is produced, transformed, distributed, consumed and regulated”. Therefore, it is important to acknowledge this complexity. Moreover, any kind of stress or disruption in the FCV ultimately reduces food security. The International Food Policy Research Institute (IFPRI) (2015) also highlights the importance of food systems in achieving food security in its 2020 Vision towards Food, Agriculture, and Environment security that aims to establish sufficient food accessibility for all through food systems that are compatible and sustainable. According to De Lange (2015), the activities of food systems (production, processing, distribution,

and consumption) and the outcomes of these activities influence food security (i.e. availability, accessibility, utilisation, and stability). Therefore, in the sections that follow, the relationship between food security and the FCV is demonstrated through the four pillars of food security.

2.5.1 Food availability

The availability of food in a country can be ensured by producing own food or importing products (FAO, 2017). The World Wide Fund for Nature (WWF-SA) indicated that food productions need to increase by 50% to meet the demands of the growing population while ensuring that citizens have adequate food availability in South Africa by the year 2050 (Von Bormann, 2017). On the contrary, South Africa takes pride in being a net importer of value-added food (mostly packaged food) which shows how the country has failed to turn its inherent natural wealth to benefit citizens (Nassirou, 2016). According to the FAO (2017) the first step in addressing this failure is by promoting and supporting integrated agri-business and agro-industries approaches to create value that meet the market demands.

Pereira (2013) emphasise that the following three (3) conditions are significant for food availability:

- *Physical food availability*: this entails that the national food economy can meet the minimum physiological demands of citizens of which imports catalyse these minimum demands.
- *Economical food availability*: the ability of poor households to have accessibility to essential foods. Income and food prices are key factors that drive consumers' purchasing choice.
- *The value of a food product*: this entails that the condition of the products and value is beneficial to the consumers' preference and health.

There is a lack of balance when it comes to food availability between the wealthy and the poor (Deloitte, 2015). The poor households have insufficient food availability. As a result, such households are more likely to consume cheap products with high starch and lack of micronutrient density. This is mainly because they are unable to access micronutrient foods due to high prices and at times physical availability (distance to food retails) (Nassirou, 2016). Rosegrant *et al.* (2009) goes on to say that food with high nutrient density must be available either through own production or market channels. It is important to stress that food availability is not only about having adequate food, as the condition or state that the food is also important. For example, the food available to the poor versus the wealthy does not usually have the same value, wherein the

poor have food that is of low value as compared to the wealthy (Lobell & Field, 2007). The FCV aims to provide value-added products to every individual, mainly those who are vulnerable to financial and food insecurities (Caldecott *et al*., 2013). Nonetheless, Nassirou (2016) argues that although some poor households get opportunities that improve their finances, livelihoods, and diets, they most likely struggle with nutrition transition.

Consumers make decisions to buy food based on the level of quality, especially when it comes to fresh produce such as fruits and vegetables (Deloitte, 2015). This is why retailers continuously seek to provide good value products at an affordable price (Tschirley *et al*., 2015). Consequently, food retailers are more determined to ensure that their suppliers deliver good quality products. This contributes to the improvement of food availability and ultimately food security. Furthermore, the FCV works towards designing food value products that cater to the preferences of different consumers i.e. taste acceptability, convenience, cost, consumption patterns etc. (KPMG, 2013). This highlights the efforts taken by the FCV to provide value-added products that promote food security by increasing the variety of products (Gómez & Ricketts, 2013).

Bryan *et al.* (2009) indicates that food diversification is a vital component of food availability. A combination of actions which includes increased food productions; reduced losses in the post-harvest phase; enhanced market efficiency of staple food; and strengthened trade flow is needed to ensure that the availability of food is sufficient (Keatinge *et al*., 2011). The importance of food diversification does not entail that attention on traditional/ staple food products should be reduced mainly because staple food are unlikely to be wasted and they strengthen food security (Gómez & Ricketts, 2013).

The loss of post-harvest contributes to food insecurity in the sense that food loss means less food available for consumption or selling. Each year, 15 to 50% of post-harvest is lost in developing regions (Nahman & De Lange, 2013). Research by Graef *et al.* (2014) shows that markets have the power to influence food loss across the FCV.

According to Gómez and Ricketts, (2013), Graef *et al*. (2014) and KPMG (2013) The FCV can assist to improve the efficiency of food markets through the following ways:

- *The calculation and reduction of transactional costs:* FCV analysis pay attention to data and information about transactional costs and margins that take place within all stages in the FCV. This information can be used to enhance the availability of food by identifying the gaps within the marketing systems while quantifying the loss or gains of the food chains.

- *Understanding the food market and the distribution patterns*: food availability can be threatened by the function of market flow. This can be observed in a context where agri-food surplus within poor areas are sent to areas with advanced equipment and markets for manufacturing. The purchase price increase when the food is returned to the poor or deficit areas due to transportation costs and poor market performance. Therefore, the approach of the FCV assists to ensure that the increased food productions can effectively reach those who are food insecure.
- *Analysing and addressing obstacles within the business enabling environment:* the business enabling environment shapes food availability through a range of factors such as trade and tariff policies, required product standards or grades, and transparent systems in food markets. Food availability and security can be significantly improved through the support towards a marketing structure which is based on transparency across all market actors. This will contribute to end unequal and discriminatory treatment of informal markets by policymakers which would provide enormous benefits to households that are food insecure.

2.5.2 Food accessibility

Food accessibility is a fundamental human right for everyone and this access is influenced by several factors such as income and food prices, crop failure, and household capacity to deal with climate shocks (Walker *et al.*, 2010). The fact that South African households continue to experience high food insecurity indicates that the problem does not necessarily lie in inadequate food, but rather lies in inaccessibility to food (Aliber, 2009). Food accessibility tends to be low in the households headed by Black Africans and Coloured groups compared to households headed by Whites and Indians (De Cock *et al*., 2013). In addition, children headed households are most likely to experience inadequate food accessibility and food security mainly due to lack of income (Van Wyk & Dlamini, 2018).

Food inadequacy and hunger remain a challenge for South African citizens (Frayne *et al*., 2014). Pereira and Ruysenaar (2012) assert that hunger is not merely a result of inadequate food availability but it is caused by a combination of factors which include accessibility, utilisation, and quality of food. This can be seen across South African households that experience hunger due to poor accessibility and utilisation practices. Poverty-stricken households are unable to adequately produce their food and purchase food wherein economic shock serve as a factor that contributes to food insecurity (Aliber, 2009). As a result, the FCV is working towards expanding the production

of nutritious food, maintain price affordability for poor consumers, and maintain quality standards while considering the cultural acceptability to enhance household diets (Hawkes & Ruel, 2012).

The FCV stakeholders work together to ensure that consumers have access to any food products throughout the year. This means having access to all fruits and vegetables in all the seasons such as having lettuce in the early spring, avocados in summer and corn throughout the year (Nassirou, 2016). Although this year-round food access can be costly, most high and middle-income groups are willing to pay the price (Barrett, 2010). Nassirou (2016:568) further posits that "there is a need to integrate food chains with support services (e.g. water and energy) for targeted commodity chains based on the market demand". This emphasises the fact that affordability and physical access have a major influence on food accessibility (FAO, 2017).

The FCV infrastructure and storage systems affect the amount of food lost or wasted throughout the supply processes whereby large amounts of post-harvests are lost (Coleman-Jensen *et al*., 2004). The rapid increase in food markets and stores by retailers shows a positive influence on food accessibility and food security (Deloitte, 2015). Retailers offer convenient and affordable products and services. On the other hand, food outlets tend to influence people's food choices through advertisements and available products in stores (Barrett, 2010). This is a problem, especially for those in poor rural areas since there is an uneven distribution of food markets within the immediate neighborhoods (Aliber, 2009). In addition, the barrier of access to food is the cost of transportation that decrease the potential for residents to access healthy foods (Evans *et al*., 2015). This makes maintaining a healthy diet in a food desert area very difficult (Walker *et al.*, 2010).

The FAO (2017) proposes that food waste can be optimally minimised using a food energy efficiency approach such as avoiding over-buying fresh foods and food recycling waste. The food energy efficiency approach improves the FCV because energy loss will be reduced from harvesting to processing and consumption. Food manufacturers have identified storage (especially refrigeration) as a challenge that increases food waste (Evans *et al*., 2015; Scholtz & Von Bormann, 2016). Processed food with non-refrigeration requirements such as precooked and canned foods is one of the measures developed to reduce food waste and these products are continuously improving with the evolving consumer demands. Processed products offer value for money because they generally expire after longer periods, are packed with flavor and preserved nutrients (Pereira, 2014). Deloitte (2015) states that canned foods offer affordability and convenience to consumers and the incorporation of canned fruits and vegetables can improve daily diets. Consequently, this reduces the chances of food waste since these products have long shelf life that can last for up to five years (Evans *et al*., 2015).

The food chain role-players propose the application of FCV approaches to address the issues and challenges hindering sufficient food access (Berti *et al*., 2004). These approaches include increasing and diversifying household food productions; balancing income and consumption; and reducing the cost of attaining food (Hattersley, 2013; Hawkes & Ruel, 2012; Graef *et al*., 2014).

- *Increase and diversify food production*: the FCV approach is focusing on increasing yields from existing food chains to improve crop productions that are essential for food security. For example, the Kenya Maize Development Programme (KMDP) focused on increasing maize productions for household access and minimising the land space used to cultivate maize to use other lands to cultivate various profitable crops for income and diverse diets.
- *Balancing income and consumption:* The FCV promote the horizontal food chain relationships which promote bulk food productions into marketable quantities to enable better revenue for purchasing food and surplus food for household consumption. Another important approach is to encourage diverse income sources where risk can be divided into multiple income sources for better cash flow stability.
- *The reduction of costs associated with attaining food*: FCV initiatives aims to increase the efficiency of agricultural productions while lowering purchase prices through sustainable practices. Since rural areas tend to suffer most from inadequate food access, the FCV assists in improving the cost and reliability of food. This can be done through increasing market information, reducing trade barriers, especially in staple food and harmonising food standards across regions.

2.5.3 Food utilisation

The FCV recognises and acknowledges the importance of education and information sharing regarding the origin and nutritional value of food products (Gómez & Ricketts, 2013). The FCV stakeholders provide information regarding the cycle of food products (i.e. contents of the product, how and where products are made and so forth). When consumers have an understanding of the origin and nutritional guide then better food utilisation is likely to transpire (Von Bormann, 2017). According to Scholtz and Von Bormann (2016), the first step begins with the food chain stakeholders in terms of understanding the importance and aim of providing value-added goods and services to consumers. Once all the stakeholders are on the same page then the message can be effectively transmitted to consumers (Von Bormann, 2017).

The quality of food can be reduced by the consumers' ability to handle and prepare food appropriately where filthy and unsterile facilities can cause contamination and food poisoning

(Abecassis *et al*., 2018). Thus, the food chain stakeholders apply various measured to promote better food utilisation such as printing information on the products' package: simple but healthy cooking or baking recipes, hygiene tips (e.g. hand wash), preparation and storage instructions (Fieldhouse, 2013). In addition, some food companies have developed easy to access websites where consumers can share and download healthy diet plans (Pereira, 2013). This is another way to understand and keep up with the consumers' needs and promote healthy lifestyles which are key to achieving food security (Abecassis *et al*., 2018; Pereira, 2014).

Research indicates that demographics, gender, and culture are the leading dimensions that influence how households use the food they have (Gómez & Ricketts, 2013). The millennial group is health conscious and follow health-promoting diets and well-being, even so, the aging group is also shifting towards good health and longevity hence, the rapid growth in "healthy aging" (Coleman-Jensen *et al*., 2014). The FCV offers basic products that have good taste and healthful benefits rather than diet fads which come and go over time (Deloitte, 2015). The high price range of food products tends to threaten household food stability (Gómez & Ricketts, 2013).

Studies show that most rural households are depended on subsistence production however, both rural and urban households are evolving and are increasingly becoming dependent on market purchases (FAO, 2017). According to Pereira (2014) low-income households usually spend more than 70% of their income on food. Botai *et al.* (2016) promote subsistence farming as a strategy to fight food insecurity and high food prices. This does not mean households that produce their food are not always food secure. Food consumption patterns and consumers' needs are changing with a sharp rise in meat and dairy intake. The challenge is that such products require intensive resources for production, which puts pressure on the global food chains (Deloitte, 2015). Research conducted by Godfray (2010) reveal that the production, processing, storing, and distributing patterns need to be changed to create effective food security strategies. Deloitte (2015) shares the same view with Godfray (2010) and further says that households have different ways of preparing, allocating, and consuming food and this has indirect influence on food security strategies by means of food utilisation (Deloitte, 2015).

The FCV works towards improving food utilisation through the following (Berti *et al*., 2004; Graef *et al*., 2014; Hawkes & Ruel, 2012; Keatinge *et al*., 2011):

- *Enhancing the analysis of nutrition-sensitivity:* the FCV considers and analyse various strategies to increase nutritional value while minimising harmful effects by focusing on all processes within in the food chain and the implications of the evolution of consumers' demands.

- *Promoting the demand for more nutritious food:* the FCV focuses on matching the consumer preference (e.g. taste, texture, and colour) with the nutrition value. This is important because consumers may not be willing to pay for nutritious food that does not taste or look appetising. For example, the Golden rice is high in vitamin A and beta carotene which offers positive health benefits. However, the rice has a yellowish appearance due to beta carotene and this turned off most consumers who are used to rice being white. In a study conducted by Hawkes and Ruel (2012) consumers in Mozambique were not willing to pay for orange-fleshed sweet potato until they became informed about the nutritional content in those sweet potatoes. In Australia, the amount of sugar in processed canned peaches was reduced after consumers raised their concerns (Hattersley, 2013). Thus, the balance between consumer preference and the FCV is key to promote food-secure households.
- *Improving household nutrition intake through leveraging relationships:* leveraging relationships with the food chain role-players enables transformation in household food utilisation through various ways such as behavioural change and nutritional communication.
- *Identifying opportunities for food safety and value-added products*: the focus of the FCV lies on balancing health benefits and minimising waste.

2.5.4 Food stabilisation

The FCV carries out the function to deliver a constant level of nutritious and affordable food supply throughout the year and in the long-term (Caldecott *et al*., 2013). However, short-term disruptions and shocks such as price fluctuations, trade and disasters may result in long-term effects within the FCV activities (Wagner & Bode, 2009). According to the FAO (2017), Pereira (2013) and Abecassis *et al.* (2018) the high and unstable food prices are a major cause of food instability in developing countries, including South Africa. Fluctuations in agriculture contribute to stress and uncertainties for farmers which influence their decisions, productivity, and revenue (Hawkes & Ruel, 2012). This, in turn affects consumers, especially the poor since a high percentage of their income is spent on food (Deloitte, 2015). The increasing food costs force low-income households to spend income on consumption expenditure rather than investing or saving (Van Wyk & Dlamini, 2018). The food inflation in South Africa increased from 3.6% in December 2019 to 4.6% in March 2020 (Simpson, 2020). According to Van Wyk and Dlamini (2018), an increase of 1% in food prices can significantly impact household welfare by 20% and these food items that had notable price rise such as bread, cereal, fish, and meat. Therefore, it should be noted that such price

increase tends to shake the food stability for poor households which ultimately threatens food security for these households (Von Bormann, 2017).

The relationship between food security and trade is complex due to a range of factors that influence the dimensions of food security directly and indirectly (Ashley, 2018). These factors include food production, competitiveness, prices, employment, marketing channels, and government revenues. As a result, food stability becomes reshaped through government services, food supply chains, household income and purchase power (Caldecott *et al*., 2013). Trade policies are important because traditional food supply chains have difficulties keeping up with the ever-changing and diversification of urban diets (Mabotja, 2019). Therefore, food imports provide a balance and make it easier to satisfy these demands (Wagner & Bode, 2009). However, some trade policies limit market access for emerging food chain stakeholders and increase the fluctuations of various commodities. This does not only affect food stability but food security as well, and most importantly the economic state of a country (Ashley, 2018). Most governments across the world implemented restrictions on trade policies during the 2008 price crises to promote domestic food security. These restrictions resulted in different impacts including expecting lower commodity prices, reducing cultivation areas due to high input costs, and panic-buying (Barrette, 2010). Furthermore, the restrictions increased food price fluctuations which increased global food insecurity (Wagner & Bode, 2009).

The occurrence of conflicts threatens the food supply stability significantly (Barrette, 2010). The FAO (2017) revealed that food insecurity is mostly high in countries that face or have faced conflicts. Food accessibility becomes an issue during and after conflicts mainly due to disruptions in the supply network and transportation of commodities. Consequently, people who experience persistent conflict are more likely to migrate to other regions in search of better living conditions (FAO, 2013). The challenge is that these immigrants are likely to become refugees and if there is a lack of support then it may lead to increased food instability and insecurity. Therefore, this results in a vicious cycle of conflict migration and food insecurity (FAO, 2017). The frequent xenophobic attacks in South Africa have raised major concerns for citizens and governments across Africa. Although the free trade agreement is not impeded, some governments became reluctant to take attend the World Economic Forum for Africa held in Cape Town, South Africa to discuss arrangements for free trade that could enhance economic interactions in Africa (Turkewitz, 2019). This accentuates the sensitivity of food systems and the influence of external factors (socio-economic, political, and environmental) on food security (Von Bormann, 2017). Not addressing these influential factors will lead to food emergencies where the food system is unable to respond or adapt to crises.

2.6 Key challenges and constraints towards sustainable food systems

A food system is defined as the coordination that consists of various dimensions and activities related to food production, processing, preparation, distribution, and consumption (i.e. inputs, people, markets, trade, and environment) (Barrett, 2010). A food system is sustainable when it produces adequate and nutritious food in such a way that the food and nutritional security of the next generation are uncompromised; this is regardless of stress and shock (Ashley, 2018). A food system should withstand extreme disaster events without disengaging components of the food chain which can make other elements exposed to risk. Key challenges and constraints faced by the food systems in South Africa are discussed in this section.

2.6.1 The role of business

The role of businesses in food systems is controversial in the sense that some businesses operate towards value-added, while others focus merely on profit while compromising consumers' health (Pereira, 2013). This role is driven by the concentration of food production and distribution, urbanisation, and globalization of food trade. Food retailers have a significant role in the agro-food chain whereby supermarkets offer a variety of food products to consumers (Scholtz & Von Bormann, 2016). Therefore, improving the relationship of businesses/retailers with local, national and global food chains is significant for food security (De Cock *et al*., 2013). In addition, the support and contribution by the government towards the business continuity planning for FCV actors is essential for improving the relationship of businesses within food chains (Wagner & Bode, 2009). Although a business continuity plan is common in large and multinational businesses, small agribusinesses tend to experience great losses during disaster events due to lack of business continuity plans. The establishment of business continuity plans for small businesses will contribute to establishing resilience and harnessing business operations and strategies to fight food insecurity (Hill & Pittman, 2012).

A study conducted by Noy (2009) revealed that disaster events reduce the 5-year growth of businesses and cause a rise in account deficit and debt. Therefore, innovation is a key component in food system businesses whereby adaptation and resilience against harsh environmental and economic changes can be enhanced (Pereira, 2013). In addition, innovation can also improve the consumption patterns by offering nutritional alternatives, particularly to consumers who are vulnerable to food insecurity. The retailers' business strategies and marketing of products are constantly motivated by the consumers on the end commodity chain (Scholtz & Von Bormann, 2016). Research shows that consumers expect food products that will always be available,

irrespective of seasons, thus the food system must apply innovative strategies to meet this demand. For instance, the availability of apples throughout the year, however, the season for apples is known as January to March (Pereira, 2013). This means that businesses need to find a balance between innovation and resilience (Gómez & Ricketts, 2013).

2.6.2 Research and multidisciplinary approach

Research initiatives and collaboration with scientific units play a major role in reshaping food chains into resilient systems (FAO, 2013). Multidisciplinary research is needed within the food systems of South Africa to discover hidden or unknown factors contributing to food insecurity (Mal *et al*., 2018). Although there are numerous studies based on agriculture and the threats thereof, studies based on other activities of the FCV are significantly limited. Moreover, information and statistical data are mostly separated from other threats which means that there is a knowledge gap on integrated analysis of multiple influencers and the cumulative impacts on food systems and food security (FAO, 2013). The multidisciplinary approach will help eliminate inter-sectorial barriers, preconceived notions, and overcome a lack of encouragement to closer cooperation. This is essential since the food system is influenced by a range of sources including socio-economic, political, and environmental structures (De Lange, 2015). The key point is that extensive coordination and corporation across the food systems is needed because the bottlenecks within the food system cannot be addressed by a single department or sector (Gómez & Ricketts, 2013; Graef *et al*., 2014). There are several assessment models and frameworks for assessing the food production sector, however, combining these approaches will lead to a richer and holistic assessment of food systems (Wood *et al*., 2010). Furthermore, it will fill up the existing knowledge gap and provide greater insights that are essential for coordinated and concerted food security in South Africa and across the globe (FAO, 2013).

There is a lack of research evidence on how consumers perceive information food safety issues (Wood *et al*., 2010). In a research conducted, nutritionists hoped to receive good feedback when they indicated the nutritional value of orange-fleshed sweet potato, however, this revealed negative results from the expectations of the consumers (Lagerkvist *et al*., 2016). This shows that even positive information may not be perceived as good according to consumers. Thus, stakeholders from other sectors can contribute to fuller research regarding the food system as a whole (Gómez & Ricketts, 2013).

The need to bridge the research gap is of great importance in acquiring an insight into the behaviour of the FCV and DRR (Lagerkvist *et al*., 2016). Although there are statistics regarding

the occurrence and impacts of disaster incidence, they fail to indicate the impacts of such incidence on the food systems at the local level. Thus, this emphasises the need for awareness and data interpretation of the role of disasters in food systems (Tirivangasi, 2018). Scholtz and Von Bormann (2016) go on to say that achieving sustainable food systems requires targeting and engagement with poor consumers to understand the nutritional gaps and establish food chains that can sustainably address these gaps. In addition, these food chains should incorporate the background and traditional profile of communities for effective results.

2.6.3 Culture and religion

Food forms a major part of our culture and lives in terms of what can be eaten, what is eaten, when and where it is eaten, and who can eat what (Madiba, 2006). Therefore, culture and religion have the power to influence the food system through what consumers ruminate as acceptable for consumption (Chakona & Shackleton, 2019). Various cultures and religions have different preferences and appreciation of food and cultural believes and norms hold much power in the sense that they guide daily decisions and activities (Kittler *et al*., 2011). A study conducted by Botlhoko and Oladele (2013) on farmers' participation in government projects in South Africa revealed that most farmers applied their traditional believes in farming for example, some farmers chose not to use drought-resistant seeds because of cultural beliefs. This shows that certain decisions may be guided by traditional norms mainly due to the fact that that has always been the way of doing things (Botai *et al*., 2016).

Food taboos that are based on traditional backgrounds influence the local food markets mainly because food is subjected to traditional believes before being accepted for consumption (De Cock et al., 2013). Often if not all the time, the food taboos are based on a hypothesis that has not been proven, however, they hold so much power and are passed on to generations (Botlhoko & Oladele, 2013). The challenge is that such taboos can reduce nutrient intake and promote health risks for example, a study based in the Eastern Cape province of South Africa revealed that pregnant women are not allowed to consume various food which includes the entrails and internal organs of animals, eggs, pumpkin, and fish because it is believed that these will cause miscarriage (Chakona & Shackleton, 2019; Madiba, 2006). Thus, various communities have different meanings of food which has a significant impact on the supply chain across communities whereby food accepted by one culture may be rejected by another cultural group (De Cock *et al*., 2013). Another example hereof is grasshoppers which are considerderd as an important and common source of protein in the Limpopo Province, but not so common in other South African provinces (Madiba, 2006). South Africa is well known for its cultural diversity, however,

information on the impact of culture and religion on food systems in the South African context is fairly limited (Chakona & Shackleton, 2019).

The most common religious practices among the black population in South Africa involve chicken and goat slaughtering, however, not all of these slaughtered animals are reflected in the records of Livestock Identification and Tracibility System (LITS) (Delport *et al*., 2017; Kittler *et al*., 2011). As a result, this influences the demand for livestock which adds a strain to the food system's capacity to deliver livestock that is used primarily for rituals and/or consumption (Delport *et al*., 2017). The demand for meat production has increased from 38.6 per capita consumption in kilograms to 41.2 per capita consumption in kilograms from the year 2014 to 2017 (Delport et al., 2017). On the contrary, some religious beliefs prohibit meat consumptions. According to the Islamic religion and Zionist Christian Church believers, pork should be avoided altogether while the Roman Catholics avoid meat on Fridays and during Lent. Some Muslims eat only halal-slaughtered beef, while others are Lacto-vegetarian (Madiba, 2006). It is important to understand the role of culture and religion in food consumption because this influences food demands, food markets and consumption patterns all of which play a role in food security (Botlhoko & Oladele, 2013).

2.6.4 Changing food consumption patterns

What and how people consume food is highly influenced by residential sites, socio-economic, and political factors surrounding people along with the processes of change (Pereira, 2013). According to Pereira and Ruysenaar (2012), the growing transformation of rural-urban migration has led most South African households to purchase some if not all of their household food. Food consumption in South Africa has been shifting from the traditional diet towards Western diets and this is indicated in several food-related studies (Delport *et al*., 2017; Pereira & Ruysenaar, 2012; Weatherspoon & Reardon, 2003). The overall intake in daily kilojoules has increased with higher caloric sweeteners, high interest in processed and packaged products, and increased livestock consumption. Consumers have shown a high interest in the consumption of soft drinks, fats and oils, sweet and savoury snacks and sauces with a shift from fruits and vegetables (Tschirley *et al*., 2015). This shift is motivated by the consumers' convenience, indulgence, the commodification of products and nutrition. The downside of such a shift is the impacts of low nutritional intake that contributes to obesity and other food-related diseases (Labadarios *et al*., 2005).

In South Africa, most white people have a high intake of sugar-free, low fibre and carbohydrates that consist of three meals per day, whereas most black people follow a traditional diet with low sugar, moderately high fibre, and high carbohydrates (Madiba, 2006). However, some black people are changing to Western food consumption patterns, especially those residing in urban areas (Pereira, 2013).

In South Africa, the black population commonly uses livestock for cultural practices and rituals. For example, a goat is usually used as a sacrifice to please the ancestor and to unite families after marriage (Madiba, 2009). There is uncertainty regarding future livestock and how the demands will be met sustainably while considering the social and environmental impacts (Kittler *et al*., 2011). Livestock systems depend heavily on natural resources, thus, keeping ecosystems sustainable is vital. Some authors have researched livestock systems but they do not address livestock issues in an integrated and comprehensive manner (Rosegrant *et al*., 2009; Monteith, 1997). As a result, the future development of a sustainable livestock system is downplayed in South Africa (Bruinsma, 2017; De Cock *et al*., 2013; Delport *et al*., 2017).

2.6.5 Agricultural sector

The Agricultural Research Council (ARC) has indicated that the number of commercial farmers has declined, and this is mainly due to lack of knowledge, expertise, and water shortages in South Africa and other developing countries (Pereira, 2013). The agricultural industry requires and consumes the largest amount of freshwater and this amount is further affected by the increasing demand for water for municipal and industrial usage (Botlhoko & Oladele, 2013). Research shows that 1 kg of beef production requires 15 500 litres of water, 1 kg of poultry – 3 900 litres and 1 kg of wheat – 1 300 litres (Kwasek, 2012). This is projected to put a strain on freshwater sources, especially blue water that is used for irrigation. Furthermore, climate change is another leading threat in agricultural productions with drought and floods as common threats to the country (Nahman & De Lange, 2013; Pereira, 2013). As a result, the use of pesticides and antimicrobials leading to pathogens and the antibiotic-resistant pest is increasing (Bryan *et al*., 2009). Other studies project a potential disruption of phosphorus in the future due to the large quantities of nitrogen (Kwasek, 2012; Rosegrant *et al*., 2009; Swartzendruber, 2014). The ARC pointed out that there is a need for the integration of small-scale and large-scale farmers to support and facilitate sustainable agricultural practices such as agribusinesses, nutrition-sensitive agriculture, climate-smart-agriculture, and agroforestry (Pereira, 2013). Although there is vast literature based on agriculture and sustainability, there is a gap in terms of implementation and practice in South Africa (Botlhoko & Oladele, 2013; Gulati *et al*., 2013; Hamann *et al*., 2009).

The high food demand coupled with climate change uncertainties presents a challenge for food producers in terms of reaching a balance to produce 'more' versus 'better' products (Mal *et al*., 2018). The South African population growth is estimated to be 1.2% per year and it has reached 55,7 million with the Gauteng Province as the most populated (i.e. 24.1% in the year 2016) (Stats SA, 2017). Farmers need to produce more food using less intense resources particularly with regards to natural resources for example, an initiative called "Farming for the Future" is reinforced by Woolworths to build capacity of farmers regarding climate change adaptation and sustainable farming skills (Pereira, 2013). Another example is from the Tiger Brands Company. This company uses only sorghum in the production of its instant porridge called Morvite and this is because sorghum is more resistant to climate change and more adaptive to most geographic areas as opposed to maize (Pereira, 2014).

2.6.6 Building capacity around sustainable food systems

Food systems in South Africa pose a challenge to the future because of the decline in commercial farmers and this may mean that the country is likely to depend on exports for food (Clapp, 2017). However, this can be turned around with the focus on collaboration and partnership among the food system stakeholders together with other sectors. This means that building capacity in food systems requires the involvement of everyone in the country since everyone is a member of the food chain (De Lange, 2015). Sustainable food chains need more exposure and promotion through which other producers can learn and apply sustainable practices. In addition, information platforms where consumers can be educated about sustainable food products and their social and environmental benefits have to be strengthened (Deloitte, 2015).

The need for training, expertise, and specialization in sustainable food systems cannot be overemphasized in the country (De Cock *et al*., 2013). The FCV stakeholders need to be educated and trained about the importance of diversified organic production systems such as agroforestry, livestock, legumes, fruits, and vegetables. The use of farm models can be used to experiment with such practices because the models offer an opportunity for testing strategies and solutions. Furthermore, these models can create an environment that promotes market-based approaches and resilient food systems (Clapp, 2017). The destruction of farms and livestock is the most recognised, however, the impacts of climate change and disasters go further into the entire food chain (Deloitte, 2015). A disruption or breakdown of one stage in the food chain is more likely to influence the other stages or the entire food chain. It is important to address the poor integration between the food industry and other sectors to understand the diversity and extent of disaster risk on the FCV to propel sustainability against food insecurity (De Lange, 2015; Godfray, 2010).

2.7 Conclusion

The rapid population growth continues to put a strain on food markets with climate change as a catalyst to food insecurity. The high prevalence of food insecurity indicates that the food markets are ineffectively performing their role of connecting the producers to consumers. This is marked by the number of citizens with severe inadequate access to food in South Africa. The increase of climate change-related hazards in terms of frequency and extent intensifies vulnerability to food insecurity.

Key challenges and constraints faced by the food systems in South Africa were highlighted to understand the gap and opportunities needed for improvement. Each year livelihoods and food chains are destroyed due to disaster events and this threatens the availability, accessibility, and stability of food. Analysing the FCV from the perspective of DRR is crucial for addressing the threats within the food chain, promoting sustainable value-added products, and ensuring resilience. Since both the FCV stakeholders and disaster risk management role-players share the goal of improving food security while protecting the environment, an integrated approach would enhance the strategies and policies towards securing this goal. The next chapter will investigate the benefits and challenges of implementing integrated policies. The integrated FCV and DRR programmes will also be discussed to highlight the opportunities or challenges for such integration.

CHAPTER 3: LEGISLATIVE AND STATUTORY INTEGRATION FOR FOOD SECURITY

3.1 Introduction

The previous chapter mainly focused on the relationship between the Food Chain Value (FCV) and Disaster Risk Reduction (DRR) which indicated that food security and disaster risk are closely related therefore, there is a need for a multi-sectorial approach that will lead to a holistic analysis to address food insecurity. Furthermore, it revealed the importance of DRR in the FCV which strengthens the state of food security. Chapter 3 further explores the context of DRR legislation concerning food security and policy integration. This chapter aims to address research objective three (3), i.e. to explore how DRR legislations and statutory frameworks integrate the FCV for improved food security in South Africa. This chapter begins with analysing the emergence of DRR and Disaster Risk Management (DRM) legislation from a global perspective with the focus on prominent international policy developments such as the Hyogo Framework for Action of 2005 to 2015 (HFA) and Sendai Framework for Disaster Risk Reduction 2015–2030 (SFDRR). Secondly, a discussion on the history and make-up of the DRR profile in South Africa is provided to show the development of legislation and structures concerning DRR in the country. Then, an investigation into the key gaps that influence the implementation of DRR legislation is given. Furthermore, an analysis of South African food security initiatives is provided, with a focus on policy integration and its importance in addressing food insecurity. International frameworks and programmes with integrated FCV and DRR are discussed, and lastly, a discussion about the programmes and policies that effectively improve food security through the integration of DRR and FCVs in South Africa is given.

3.2 Global policies leading the agenda of Disaster Management

The development and establishment of policies with the agenda to promote safe living conditions through disaster management and risk reduction globally started in 1989 (UNISDR, 2004; Van Riet, 2016). These policy developments include the International Decade for Natural Disaster Reduction (IDNDR); Yokohama Strategy and Plan of Action; International Strategy for Disaster Reduction (ISDR); Hyogo Framework for Action 2005–2015 (HFA); and the more recent Sendai Framework for Disaster Risk Reduction (2015–2030) (Figure 3-1) (Aitsi-Selmi *et al*., 2015:166).

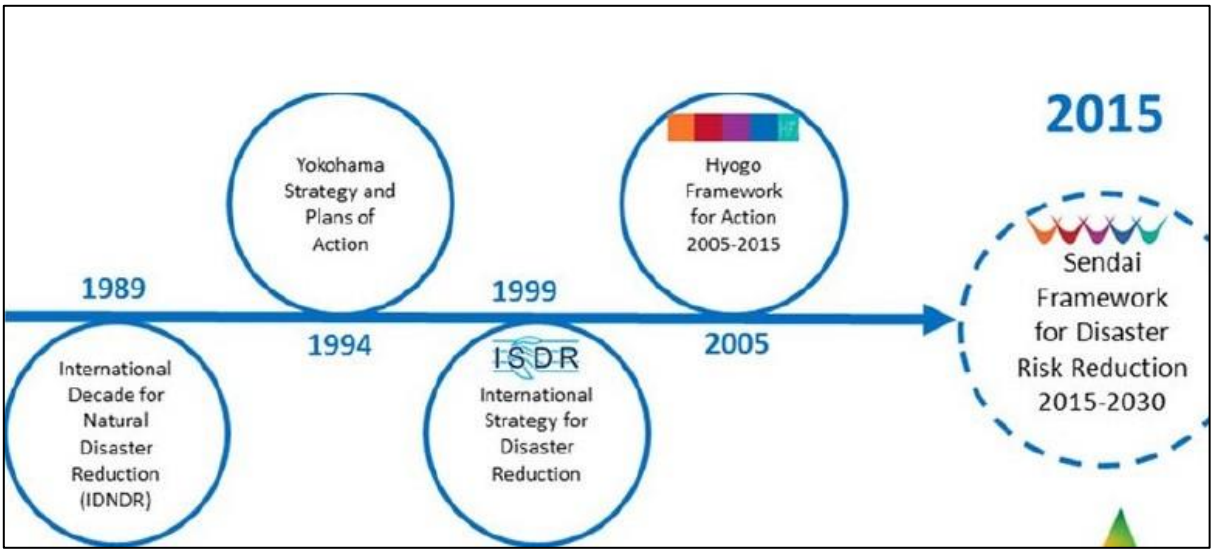


Figure 3-1: Global policy development towards disaster management agenda (Aitsi-Selmi *et al*., 2015:166)

3.2.1 Yokohama Strategy and Plan of Action

The International Decade for Natural Disaster Reduction (IDNDR) was developed by the United Nations General Assembly and launched in the year 1990 (UNISDR, 2004; Westgate, 2005). Although the IDNR ended in 1999, it became an eye-opener with several lessons learned from this period in time (Westgate, 2005). As a result, the Yokohoma Strategy and Plan of Action was established in order to address the issue of DRR integration into development processes in 1994 (UNISDR, 2004). The strategy recognised the importance of mainstreaming disaster prevention and preparedness into policies at national, regional, bilateral, multilateral, and international levels (Olowu, 2010). The Yokohama Strategy and Plan of Action recognise the importance of mainstreaming disaster prevention and preparedness into policies at national, regional, bilateral, multilateral, and international levels (Olowu, 2010). The strategy specifies that the integration of DRR and relevant developmental issues should be the focal point when designing development policies. This integration is said to reduce vulnerabilities holistically. Moreover, this integration was emphasised on due to a limited understanding and exploration of the potential benefits which needed to be tapped on across various sectors, particularly the public and policymakers (De la Poterie & Baudoin, 2015). Several factors were identified as barriers to this lack of integration, such as lack of resources, absent political will, and implementation activities across all levels (Olowu, 2010). These gaps were to be addressed through the assistance of the International Strategy for Disaster Reduction (ISDR), which was created to integrate disaster reduction and sustainable development (De la Poterie & Baudoin, 2015).

3.2.2 International Strategy for Disaster Reduction (ISDR)

The International Strategy for Disaster Reduction (ISDR) was established in 1999 and it continued the objective to promote DRR through raising awareness and facilitating risk assessments and management (UNISDR, 2004). The ISDR had the main goal of assisting communities to work towards achieving resilience against disasters and protect valuable assets, which included the environment. The broader objective of the ISDR was also in line with the IDNDR and the Yokohama Strategy i.e. to integrate DRR into sustainable development (Llosa & Zodrow, 2011). The ISDR facilitated an inter-agency effort by governments and communities, particularly the vulnerable groups, to integrate risk management into development initiatives. Furthermore, the ISDR called on governments and other organisations to integrate DRR into the establishment of poverty reduction initiatives and other development policies (UNISDR, 2004; Van Riet, 2016).

On a practical level, the ISDR called for the integration of DRR in agriculture and food security policies. This is recognised as crucial because numerous people, particularly in developing countries, depend on agriculture for food and survival (Llosa & Zodrow, 2011; UNSCD, 2004). The ISDR task team focused on addressing the issues of drought and land use planning to accomplish this policy integration. In the year 2005, the second World Conference on DRR was to be held in Hyogo, Japan to enhance DRR and the integration thereof (Westgate, 2005). During this conference, the Hyogo Framework for Action 2005–2015 (HFA) was adopted which became the leading international policy to represent DRM for more than a decade (UNISDR, 2005).

3.2.3 Hyogo Framework for Action 2005–2015 (HFA)

The Hyogo Framework for Action of 2005 to 2015 (HFA) consisted of 168 signed country stakeholders who aimed to build resilience against disasters in nations and communities (Olowu, 2010). Additionally, the HFA had the objective to identify gaps and to promote knowledge and information sharing. The set objectives were believed to fulfil the expected outcome of reducing disaster losses which include lives, socio-economic assets, and the environment (UNISDR, 2005). To successfully realise this outcome, five (5) priority areas were identified.

The UNISDR (2005) highlighted the five priority areas that were set to ensure resilience against disasters. The first priority area was focused on ensuring a strong institutional foundation for the implementation of DRR as a priority at the national and local levels. The second priority for action aimed to enhance the identification, assessments, and monitoring of disaster risk while also improving the establishment of early warning systems. The third priority supported and promoted

the need for creating a culture of safety and resilience using the sharing of knowledge, education, and innovation. The fourth priority was targeted at reducing the underlying risk dimensions. Then, lastly, the HFA prioritised disaster preparedness to enhance the response to disasters.

The first priority area (i.e. DRR institutionalisation) emphasised the need for policy integration which can be through the creation of national legislative frameworks that encourage mechanisms for DRR integration (UNISDR, 2005). To achieve this, various platforms such as the Global Platform where knowledge and experiences were shared among countries, and national platforms to monitor the implementation efforts of this integration had to be implemented. The fourth priority area (i.e. reducing underlying risks) also involved the integration of DRR into development plans such as poverty eradication. Although the relevant stakeholders or sectors were not specified, the value of the integration was acknowledged (Olowu, 2010). Following the HFA, the Sendai Framework for Disaster Risk Reduction (SFDRR) was implemented for the years following 2015 until 2030 (UNISDR, 2005).

3.2.4 The Sendai Framework for Disaster Risk Reduction 2015–2030 (SFDRR)

In 2015, the Third United Nations World Conference was held at Sendai, Japan whereby the Sendai Framework for Disaster Risk Reduction for 2015–2030 (SFDRR) was adopted (UNISDR, 2015). This framework is a 15-year plan that is expected to end in the year 2030. The priority areas of SFDRR are similar to those of the HFA, because the main focus of both frameworks is to enhance and build on past experiences and lessons learned from previous policies (Carabine, 2015).

The SFDRR however, only has four (4) priority actions (and seven Targets) towards preventing and reducing the emergence of new disaster risks. The first priority area focuses on improving the understanding of disaster risk. The second priority focuses on managing disaster risk through strong and good governance. Thirdly, the priority is focused on establishing resilience by investing in disaster reduction. Lastly, the fourth priority action is about strengthening disaster preparedness for better response, recovery, rehabilitation, and reconstruction to disaster impacts (UNISDR, 2015). These priorities have an important connection to this research study in the sense that policy integration is a central component of the SFDRR and of this study.

In section 27 (a) of the SFDRR, policy integration is further emphasised by ensuring that the priority action 2 is attained, and through the call for mainstreaming of DRR into all sectors (UNISDR, 2015). Additionally, better coordination and coherence of national and local legislation

is promoted. Section 27 (g) highlights the importance of coordinating forums and relevant role-players which can be carried out in the establishment of DRR platforms when addressing issues of disaster risk (Carabine, 2015). In addition to the seven Targets of the SFDRR, the Africa Regional Plan of Action adds another five targets specific to African countries (UNISDR, 2015). For the purpose of this research study, the integration of DRR and the FCV is relevant and highlighted as a need for improving food security.

Therefore, the above-mentioned global policies highlight that each country needs to take responsibility and accountability for the implementation of legislation that integrates DRR and other issues faced by civil society (UNISDR, 2015). It is worth noting that these international policies do not have a clear specification about integrating DRR with the FCV, nor with food security. The sense of integration is based on a broader context of developmental issues which include poverty and agriculture (Carabine, 2015). The downside of this ambiguity is that government bodies are less likely to prioritise matters concerning the FCV and food security. Each country is different and therefore the establishment and implementation of the international policies are more likely to differ (Llosa & Zodrow, 2011). Thus, a call for national governments to transform international policies to accommodate the citizens and their conditions. South Africa is one of the countries that has been making progress in transforming international policies to build national legislation concerning DRR (Van Riet, 2016). The following section is focused on unpacking the development of DRR in South Africa.

3.3 The South African DRR profile

The development of DRR followed a different path compared to other continents like Latin America and Asia in the sense that there was no explicit policy stature and secure financial commitment before the 1980s (Schipper & Pelling, 2006). This was mainly due to lack of finance and knowledge regarding risk reduction. Thus, Africa has become dependent on international assistance as a way of disaster relief, which is a short-term solution that does not promote resilience (Westgate, 2005). Although international assistance offers good results, it creates a sense of dependency on international countries which contributes to the delay in the establishment of local DRR strategies and programmes (Van Niekerk, 2008; Van Wyk, 2007). Political priorities in Africa, particularly in South Africa, are shaped by historical events that focus on struggles for independence and freedom from oppression. Unfortunately, even after democracy, the primary focus of policy making is not environmental protection and disaster reduction (Lukamba, 2010; Van Wyk, 2007). As a result, issues based on nature conservation

and sustainability do not receive the same attention and efforts as other development and security issues in Africa (Van Niekerk, 2008). This is despite a lot of literature and publications indicating the close relationship between disaster risk and development (Hoogstad & Kruger, 2008; Lukamba, 2010; Schipper & Pelling, 2006). Furthermore, it has not been easy to translate potential technical lessons that have been learned from other regions due to Africa's unique risk profile (Mercer *et al*., 2010).

The South African DRR profile shows a positive trend with regards to the establishment of institutional policy frameworks and legislation for DRR (Westgate, 2005). According to RSA (2005) and Van Wyk (2007) the South African disaster risk legislation is considered pioneering in Southern Africa. While most Southern African countries have altered their legislative frameworks, the ability to adapt and keep up with these alterations remains difficult to achieve (Mercer *et al*., 2010). The South African government developed national policies for disaster management after 1994 when the country marked a constitutional democracy. The aim was to make the country a better and safer place for every citizen against the backdrop of Apartheid (Hoogstad & Kruger, 2008). The government began to acknowledge the role of disasters and the need for implementing measures to manage and reduce the risk for citizens. Thereafter, the cabinet approved the Inter-Ministerial Committee for Disaster Management in 1997 which was assigned to establish legislation for disaster management in South Africa (RSA, 2005). The Green Paper on Disaster Management developed in 1998 provided a platform for analysing current and future disaster management strategies while promoting public participation. This was followed by the development of the White Paper on Disaster Management in 1999, which focused on translating disaster management strategies into priorities (Schipper & Pelling, 2006). In the year 2000, the Inter-Ministerial Committee for Disaster Management made the Disaster Management Bill open for public debate, which has created opportunities for multi-disciplinary engagement and knowledge sharing. The public posited that integration, coordination, and a uniform approach are essential to facilitate disaster management (RSA, 2005).

As a result, various institutional arrangements and structures were developed to support the implementation of better coordination for disaster management across different departments (Reid & Van Niekerk, 2008). For example, the National Disaster Management Centre (NDMC), the National Disaster Management Advisory Forum, and the National Disaster Management Framework (NDMF) (Reddy, 2010; RSA, 2005) were established. The subsections that follow offer discussions on the various disaster management frameworks and structures that form part of the DRR profile and the implementation thereof in South Africa.

3.3.1 The Disaster Management Act 57 of 2002 (DMA)

In 2002, the Disaster Management Act 57 of 2002 (DMA) was promulgated and became effective as of the 15th of January 2003 (Luphindo, 2012). The DMA focuses on disaster reduction and the requisite for proper arrangements, planning, incorporation, and coordinated disaster management systems of which policies from other countries were assessed to gain insights that build understanding and knowledge regarding the legal composition of disaster legislation (Erasmus, 2005; Llosa & Zodrow, 2011; RSA, 2005).

The Act states that it is the responsibility of the South African public sector to carry and ensure that functions of disaster management are fulfilled throughout all three spheres of government (i.e. from national, provincial, to local municipality level) (RSA, 2002a). In addition, it provides guidance and advice to line departments regarding functions of disaster management in various areas of expertise (Luphindo, 2012; RSA, 2005). This emphasises the importance and need for the involvement of various stakeholders in the cause to make the environment safer for all.

The DMA further facilitates the integration and coordination of a disaster management policy that aims to prevent, reduce, and mitigate disaster risks and establish effective preparedness, response, and post-recovery (RSA, 2002a).

The success and effectiveness of the Act is highly dependent on the integration and coordination of various stakeholders towards the reduction of disaster risk (Luphindo, 2012). This is aligned with the focal point of this research study which calls on the integration of co-related sectors to address the issue of food insecurity. According to Reddy (2010) it would be impossible to achieve a sense of cooperative governance and policy integration without flexible institutional arrangements as stipulated by the DMA. It is important to note that certain platforms or structures (e.g. NDMC and National Disaster Management Advisory Forum) need to be established to achieve the cooperativeness and integration as envisioned by the Act (RSA, 2002a). For this study, national governmental structures are discussed, particularly those that emphasise integration.

3.3.2 The National Disaster Management Centre (NDMC)

On 19 March 1997, the Cabinet sanctioned for the establishment of the National Disaster Management Centre (NDMC) which is a structure that is in accordance with the DMA (RSA, 2002a). This was after realising that there is a need for a facility structure that will provide an environment that promotes the responsibility to support provinces and local government in the establishment of disaster management and reduction (Reddy, 2010). The NDMC is obligated to

support the integration of disaster management approaches and development plans as stated in section 20(1)(c) of the DMA (RSA, 2002a). Furthermore, the NDMC is tasked to establish guidelines for preparing, reviewing, monitoring, and updating disaster management plans and strategies set by various stakeholders and line departments as stipulated in section 19(a) of the DMA (Erasmus, 2005; RSA, 2002a). The line departments include DAFF which would mean that the food security legislation and initiatives set out by DAFF consist of DRR measures (Van Riet, 2016). The NDMC is also obligated to establish institutional arrangements for the development and approval of integrated DRM policies as stipulated in section 4 of the DMA. To achieve this, a national forum known as the National Disaster Management Advisory Forum (NDMAF) has been established to enable and promote dialogue (Reddy, 2010).

3.3.3 The National Disaster Management Advisory Forum (NDMAF)

The National Disaster Management Advisory Forum (NDMAF) was established by the Minister for Provincial and Local Government in terms of section 5 of the DMA (RSA, 2002a). The NDMAF is a body whereby disaster management stakeholders and other line departments consult each other in order to coordinate their actions towards effective disaster reduction (RSA, 2005). The forum consists of the Intergovernmental Committee on Disaster Management (ICDM) which includes national cabinet ministers, provincial cabinet, and municipal councils who are all selected by the South African Local Government Association (SALGA) (Erasmus, 2005). The NDMAF provides advice and recommendations for disaster risk reduction and management to the ICDM and other line departments (Reddy, 2010).

It can be noted that the integration of disaster management legislative structures is encouraged in various line sectors (Hoogstad & Kruger, 2008). The NDMC and the NDMAF play a crucial role in facilitating this integration. Other than these legislation structures, the National Disaster Management Framework (NDMF) is a national document that serves as a national guideline for the integration of disaster management into various departments (Luphindo, 2012; Van Riet, 2016).

3.3.4 The National Disaster Management Framework (NDMF)

In April 2005, the Government Notice 654 of 2005 published the National Disaster Management Framework (NDMF). The call for the establishment and implementation of the NDMF is stipulated in section 6 of the DMA (RSA, 2002a). The NDMF aims to provide uniform approaches towards addressing disaster risks in South Africa through a coherent and transparent policy that focuses

on various disasters and reducing vulnerability in disaster-prone areas. The framework recognises integration and coordination as crucial aspects that form the foundation for the application of DRR approaches (Luphindo, 2012; RSA, 2005).

The NDMF has four (4) key performance areas (KPAs): (KPA1) Integrated institutional capacity for disaster risk management; (KPA2) Disaster risk assessment; (KPA3) Disaster risk reduction; and (KPA4) Response and recovery (RSA, 2005). The KPAs will be discussed below with emphasis on policy integration.

Key performance area 1 (KPA 1) focuses on implementing effective DRM legislation by integrating institutional capacity across all tiers of government in South Africa (RSA, 2005). This involves the adaptation of DRM policy and implementing relevant approaches for effective cooperative governance which is in line with section 4(3)(a) of the DMA (RSA, 2005). KPA 1 provides direction for integrated arrangements and implementation of disaster policies through the NDMC. Luphindo (2012) indicates that the location of the NDMC can facilitate or hinder the potential and functioning of the centre. Given the importance and need for coordinated governance in disaster management, the NDMC should be placed in the Presidency and not in the Ministry of the Department of Cooperative Governance to indicate the interest and commitment by the South African government (Reddy, 2010). A position in the Presidency would mean timely decision-making, response, and implementation of DRR. This KPA does not only focus on the national and local levels but it also extends to an international level where mutual agreements and partnerships can be formed in support of DRR (Erasmus, 2005).

Key performance area 2 (KPA 2) provides an approach that is uniform for conducting disaster risk assessments and monitoring which guides DRM planning and DRR (RSA, 2005). The risk assessments help reveal the likelihood and outcomes of disaster events experienced and future forecasts. Furthermore, disaster risk assessments incorporate and promote sustainability through development planning and identifying potential threats that undermine the development's success and sustainability (Luphindo, 2012). KPA 2 therefore, entails that identifying the threats makes it easier to design measures that address the problem from the root cause. The disaster management stakeholders and other role-players have the responsibility to monitor, update, and track disaster risk assessments (RSA, 2005). Nonetheless, there is poor integration and involvement between the NDMC and other role-players in conducting disaster risk assessments (Reddy, 2010).

Key performance area 3 (KPA 3) aims to ensure that DRR initiatives align with developmental plans through multi-stakeholder engagement (RSA, 2005). In sections 25, 28, and 35 of the DMA it is stated that preparations and alignment of disaster management plans and frameworks are

essential and should be carried out by government tiers, the public, and the private sector. This ensures that the aspects of disaster risk prevention and reduction carried out into ongoing development plans and initiatives which further strengthens opportunities for sustainability (Reddy, 2010). In essence, KPA 3 emphasises integrated planning for disaster management stakeholders and other role-players who tackle various developmental issues that are relevant to this research study for the promotion of food safety and security in South Africa (Erasmus, 2005).

Lastly, key performance area 4 (KPA 4) focuses on creating a coordinated and integrated policy that ensures timely and effective disaster response, recovery, and rehabilitation (RSA, 2005). KPA 4 assigns responsibilities to disaster management role-players according to the kind of expertise possessed by various role-players (RSA, 2002a). Given the four KPAs and the limited resources in South Africa, the Disaster Management Amendment Act (DMAA) is a good fit in ensuring a balance between outcomes and inputs.

3.3.5 Disaster Management Amendment Act No 16 of 2015

In 2015, the Disaster Management Amendment Act No 16 (DMAA) was approved (RSA, 2015). The amended Act is focused on elevating disaster management and DRR approaches within all three government spheres where major decisions are made (Van Riet, 2016). This includes strengthening support to organs of state regarding the reporting system on disaster occurrences, expenditure on response and recovery, risk reduction actions, and challenges in dealing with disasters (i.e. classification and declaration of disasters) (RSA, 2015). This is important because several disasters go unreported in South Africa and this makes it difficult to record trends or patterns and implement effective solutions (Becker & Van Niekerk, 2015; Manyena, 2013). The DMAA provides for the South African National Defence Force (SANDF), South African Police Service (SAPS), and any other organ of state to assist the disaster management structures in crucial events. Therefore, the Act emphasises the importance of collaboration and coordination to perform risk reduction and protect people from adverse impacts (Van Riet, 2016). For instance, the SANDF and SAPS are some of the frontline workers that protected citizens during the Coronavirus pandemic in 2019–2020. Another amendment is in line with the disaster management plans which need to include conducting disaster risk assessments for functional areas and risk mapping of various areas and communities that are vulnerable to disasters (RSA, 2015). The improvements of disaster management plans, specifically at the community level, will reduce the number of mortalities and livelihood disruptions caused by disasters due to the improved preparedness and institutional arrangements that need to be established as stipulated in the Act. The DMAA clarifies the roles and responsibilities of the national, provincial, and local

municipalities and this approach is said to improve the state of DRR implementation and accountability (Van Riet, 2016).

Overall, the establishment and growth of disaster management in South Africa has a sound legal foundation (Reddy, 2010). The important message from these legislative structures is that a multi-disciplinary approach and multiple sectorial integration are key components towards achieving sustainability and resilience (Van Riet, 2016). Additionally, the reality that disasters affect everyone, and any sector emphasises the need for a multi-sectorial approach for risk reduction (Reddy, 2010).

The downside of the disaster management legislation in South Africa is the lack of implementation (Schipper & Pelling, 2006). One of the major challenges is that DRR has failed to create an environment for the pro-active participation of the private and public sectors (Pereira & Ruysenaar, 2012). This is important because DRR is a multi-disciplinary approach. This means that various professions and sectors need to participate in order to create this holistic approach successfully (Reid & Van Niekerk, 2008). Schipper and Pelling (2006) illustrate that poor consultation with a wide range of stakeholders and conflicts with other legislation such as nature conversation or environmental laws are major mistakes made by the South African disaster management. The legislative gaps tend to inhibit the success of policy integration (Schipper & Pelling, 2006).

3.4 Gaps in legal frameworks and implementation of DRR policies in South Africa

The challenges and opportunities for the implementation of DRR legislation are influenced by the circumstances and experiences of a region (Pelling & Holloway, 2006). DRR policies are important because they translate ideas into motion for required actions. In addition, policies enhance the attention of government and other role-players on critical issues (Luphindo, 2012). Mattingly (2002) says that DRR legislation incorporates measures of prevention and risk reduction into everyday life. This section identifies the key gaps in disaster legislation and implementation that hamper the progress of DRR policies in South Africa.

3.4.1 Institutional arrangements and clear definition of roles and responsibilities

The institutional arrangements for DRR legislation involve the framework of laws, executive orders, regulations, acts, and other legal instruments that form the foundation for governmental and non-governmental actions for risk reduction and disaster management (Llosa & Zodrow,

2011; Pelling & Holloway, 2006). Institutional arrangements help define the authorities, roles, and responsibilities of officials and relevant stakeholders. Additionally, these institutional arrangements enable proper coordination and implementation of tasks or duties for successful outcomes (Holloway, 2009).

The primary challenge for DRR legislation in South Africa is the misalignments of responsibilities for disaster management, preparation of DRR plans, and financial allocation for disaster management (Hoogstad & Kruger, 2008; Luphindo, 2012). The state has the responsibility to protect the citizens' assets by preventing and minimising damage resulting from disasters (Pelling & Holloway, 2006). This means that the state has to ensure that the necessary resources and capacity are adequately provided to people and to facilitate multiple stakeholder interaction for DRR activities (Wisner *et al*., 2004). The hierarchical structure that governs DRM in South Africa is defined in the DMA and the NDMF across all spheres of government. However, the sense of clarity regarding responsibilities is still missing (Llosa & Zodrow, 2011). For instance, the metropolitan and district municipalities are obligated to ensure disaster management at a local level, and the legislation indicates the relations among district municipalities. However, the DRR legislation has gaps on establishing a balance regarding underlying drivers in the municipality structure such as budget planning, resource allocation, and prioritising disaster management (Holloway, 2009).

The DMA indicates that risk management plans should be incorporated with the Integrated Development Plan (IDP). However, this is not adequately carried out as a proactive practice (Llosa & Zodrow, 2011). Luphindo (2012) posits that the integration of DRR into the IDP needs to be analysed and explored fully. This can enhance community resilience through the increase of public participation which is a central goal in both the IDP and DRR. The important thing is to understand how DRR can be practically integrated into the processes of the IDP and to investigate the effectiveness of disaster management when integrated or separated from the IDP (Holloway, 2009; Van Riet, 2016).

There is a need for consistency between various but related legislation and plans for effective and comprehensive DRM in South Africa (Holloway, 2009; Llosa & Zodrow, 2011). This is relevant since different types of stakeholders are involved in ensuring the safety of communities and environmental protection, therefore, it can be expected that different opinions will arise. Thus, the importance of mediation of different opinions, interests, and actions would deliver the best results for communities (Van Riet, 2016). The function of land management is unclear in South Africa and this is mainly due to the lack of well-developed approaches and declaration of the Land Use Management Bill (Lukamba, 2010; Hoogstad & Kruger, 2008). Although this is a significant gap,

it should be considered as an opportunity to establish DRR as an integrated aspect in the land use legislation. On the other hand, the legislative structures for water and other natural resources are mainly well-developed however, the prominent disaster incidence of water issues and drought in South Africa remains a challenge (De Wet, 2020; Hoogstad & Kruger, 2008). Mattingly (2002) indicates that the lack of a standardised approach and inconsistency in DRR creates uneven development of capacity for communities. This is because a community can be approached by different stakeholders who use different modules or interventions for training and this leads to confusion among community members. Thus, arrangement and planning in the DRR legislation require an approach that is both consultative and interactive (Llosa & Zodrow, 2011; Mattingly, 2002).

Llosa and Zodrow (2011) warn governments and role-players against becoming too dependent on rules and regulations to govern their roles, actions, and responsibilities because this can cause holes or delays in areas where the rules do not cover specific circumstances. Two main approaches can be implemented to minimise such deficiencies: (1) establish a consensus between stakeholders regarding institutional deficiencies and overcoming such deficiencies, and (2) propose new legislation and encourage political support for DRR (Ling, 2002; Mattingly, 2002).

Transparency in DRR legislation and the decision-making processes are required to address uncertainties and reduce corruption (UNISDR, 2004). Transparency exists when dialogue and decisions are consistently applied and enforced in a way that complies with the regulations. In addition, it is about making information available to civil society in terms of clarity regarding government rules, regulations, and decisions (Becker & Van Niekerk, 2015). This is important because the level of uncertainties and corruption are exceptionally high in South Africa. The application of transparency encourages accountability, which means that DRR role-players can take responsibility to ensure good performance. Additionally, accountability also applies to the proper use of resources (i.e. human and technical) (Van Riet, 2016).

3.4.2 Adequate resources for DRR

The implementation and effectiveness of DRR legislation highly depend on supporting resources which include human, technical, material, and financial resources (Combaz, 2014). Therefore, it is important to acknowledge the existing policy integration that fulfils DRR functions to avoid duplication. This is important because it will reduce competition for power and resources; overloading laws that do not have comprehensive or coherent frameworks; avoid repeating mistakes; and financial losses or over-stretching budgets (Llosa & Zodrow, 2011).

Funding remains one of the biggest challenges in DRR legislation and implementation across the globe, including South Africa (Becker & Van Niekerk, 2015). The issue of funding has a negative impact on DRR initiatives, training, response, and rehabilitation activities. Llosa and Zodrow (2011) posit that governments need to ensure sufficient public expenditure for risk reduction and manage the residual risk through sufficient financial arrangements. However, poor or inappropriate budget allocation create a barrier for effective DRR legislation. The DMA does not provide clarity regarding the sources of funding for establishing and managing provincial disaster centres (Hoogstad & Kruger, 2008; Luphindo, 2012).

Clear regulations to compel the private sector to carry out risk reduction are omitted in the DMA (Hoogstad & Kruger, 2008; Van Riet, 2016). Private businesses need to be able to protect themselves from disaster impacts and uncertainties. On the other hand, the private sector can contribute opportunities towards strategies and resources to achieve resilience. This includes designing and establishing risk assessments, innovative tech devices, and fundraising (Llosa & Zodrow, 2011). For example, meteorologists, geographical information system (GIS) specialists, telecommunications, information technology (IT) specialists, statistical analysts, and media are some of the supporting mechanisms that the private sector may contribute towards DRR. This is important because it will facilitate participation, expand expertise and enhance risk reduction in South Africa (Becker & Van Niekerk, 2015). In Indonesia for example, businesses are required to adhere to disaster management legislation and report to the government while sharing information with the public and supporting humanitarian initiatives (Mattingly, 2002).

The process of knowledge and information sharing is usually susceptible to bias. This bias can occur in various ways such as organisational preference where priority is given to rural areas while urban areas are merely excluded (Becker & Van Niekerk, 2015). Pelling and Holloway (2006) note that it is crucial for researchers (among other role-players) to restrict bias from over-clouding real matters and the outcomes thereof. Partnership arrangements are required to eliminate confusion and promote knowledge sharing since multiple stakeholders are involved in DRR implementation (La Trobe & Davis, 2005).

Furthermore, there is a need for the application of highly advanced technology in DRR, especially within developing countries (including South Africa) where disasters threaten the livelihoods of the poor (Van Riet, 2016). Picard (2014) proposes that the use of data from earth-observation satellite and big data technologies needs to be increased for better forecasting and preparedness for disasters. The use of high-end technology can help establish portable and community-based early warning systems; impact-based early warning information and risk mapping; real-time data for efficient resource allocation; and timely emergency response. There are various examples of

the application of technology in DRR. The Spirit oil spill in Hebei in 2007 was successfully contained using DRR technology (Jones, 2015). The Watergen GEN-350 device was developed after the devastating incidence of wildfires in Southern California. This device cleans water that is sourced from the atmosphere to provide water to fire-fighters and other relief workers during high demand (Picard, 2014). In South Africa for example, the What3Words is used to assist emergency workers to locate disaster sites and victims on time. What3Words sends a link of the exact location (including areas without formal residential address) to emergency respondents through the caller's phone (Jones, 2015). The company of Itec Group South Africa has also designed a thermal screening device that has a thermal camera to detect the human temperature in real-time and provide an alert when the temperature is abnormal during the Coronavirus epidemic in the year 2020 (Mail & Guardian, 2020).

The use of technology and innovation has therefore been identified as crucial as the country aims to move into the fourth industrialisation (Scholtz & Von Bormann, 2016). To achieve this, the level of education and skills need to be significantly improved (Combaz, 2014; Van Riet, 2016).

3.4.3 Enhanced education, knowledge, and skills development

Education, awareness-raising, and training are critical for stimulating constructive behaviour and attitude for the development of sustainable practices which in turn leads to capacity building (UNISDR, 2004). Public awareness and outreach programmes have the ability to increase community empowerment, which means that people can effectively protect livelihoods and assets (Wisner *et al*., 2004). The partnership between disaster management stakeholders and communities contribute to the establishment of community based DRR approaches where a positive mental shit is stimulated. This mental shift assists communities to address the root causes and missing pieces that cause disaster risk (La Trobe & Davis, 2005; Maartens, 2011). Mattingly (2002) indicates that outreach programmes have positive results, however, these programmes are usually once-off events that may not be sufficient to change the behaviour and actions of people to reduce risk factors.

There is a great need for in-depth education and skills development across communities through which community members can take responsibility in ensuring the success of DRR initiatives, especially in urgent situations or when confronted with the need to complete or take over projects (Maartens, 2011; Wisner *et al*., 2004). Schools and higher education systems have a major role in promoting DRR education by introducing disaster management and reduction in the school curriculum or academic subjects (La Trobe & Davis, 2005). The efforts to integrate disaster

studies in higher learning have shown significant growth, however, lack of financial support by government remains a challenge in Southern African countries (Manyena, 2013). The government of Indonesia established the National Strategy for Mainstreaming DRR in Schools in 2010 to integrate DRR into subjects in school curricula to help children better understand and cope with disasters. This strategy is flexible and can be adjusted to fit the school programmes while in line with the national and local disaster management frameworks (Aitsi-Selmi *et al*., 2016). The South African National Disaster Management Framework (NDMF) identifies the integration of DRR into primary and secondary schools as crucial. However, there is a lack of practical integration which is mainly due to a lack of DRR training held by teachers and the finance to execute this integration. Nonetheless, several efforts have been implemented by various role-players such as the GIRRL Project (Girls in Risk Reduction Leadership) which was established by the African Centre for Disaster Studies (ACDS) at the North-West University, which aims to assist marginalized adolescent girls in understanding disasters and building resilience (Maartens, 2011). The North-West University established another project called the EAGER project (Engaging African G.I.R.R.Ls in Gender Enriched Risk Reduction) which was built on the success of the GIRRL initiative. The EAGER project was aimed at building capacity and public awareness concerning gender inequality and DRR. This included identifying and addressing issues around gender and disasters; advocating gender-based DRR knowledge; enhancing network channels and partnerships with international organisations; and improving research in academia that focused on mainstreaming gender equity and risk reduction (Van Niekerk *et al*., 2018). Such projects create a platform for skills development and community empowerment.

Priority needs to be given to knowledge development whereby people are taught about the complex dimensions related to DRR (Reid & Van Niekerk, 2008). The distribution and accessibility of information regarding DRR need to be made available to everyone i.e. organs of state and communities. This is important because it will help raise awareness and public participation which contributes to better decision-making in policymaking (Combaz, 2014). Research indicates that well-informed stakeholders make better and effective decisions (Aitsi-Selmi *et al*., 2016).

The sharing and transfer of information is important to enable community resilience, however, transformation across DRR role-players is the first step (UNISDR, 2004). This can be done by sharing knowledge, ideas, experiences, and information through various platforms such as forums, conferences, and workshops promote this transformation (Mattingly, 2002). Furthermore, joint training (theoretical and technical) and capacity development need to be integrated into various sectors to contribute towards disaster management and reduction. The annual Disaster Management Institute of Southern Africa (DMISA) Conference is a good platform for various stakeholders across Southern Africa and beyond to contribute meaningfully towards disaster

management and reduction (Pelling & Holloway, 2006; Van Riet, 2016). This platform is regarded as the biggest disaster conference in Africa. The Southern African Society for Disaster Reduction (SASDiR) is another Southern African Development Community (SADC) network platform that facilitates learning, teaching, research, and mentoring for DRR role-players while encouraging the sharing of innovative practices in Southern Africa through different tactics such as publications, seminars, conferences, and workshops. Such platforms as the few mentioned above contribute to the stimulation of new knowledge while recognising the value of indigenous and local knowledge. The members of these platforms become well equipped with knowledge that can be effectively shared with the community members to build awareness and empower communities (Picard, 2014; Van Niekerk *et al*., 2018).

The gaps within education and knowledge are further increased by different factors such as poor communication, inadequate sharing of best practices, poor decision-making based on limited information, lack of research, and unsubstantiated information and data (Wisner *et al*., 2004). One of the important ways to address these challenges would be to mainstream DRR with development facets such as education, public works, health department, construction, and environmental management (Van Riet, 2016).

3.4.4 Mainstreaming DRR with developmental planning

The objective of mainstreaming is to put critical cross-cutting matters into the forefront so that various sectors, businesses, and civil society can contribute towards addressing complex and cross-cutting matters (Van Riet, 2016). Mainstreaming DRR involves any action or process to integrate risk factors and identify DRR as an essential component for socio-economic and environmental development (Hoogstad & Kruger, 2008). The process aims to integrate DRR into conceptual and strategic frameworks across projects and policies within all governmental spheres. Thus, mainstreaming is an important process for institutionalising DRR into the functions of development processes and plans (La Trobe & Davis, 2005; Schipper & Pelling, 2006).

The side effects of development projects that are not centred on environmental protection and risk reduction result in higher risk for natural hazards (Manyena, 2013). Often, the government realises the importance of incorporating DRR in development planning only after an actual devastating disaster has happened (Luphindo, 2012). Section 5 of the DMA stipulates that the municipalities' integrated development plans need to incorporate disaster management plans, however, this remains challenging to date. At times, there may be a trade-off when it comes to economic development and risk reduction (Reddy, 2010; Van Riet, 2016). For instance, the

Reconstruction and Development (RDP) houses that were built in the KwaZulu-Natal, near Port Shepstone had collapsed during heavy storms and flooding in the year 2019. These houses should have been built with strong materials for flood-resistance since the area is prone to flooding but that was not the case and as a result, people lost lives, assets, and livelihoods (Singh & Mkhize, 2019). Llosa and Zodrow (2011) point out that many infrastructure constructions are rarely updated in line with the evolving risk profile of a particular area across the country. The Coronavirus pandemic in the year 2019–2021 disrupted the livelihoods of people globally, especially the poor. This was the first experience of such a large scale disaster occurrence in South Africa and this has shaken the government to implement disaster management measures and relief programmes that were not initially planned for (Van der Merwe *et al*., 2020).

The rapid economic development in South Africa has increased the probability of vulnerability of infrastructure (Aitsi-Selmi *et al*., 2016; Hoogstad & Kruger, 2008). There are several socio-economic vulnerabilities in South Africa such as lack of housing, poverty, food insecurity, and unemployment that expose people to disasters and have led to the loss of lives and livelihoods (Van Riet, 2016). The social development and social protection programmes like the South African Social Security Agency (SASSA) and Reconstruction and Development Programme (RDP) initiatives have lifted some of the weight on poor citizens. While these social programmes minimise vulnerabilities and enhance coping capacity, a lot of these developmental actions have created new risks that could have been avoided if DRR was mainstreamed into development (Aitsi-Selmi *et al*., 2016). Therefore, there is a need to use the experiences and lessons learned from previous disaster events to improve development initiatives (Van Wyk, 2007).

The establishment of development initiatives is highly dependent on natural resources and environmental conditions such as water, land, and temperature (Mattingly, 2002). In addition, development initiatives are influenced by hazards which in turn cause adverse impacts that creep up on poor communities. The occurrence of disasters can create opportunities for efficient development planning and development projects such as proper work training, housing construction, and land reform (Van Riet, 2016; Van Wyk, 2007). It is, therefore, worth noting that mainstreaming DRR will assist to identify and scrutinise underlying risk factors and to implement constructive actions (Becker & Van Niekerk, 2015).

3.4.5 Lack of benchmarks for action and DRR evaluation procedures

According to Van Riet (2016) most of the DRR policymakers in South Africa tend to be over-ambitious in setting objectives and demands that are unrealistic This has resulted in a failure to

implement such policies because the reality is that the country does not have the full capacity and the expertise for the implementation of over-ambitious policy structure (Picard, 2014).

There is poor evidence-based feedback systems and monitoring approaches within the existing policies (Becker & Van Niekerk, 2015; Wisner *et al*., 2004). This means that it is difficult to separate policies that are effective from the less effective ones. An important approach to overcome this challenge is through the application of monitoring and evaluation throughout the planning and execution processes (Mattingly, 2002; Van Riet, 2016).

The humanitarian organisations usually restructure or change their operational approaches, and this can at times cause communication confusion within DRR role-players and communities. This further contributes to a delay in benchmarks for action and evaluation procedures (Van Riet, 2016). Nonetheless, some changes are necessary and yield positive outcomes. Baudoin *et al.,* (2017) say that disaster risk management plans tend to be hampered by limited attention on DRR and lack of updates in existing legislation. This can be observed in the lack of actions for drought preparedness, which is identified as an important disaster risk by the disaster risk legislation. Drought strategies tend to focus on addressing the symptoms or consequences of drought such as the focus on the provision of water and food aid during drought rather than tackling the root cause(s) (Holloway, 2003). This is further driven by the challenge to move the focus from drought relief and emergency support to preparedness (Holloway, 2009).

Limited competency of human resources serves as barriers for exercising actions and monitoring of DRR legislation (UNISDR, 2004). A study by Hoogstad and Kruger (2008) reveal that there is a need to bridge the inadequate training and competency gap among disaster management workers across municipalities in South Africa. Although there are good policies in the country, lack of expertise in risk reduction and disaster management limits the implementation of these policies. This is a major concern for ensuring the success of risk reduction in South Africa (Becker & Van Niekerk, 2015).

DRR legislation aims to ensure that role-players comply with the implementation of policies to reduce risks. However, there are no clear penalties or incentives for those who are compliant or non-complaint (Picard, 2014). Clarifications regarding penalties or incentives mechanism requires an integrated approach of investment in resources and capacity building that promotes legal responsibility and accountability towards risk reduction (Picard, 2014). For example, the Philippines' DRM legislation of 2010 mandates all disaster management officials to carry out training and public education on disaster management laws across the country, which assists in building a culture of DRR compliance while establishing resilience (Manyena, 2013). Another example is China where construction laws are integrated with DRR legislation. The Ministry of

Housing and Urban/Rural Development in China has enforced regulations that require compliance of quality measures and codes to withstand floods, earthquakes, fire control, and penalties for the non-complaint (Picard, 2014).

Ultimately, only integrated actions towards risk reduction and management principles will bring about positive outcomes and resilience that can be seen across all levels (i.e. international, national, provincial, and local) (UNISDR, 2004). Van Riet (2016) notes that several DRR role-players have implemented good initiatives to combat disasters, however, the fact that resilience is poorly defined and does not have specific indicators has caused greater challenges at a local level. Picard (2014) goes on to say that resilience cannot be achieved if people do not understand its importance, show poor interest, and lack capacity to employ risk reduction actions. The disaster management sector has the responsibility to ensure the feasibility and effectiveness of risk reduction and disaster management legislation, however, everyone has the responsibility towards effective implementation (Aitsi-Selmi *et al*., 2016; Chesterman *et al*., 2016).

The fact that there is not a single sector that is immune to disaster impacts indicates the need for coordinated actions (Van Riet, 2016). Overall, the legislative gaps within DRR is a call for better relationships and proactive collaboration to protect people and the environment (Becker & Van Niekerk, 2015; Llosa & Zodrow, 2011). This research study is primarily focused on encouraging a proactive working relationship between the FCV actors and DRR role-players to improve food security. The following section unpacks the context of food security policies in South Africa to highlight the policies' effectiveness and weaknesses.

3.5 National food security policy context

This section discusses the main national policies that are set to address food insecurity in South Africa. It is important to acknowledge and understand these policies along with their potential and gaps. This will help in identifying the need for the integration of DRR. The Constitution of the Republic of South Africa is the main legislative structure that lays the foundation of food security and promote food access in this country. The Constitution of the Republic of South Africa of 1996 under section 27(1)(a) states "that everyone has the right to have access to sufficient food and water" (RSA, 1996). Thus, the government has from the dawn of democracy prioritised food security as a policy objective and established several initiatives in order to ensure that this constitutional right is met successively (Manyena, 2013). For example, child support grants, free health services for children between the ages of 0–6 years and pregnant women, pension funds for the elderly, children, and the disabled, food aid assistance, school feeding schemes, working for water, and Community Work Programme are some of the initiatives established by government

to promote food security (Drimie & Ruysenaar, 2010). Although these initiatives have assisted many disadvantaged people, food insecurity is still high (Mohamed Sayeed & Pillay, 2011; De Lange, 2015). As a result, the government has since decided to establish a national food security policy that assimilates and complement different food security initiatives into the Integrated Food Security Strategy (IFSS) (Drimie & Ruysenaar, 2010).

3.5.1 Integrated Food Security Strategy (IFSS)

The Integrated Food Security Strategy (IFSS) was established in 2002 with the main aim to end hunger, food insecurity, and malnutrition by 2015 in South Africa (RSA, 2002b). The establishment of this strategy involved several public agencies, NGOs, universities, national and provincial governments with the Ministry of Agriculture and Land Affairs (MALA) as the leader (RSA, 2014). The IFSS focused on enhancing food security at household level without undermining food security at national level. Active partnership and coordination of the public, private, and civil society are at the heart of this strategy (Drimie & Ruysenaar, 2010).

The core strategic objectives of the IFSS include the enhancement of food emergency management systems and safety nets against food insecurity for the vulnerable groups (RSA, 2014). This is important because disaster events tend to hinder food accessibility (RSA, 2002b). Archiving these objectives requires the involvement of all departments and sectors. The lack of partnership is one of the reasons for the slow progress in eradicating hunger and malnutrition in South Africa (Mohamed Sayeed & Pillay, 2011). Meijers and Stead (2004) support this by stating that most strategies and policies fail due to poor partnership and dialogue. According to RSA (2002b) the IFSS policy recognises disaster management as essential in the section of safety nets and food emergency management. The IFSS policy mentions that one of the issues within the policy is establishing a disaster management plan that integrates all food security strategies from the local to the national level (RSA, 2002b). However, the IFSS policy does not clarify the responsibilities and role of DRR for the mentioned integration within this policy (RSA, 2014). Drimie and Ruysenaar (2010) conclude by saying that this integration is likely to end as just a theoretical impression than reality.

The IFSS focuses on selected factors that are closely linked to food security; namely: food production and trading, income, nutrition, food safety nets, and emergency (RSA, 2002b). The adverse impacts of disasters on food security are mentioned in the strategy, however, there is a lack of clarity in terms of legislation that binds and propels authority and responsibilities within sector departments. This lack of clarification causes confusion and conflict among role-players,

which further contributed to the failure of the IFSS to achieve its aim to end hunger, malnutrition, and food insecurity by 2015 (RSA, 2014). Additionally, the policy discounted the aspects of monitoring and evaluation are crucial for any policy and strategy to assist role-players in identifying problems at an early stage and improving the standard of deliverables (RSA, 2002b). Addressing this issue may have contributed to the effectiveness of the deliverables by addressing the actual risks associated with food security (Drimie & Ruysenaar, 2010).

3.5.2 Zero Hunger Programme (ZHP)

The Zero Hunger Programme (ZHP) was established in 2002 based on the Zero Hunger model from Brazil that effectively reduced hunger for Brazilians (RSA, 2002b). In South Africa, the programme aimed to enhance adequate food access and reduce hunger and poverty by the year 2015 through the capacity building of individuals and households towards adequate access for nutritional foods (Mohlabi, 2012). This programme was established as a facilitator to strengthen the IFSS in South Africa by using the lessons learned from international and continental cases (RSA, 2002b).

The ZHP acknowledged that factors influencing food security differ for people residing in rural and urban areas. Thus, the programme offered various strategies and interventions based on the needs and capacity of people (Mohlabi, 2012). It further proposed that South Africa needs a new model of economic development which would provide equal opportunities for all citizens. This proposed model would help with setting a balance for resource distribution and access. Improving food accessibility to the poor and vulnerable is one of the objectives for the ZHP (RSA, 2002b). The programme partnered with information departments such as the Statistics South Africa (Stats SA) to acquire relevant and accurate data regarding hunger and food access (Mohlabi, 2012).

Five (5) objectives were created to address the issues of hunger and food insecurity. It was believed that achieving these objectives would ensure that the constitution fulfils its promise to create food access for all citizens (RSA, 2002b):

a. Strengthening the capacity of food production for households and poor farmers;
b. Ensuring food accessibility for vulnerable citizens;
c. Enhancing the state of nutrition security for all the citizens;
d. Establishing effective market channels through bulk government procurement of food to the emerging agricultural participants; and
e. Facilitating corporations with relevant stakeholders within the food supply chain through data inventory and surveys.

The main stakeholders were all three spheres of government and the civil society such as Social Development; Public Works; Water Affairs and Environment; Department of Health; Education; Co-operative Governance and Traditional Affairs, Housing; Rural Development and Land Reform; Science and Technology; and Statistics South Africa (RSA, 2002b). The leading department was the DAFF. The line department of disaster management (NDMC) must have been included in this programme given the close relationship between food security and disasters to assist the ZHP to identify the disaster risks associated with food insecurity and improve the household vulnerabilities, thus implementing strategies for addressing such risks while enhancing livelihoods (RSA, 2014). The attempt to copy the Brazil ZHP failed due to the underestimation of resources required, lack of expertise, and lack of customisation according to the South African context (Mohlabi, 2012). Given the failure of the ZHP, the South African government established a new strategy called the Food Security and Nutritional Policy (FSNP) (RSA, 2014).

3.5.3 Food Security and Nutrition Policy (FSNP)

The Food Security and Nutrition Policy (FSNP) is established to improve food security by providing access to physical and socio-economic means that assist citizens to constantly acquire sufficient and nutritious food (RSA, 2014). This policy aims to eradicate poverty, unemployment, and equity in South Africa by the year 2030. The FSNP objectives include the establishment and support for economy capacity towards job creation; develop a sense of labour absorption platform with attention on expanding export industry; enhance trade balance of primary and processed agricultural products; reduce the cost of living for deprived households through micro-economic reforms; and establish regional markets for energy, food, and water with neighbouring regions (RSA, 2014). This is in line with the objectives of the National Development Plan (NDP) which aims to eradicate poverty and inequality in South Africa (UNSCN, 2013). The NDP and FSNP identify key priority areas that need to be addressed for the improvement of the country of which most of the suggested strategies and recommendations will influence the food system and food security in some senses (RSA, 2019b). The FSNP emphasised on three reasons for the need of food security policy: (1) the need for the establishment of common definition about food and nutrition security since there are several definitions which can cause confusion and delay solutions; (2) to maximise the synergy between various strategies to create inter-disciplinary approaches by providing a guiding framework; and (3) to understand the constraints of safeguarding sustainability and food security (Drimie & Ruysenaar, 2010; RSA, 2014).

The FSNP policy also aims to provide a framework of guidance for the coordination of different food security policies, frameworks, and initiatives to facilitate effective partnerships (RSA, 2014).

In addition, the policy strengthens existing strategies by promoting shared dialogue (Johnston, 2019). Moreover, the FSNP offers a platform that creates understanding about the constraints and dynamics of the international obligations (RSA, 2014).

The FSNP also highlights key challenges that South Africa faces when it comes to food and nutrition security. Although the country is food secure at a national level, unequal food and resource distribution threaten food security at the household level (Drimie & Ruysenaar, 2010). The lack of safety nets and food emergency management systems serve as a barrier for those who are unable to cope with the impacts of disasters. The issue of knowledge and lack of access to information about healthy and nutritious balanced diets is still high and this causes people to make poor decisions about daily dietary requirements (De Lange, 2015). In addition, limited opportunities for small-scale farmers and lack of access to markets continue to challenge the state of food security in South Africa (Pereira & Ruysenaar, 2012). The fact that these challenges continue to threaten food security, indicates the need for the development of an integrated multi-sectoral strategy that will address all these challenges (Drimie & Ruysenaar, 2010).

The FSNP proposes five (5) pillars that can be used to promote the food security and multi-sectorial initiatives. The five pillars include:

1. *The availability of improved nutritional safety nets:* this promotes food and nutritional value through government, private sector, and non-government organisation such as feeding schemes and emergency relief.
2. *Improvement of nutrition education:* this mainly focuses on providing households with services that improve the level of nutrition through consumer literacy, food management, and healthy diet plans.
3. *Alignment of investment in agriculture:* this pillar aims at stimulating the local economic development for people in rural areas through subsidisation of inputs, support services, better food storage, distribution systems, and minimising food waste.
4. *Improvement of market participation:* to enhance attention on supporting new emerging farmers through private-public partnership, government, take-offs, and Agri-Bee Charter.
5. *Food and Nutrition Security Risk Management:* the focus in on increasing investments in research and technology. This includes research on climate change, bioenergy, and information management systems in food security (RSA, 2014).

The policy tends to downplay the capital interests of the FCV. The FSNP emphasises that the agricultural sectors need assistance from other sectors, however, the policy does not touch on how other businesses influence food systems (DAFF, 2013). The Fetsa Tlala Plan was therefore developed to address the persisting food insecurity issues, while promoting and assisting new emerging farmers (Mohlabi, 2012).

3.5.4 The Fetsa Tlala Production Plan

The Fetsa Tlala Plan initiative was approved by the Cabinet on the 11th of September 2013 with the broad aim of ensuring that "*we have food on the table*" (DAFF, 2013). This plan seeks to address structural dimensions that threaten food security which contributes to social exclusions and inequalities (Mohlabi, 2012). The Fetsa Tlala Production Plan (hereafter referred to as the Plan) does not only focus on food security, but also eradicating hunger for all South African citizens. Hence, it is known as an overarching framework that maximise concerted efforts within different programmes and strategies. The Plan involves a range of departments and stakeholders such as the Department of Water Affairs (DWA), Department of Rural Development and Land Reform (DRDLR), Department of Trade and Industry (DTI), and DAFF, with the latter being the leader of this plan (DAFF, 2013). The Plan has a set of targeted policy responses which includes:

a. *Social Relief of Distress:* this policy response seeks to restructure and facilitate chronic under-nourishment at household level. Social Development is the leading department on this target.
b. *National School Nutrition Programme (NSNP):* the policy response aims to extend the NSNP capacity so that it also covers for non-school days and holidays. It is led by the Department of Basic Education.
c. *Food fortification and Nutrition education:* seeing that there is a lack of knowledge based on nutrition, the Food fortification, and Nutrition education introduces knowledge sharing and "micro-nutrient sprinkles" that can be added to food for balanced meals. The Health Department is in charge of carrying this intervention.
d. *Food distribution:* the policy response aims to assist the government to enforce larger and efficient food distribution network centres that ensures equity through the establishment of Community Nutrition and Development Centres. This intervention is led by the Department of Social Development.
e. *One Million Hectare Food Production Programme:* seeks to promote food productions by placing 1 000 000 hectares into crop production constituted by 550 000ha from land reform beneficiaries and 450 000ha from communal lands. The responsible departments for this intervention are the DAFF facilitated by the DRDLR (Mohlabi, 2012).

Through these policy responses, the government can ensure that food accessibility is adequate for all citizens and contribute towards achieving the Millennium Developmental Goals (MDGs) particularly, eradicate extreme poverty and hunger. In addition, this creates a collaboration between state and non-state stakeholders towards food and nutrition security policy implementation (Mohlabi, 2012).

The government has partnered with the Plan to establish a platform for subsistence and smallholder farmers to increase their food productions by creating one million hectors for production by 2018/19 (DAFF, 2013). The ultimate goal is to improve smallholder farmers' access to markets and food security (Mohlabi, 2012). However, like any other initiative the Plan has several constraints. It is important to establish strategies that effectively deal with those constraints. These constraints include:

a. *Funding:* provincial departments need to commit and contribute a reasonable budget. Additional resources and funding are required for mechanisation and production inputs.
b. *Harsh climate conditions* given the unpredictable and ever-changing climate, sustainable cultivation and smart agricultural approaches are prerequisites of the initiative. This includes developing strategies for preparedness, mitigation, and resilience of disasters. This emphasises the need for the incorporation of the DRR approaches.
c. *Commodity price volatility:* policy reviews for strengthening local food productions and agricultural commodity is required.
d. *Storage and processing:* emphasis is placed on innovative but achievable methodologies that must be applied before harvesting seasons.
e. *Training and skill development:* smallholder and subsistence farmers need continuous training and capacity building to delight in long-lasting outcomes.

An important way to track the risks and constraints of this initiative is through monitoring and evaluation. Annual reports are compiled by the provincial Heads of Departments (HoDs) to indicate the annual target for each province. This includes monitoring the number of hectares planted and the actual yields in tonnes/ha by using a Global Positioning System (GPS) for geo-referencing the cultivation areas (DAFF, 2013). Overall food security policies in South Africa have benefits with several gaps and loose ends that inhibit poor citizens from accomplishing household food security (De Lange, 2015).

3.5.5 Food security initiatives in IDP municipal structure

The study area of this research is the Gauteng Province as indicated in Chapter 1. Therefore, it is important to review the two local municipalities within this province and how they incorporate food security in their IDPs. The two local municipalities are the City of Tshwane and the City of Johannesburg. The IDP is an approach that municipalities across South Africa are obligated to establish and implement in order to improve resource access and the overall standard of living of all citizens (Johnston, 2019). The City of Tshwane 2019/20 IDP report has identified priority areas

that need serious attention, and this includes improving informal settlements, supporting vulnerable individuals, integrating community, and enhancing healthcare services (RSA, 2019b). The priority area to support vulnerable individuals focuses on assisting underprivileged residents to develop skills, job opportunities, and poverty alleviation (Maphanga & Mazenda, 2019). One of the projects implemented to support the abovementioned priorities is the new food bank strategy that aims to improve food security for more than 25 000 residents by the year 2022 through the provision of food relief aids. In addition, the municipality is aiming to partner with over 120 non-profit organisations to empower beneficiaries of the food relief aid (RSA, 2019b). The Expanded Public Works Programme (EPWP) is another essential initiative that improves food security and poverty alleviation through skills development and employment opportunities, which increase household stipend and food access (Manzini, 2016). Most residents in the City of Tshwane benefit from food stamps and vouchers to help fight household food insecurity, however, this has created a sense of dependency on these vouchers which does not promote resilience against food security (Maphanga & Mazenda, 2019). Detailed information and data collection are needed to develop sustainable strategies that will address issues of food insecurity and poverty, hence, a budget of R10, 7 million has been allocated to research and development (RSA, 2019b).

The residents in informal settlements face several challenges with poverty as the biggest challenge thus, the municipality is improving access to basic services such as water and sanitation, water collection, and spatial planning in informal settlements (Drimie & Ruysenaar, 2010). Over 12 606 water connections and sewerages are installed and 187 temporary rudimentary services (chemical toilets and water tanks) with an operational budget of R37, 8 million, and R197 million for 2019/20 respectively (RSA, 2019b). The priority area to support vulnerable individuals in the Tshwane municipality is focused on assisting the poorest households to gain free access to municipal basic services. This is important because it improves access to resources that can ultimately assist communities to strengthen their livelihoods and food security (Johnston, 2019; Maphanga & Mazenda, 2019).

The City of Tshwane IDP has a priority area to promote agriculture and resource sustainability for food security through the implementation of green energy, improvement of market access for smallholder farmers, protection of agricultural land, and the facilitation of community and communal gardens (Maphanga & Mazenda, 2019). The municipality aims to establish over 25 community initiatives related to agriculture and facilitate 25 agreements for smallholder farmers by the year 2022 (RSA, 2019b).

The City of Johannesburg 2019/20 IDP annual report indicates that there are a lot of unequal opportunities within the city such as lack of income, poor housing and spatial challenges and high

inward migration (Maphanga & Mazenda, 2019). The 2019 report review indicated that 2.28 million people in Johannesburg live in poverty and are excluded from several opportunities that are available to other residential members (RSA, 2019a). Furthermore, the Gini-coefficient of this city was 0.628 in 2017 (Maphanga & Mazenda, 2019). The Gini-coefficient is a statistical approach used to measure unequal income distribution. This statistical measure approach ranges from 0 to 1 with 1 being an indication of unequal income. So, based on this, it is clear that Johannesburg has unequal income distribution. This is also illustrated by the spatial division between the rich and the poor (Johnston, 2019; Maphanga & Mazenda, 2019). Thus, the municipality aims to significantly reduce the unemployment rate by improving the economic condition within over 5% by the end of 2021 (RSA, 2019a).

The municipality developed initiatives to address the challenges of poverty and food insecurity such as the Food Resilience Programme and the Food Empowerment Zone (Manzini, 2016). The Food Resilience Programme assists food-insecure residents to fight food insecurity by planting their own food. The programme has set positive outcomes of more than 36,000,000 homesteads, establishment of four (4) farms, and an agri-zone that helps farmers to grow food (RSA, 2019a). A Food Empowerment Zone assists new and emerging farmers with business management skills while the Johannesburg Fresh Produce Market provides a platform for these farmers to sell their produce (Johnston, 2019). The municipality implemented a programme where residents clean illegal dumping areas in exchange for food. More than 142 people have participated in the programme and five (5) dumping areas are clean and transformed into community gardens (RSA, 2019a).

The efforts taken by the Gauteng municipalities have yielded significant outcomes (Manzini, 2016). The fact that the municipalities identify food insecurity as a crucial issue means that there is a way forward in addressing this challenge. Nonetheless, municipalities face several challenges such as lack of coordination, resource management, poor accountability, and limited capacity that serve as barriers to achieve food security at the local level (Drimie & Ruysenaar, 2010; Maphanga & Mazenda, 2019). Thus, detailed information on conditions leading to food insecurity across the country is crucial for the establishment or update of food security policies and initiatives (Johnston, 2019). This information should be multi-sourced through a range of relevant role-players, therefore, coordination and cooperation are essential for enhancing food security (Pereira & Ruysenaar, 2012). The important thing would be to analyse and address food insecurity through an integrative approach. This is important given that there is a lack of integration among municipalities and role-players when it comes to municipal IDPs and other municipal Development Frameworks (Manzini, 2016; Maphanga & Mazenda, 2019). Practical collaboration with other

departments and relevant role-players will enhance the efficiency of the IDPs in addressing complex issues faced by South African citizens (Johnston, 2019).

3.6 Policy integration

Comprehensive DRR calls for various disciplines, sectors, and institutions towards diverse and expanded partnerships (UNISDR, 2004). Policy integration yields better outcomes that are positive and successful compared to individual or single specialists (Ling, 2002; Pelling & Holloway, 2006; Van Wyk, 2007). Therefore, policy integration within the food industry stakeholders and other line departments enhances the functions of the food chain and ensure the fruition of food security. Mercer *et al.* (2010) points out that legislation serves as a tool of authority for establishing strategies that yield long-term effects.

There is a growing need for policy integration within different areas in order to achieve sustainable development (Meijers & Stead, 2004). The integration of policies involves the combination of the horizontal sectorial stakeholders (i.e. professions in private and public sector) and inter-governmental relations (partnership between countries) (Wilkins, 2002). Candel (2018) argues that policy integration is a process that involves different factors that may not merely move in a concerted manner, however, the integration may develop at different paces or diverse directions. This integration usually involves cross-cutting issues that exceed the boundaries of a single department or sector. The integration of policies requires collaboration, coordination, and consistency with formal institutional arrangements and stakeholder interdependence (Meijers & Stead, 2004). Policy integration has several synonyms including policy coordination (Mercer *et al*., 2010), joint-up government (Ling, 2002), inter-organisational collaboration (Alter & Hage, 1993), cross-cutting policy-making (Wilkins, 2002) and network management (Meijers & Stead, 2004).

The integration of sectors facilitates and harmonise institutional arrangements by propelling the following changes (Alter & Hage, 1993; Wilkins, 2002):

a) Enhanced intergovernmental relations within the regional, provincial, and national governments towards food security;
b) Enable the coordination and cooperation of departments, private sectors, and NGOs;
c) Strengthen the capacity of monitoring, evaluating, and responding to food security;
d) The establishment of an interdisciplinary unit that addresses food security dynamics at national to household level;
e) Ability to manage uncertainties, diversify strategies, and address complex issues; and

f) Opportunity to learn, adapt, and share costs.

Meijers and Stead (2004) and Wilkins (2002) emphasise that the integration of sectors is crucial, however, undermining the challenges of such an integration would be a big mistake. These challenges include:

a) The establishment of fair and balanced systems and incentives among stakeholders.
b) Reaching an agreement about prioritizing and categorizing food insecurity dynamics in terms of scope in the short, medium, and long-term.
c) The establishment and maintenance of monitoring and evaluation systems that are geared towards mitigation, prevention, and preparedness measures among all stakeholders.
d) Extensive support and resources are required to facilitate institutional arrangements and coordination with the consideration of human resource capacity.
e) Time-consuming actions and slow progress even on an emergency or pressing issues that require rapid response.
f) Obfuscation of roles and responsibilities within members.

The lack of implementation for the integration of DRR and the FCV practices is mainly because the two bodies belong to different communities of research and practice, employ different frameworks and approaches, are planned and implemented by different institutions and departments (O'Connor *et al*., 2017). Nonetheless, it is proposed that the benefits of such an integration outweigh the challenges because long-term sustainable development can be achieved through this integration (Meijers & Stead, 2004). The following section focuses on programmes that integrate the FCV and DRR to improve food security. These programmes were selected based on their flexibility, cooperation with various stakeholders, and successful implementation of addressing food insecurity while strengthening the FCV and reducing disaster risk.

3.7 The international frameworks and programmes with integrated FCV and DRR

The following section investigates prominent international frameworks and programmes that improve food security through the integration of the FCV and DRR.

3.7.1 The DFID Hunger and Vulnerability Programme

In 2001, the Department for International Development (DFID) established a Hunger and Vulnerability Programme in Southern Africa (DFID, 2003). This was motivated by the drought that caused the need for immediate relief aids with over 14 million people food insecure and in need of immediate relief aids. Although drought was identified as the major source, several factors also had significant influence such the HIV/AIDS pandemic, poor and inappropriate socio-economic policies, deteriorated infrastructure, and poor basic services delivery (DFID, 2011). This exposed the weakness of national policies regarding the implementation of effective response and preparedness for disasters and underlying issues thereof. Since then, the DFID has been working with deprived and vulnerable communities across Africa and other regions to tackle developmental issues through capacity building measures (Combaz, 2014; DFID, 2003).

The DFID has acknowledged that most humanitarian problems are caused or somewhat influenced by disasters therefore, there is constant commitment to reduce risks and promote resilience through its policy structure (DFID, 2011). In the year 2011, the DFID humanitarian policy implemented changes to make resilience a central approach for DFID, which led to the publication of 'Defining Disaster Resilience Approach Paper' and to ensure that this approach is applied, a framework referred to as the DFID disaster resilience framework was established (Combaz, 2014). This framework consists of four (4) primary elements to facilitate resilience building namely: context, distribution, capacity, and reaction (DFID, 2011).

The first primary element of the DFID disaster resilience framework is *context,* which is about identifying and enhancing the various contexts related to resilience building such as the socio-economic, environmental, and political context. The second element i.e. *distribution*, involves the analysis of negative factors that usually occur due to stress and shock (sudden or long-term). *Capacity* is the third element that focuses on the ability to deal with stress and shock that disrupt livelihoods or systems. The fourth element is *reaction* which is about the response or aftermath caused by disruptions within livelihoods (i.e. survive, adapt, recover, learn, transform or collapse) (Sturgess & Sparrey, 2016). It should be noted that the DFID disaster resilience framework is crucial in enabling the DFID to reach its goal (DFID, 2011).

The goal of the DFID is to assist communities in reducing vulnerabilities to food security through coordinated policies concerning availability, accessibility, and utilisation of food (DFID, 2003). To achieve this goal, the DFID focuses on the issues of stress and shocks across food systems and livelihoods, which influences household food security (DFID, 2011). This means that food security is analysed in a holistic manner whereby the focus goes beyond issues of food productions or household income. The DFID programme is committed to establishing collaboration and

coordination among governments, organisations, and communities in order to tackle the issues of food insecurity and other humanitarian problems (Combaz, 2014). Furthermore, the programme is based on multi-disciplinary and multi-sectorial approaches that bring together development and humanitarian efforts to achieve climate change adaptation, social protection, and DRR (DFID, 2011). Four (4) priority areas have been set in order to fight vulnerability and hunger: (1) strengthening vulnerability assessment and monitoring systems; (2) supporting effective measures to protect the poor from the impacts of food shortages; (3) promoting the roles of regional trade and the private sector; and (4) strengthening regional policy discussions (Combaz, 2014; Sturgess & Sparrey, 2016). Overall, the DFID demonstrates the importance of an integrated policy approach for improving food security (DFID, 2011).

The level of commitment and impact on policy integration continues to show progress though the establishment of initiative and strategies (Combaz, 2014). In 2012, the DFID Strategy Paper that focused on building resilience was developed along with the establishment of the Catalytic Fund in 2012 to foster resilience within humanitarian and development initiatives (DFID, 2011). This was followed by 'DFID's 2013–2015 Future Fit strategy' that aimed to build resilience on food security and sustainability (Sturgess & Sparrey, 2016). This shows the level of commitment to building resilient communities, which is enhanced through the annual reviews where the lessons learned from the past crises and approach measures are used to improve the state of planning and preparedness in risk reduction (Combaz, 2014).

The role of the DFID goes beyond just improving food security. It has succeeded in improving the living standards of the underprivileged through partnerships with several stakeholders such as the UN agencies, Red Cross, World Bank (WB), World Health Organisation (WHO), and Oxfam (DFID, 2011).

3.7.2 The Oxfam Strategic Framework

Oxfam is a humanitarian agent that has the vision to accomplish a world without poverty, with people being actively involved in major decisions that shape their lives while ensuring that human rights are enjoyed (Maes, 2016). The purpose of this agency is to establish long-term solutions that address the poverty injustices by empowering people to create a secure future (Jeans *et al*., 2016).

DRR is recognised as a key feature that promotes the vision and mission of Oxfam which is to overcome poverty and food insecurity, while addressing multiple disaster impacts on livelihoods (Bahadur *et al*., 2016). The Oxfam agency also notes that many disaster-affected communities

suffer from chronic food insecurity which grows into acute food insecurity during and after disaster events (Jeans *et al*., 2016). Moreover, disasters undermine long-term livelihood efforts due to the loss of assets, increased debts, and unsustainable activities for income (Maes, 2016).

To address these issues, the Oxfam strategic framework was established. This strategic framework works to integrate DRR into livelihoods for poverty reduction and food insecurity (Jeans *et al*., 2016). The framework applies the Sustainable Livelihoods Framework (SLF) and the Household Economy Approach (HEA) (Maes, 2016). The livelihood approach means that Oxfam saves lives while strengthening livelihoods towards sustainable growth. Both the SLF and HEA serve as guidelines for the information that should be collected and the way it should be analysed (Jeans *et al*., 2016). The SLF highlights five (5) assets that livelihoods depend on; namely: natural, human, physical, financial, social and political. Additionally, the connection between the context of vulnerability and people's abilities to secure assets is indicated in the SLF (Bahadur *et al*., 2016). In short, the SLF and Oxfam's objectives complement each other in a way that the two share common goals towards sustainable development and vulnerability reduction. The HEA on the other hand is used to identify and analyse people's state of food security and their coping capacity to implement effective initiatives (Oxfam SA, 2016). The incorporation of DRR into this analysis reduces the risk of emergency responses which is associated with long-term vulnerability. The approach of DRR enables Oxfam to ensure the protection of assets for the vulnerable group, while expanding on livelihoods. This emphasises that without disaster risk analysis, the impacts of sustainability can be undermined and the efforts to vulnerability reduction missed (Maes, 2016).

Six strategic goals have been set to address the issues relating to poverty and food insecurity: (1) create a global influencing network; (2) promote quality, monitoring, evaluation and learning (MEL); (3) protect lives now and in the long-term; (4) ensure sustainable foods; (5) fairness in resource sharing; and (6) financing for development and universal essential services (Maes, 2016). The fourth strategic goal is particularly important to this study as it focuses on reducing the risk of disasters and building resilience to drive transformative change regarding poverty and food insecurity while enhancing the institutional capacity to prevent disasters and stress in food systems. The Oxfam strategic framework aims to secure this goal by building relationships with an inclusive culture among stakeholders such as governments, businesses, NGOs, and communities (Bahadur *et al*., 2016; Maes, 2016). In 2007, the Oxfam raised advocacy for DRR after the East India floods (Jeans *et al*., 2016). These floods disrupted the livelihoods of the rural communities in this region, thus, Oxfam began to teach the community members about their rights and DRR. This action empowered the communities and contributed to food security (Maes, 2016).

The Oxfam strategic framework encourages community participation and support food companies to work towards sustainability (Bahadur *et al*., 2016). The support offered to companies is necessary since the food industry highly depend on the environment, economy, and society while the tasks conducted by companies can cause adverse impacts. A platform of sharing knowledge and good practices between companies and sustainability role-players is stimulated through the Oxfam network system to promote sustainable food chains (Jeans *et al*., 2016).

This overlaps with the Oxfam Framework and Guidance for Resilient Development which is a multi-sectorial approach that has flexibility and is easily adaptable (Maes, 2016). It offers a holistic approach to address vulnerabilities and risks that is not limited to social justice, gender equality, poverty, and resource management issues (Bahadur *et al*., 2016; Jeans *et al*., 2016).

The strategic framework is used as a basis in several Oxfam programmes that work to improve food security and alleviate poverty. For instance, in 2009, the R4 Initiative was established to reduce risks through national resource management and DRR approach with the aim to improve food and income security, while building resilience to climate shocks across four countries (Ethiopia, Senegal, Malawi, and Zambia) (Bahadur *et al*., 2016). In South Africa, the Saving Lives Building Resilience programme was established in the year 2015. This programme is based on DRR approach which includes the priority areas of risk assessment and analysis, disaster management, and humanitarian crisis response. Oxfam partnered with the Department of Cooperative Governance and Traditional Affairs (CoGTA) in 2009 to develop plans for reducing the disaster risks or potential impacts on underprivileged people by minimising the underlying vulnerabilities (Oxfam SA, 2016). Furthermore, Oxfam has formed collaboration with government across the national, provincial, and local levels to reach transformational change in humanitarian issues, including food insecurity (Bahadur *et al*., 2016).

3.7.3 The Global Facility for Disaster Reduction and Recovery (GFDRR)

The Global Facility for Disaster Reduction and Recovery (GFDRR) was established in September 2006 and it is facilitated by the FAO Committee by the World Bank as the leading party (GFDRR, 2007). This programme works to support activities that strengthen climate and disaster resilience in developing countries, including South Africa (Jha *et al*., 2010). The programme works with various donors to mainstream disaster reduction in development strategies and national plans for low and middle-income countries. According to the GFDRR (2007) low-income countries are eligible to obtain assistance from the International Development Association (IDA) while middle-income countries are eligible to obtain assistance from the International Bank for Reconstruction and Development (IBRD). Therefore, strengthening the global and regional cooperation among

different sectors and stakeholders is key to this programme. This cooperation is enabled in four (4) ways; namely: (1) developing new and innovative tools; (2) creating a platform at country level for generating greater investment in disaster reduction; (3) promoting communication and knowledge sharing regarding disaster reduction and resilience; and (4) developing strong capacity building against the negative impacts of climate change (Jha *et al*., 2010).

This programme has three (3) tracks namely: (i) Support to the ISDR system through the ISDR Secretariat; (ii) Support to countries for mainstreaming disaster reduction in development planning; and (iii) Standby Recovery Financing Facility (SRFF) (Duguma *et al*., 2017). The first track (i) involves financial support to the ISDR to improve advocacy and knowledge sharing about DRR at global and regional levels. This track focuses on establishing DRR mainstreaming across Southern Africa while standardising DRR approaches and practices to target poor communities. Activities in the second track involve (ii) promoting commitment towards risk reduction, enhancing cooperation towards identifying and mitigating disaster risks, expanding dialogue about DRR among the public and private sector, disseminating good practices in DRR and supporting the structures of the existing DRR initiatives. The second track further involves donor contributions that are managed by the World Bank in order to integrate disaster reduction into a development plan so that effective risk assessments, risk mitigation, risk transfer, and preparedness are in place. The last track (iii) focuses mainly on assisting low-income countries to develop accelerated disaster recovery through the implementation of joint frameworks intended for post-disaster recovery. These three tracks assist the GFDRR to ensure that the aim and goals of the programme are successfully achieved (GFDRR, 2007).

The GFDRR supports existing efforts of the International Strategy for Disaster Reduction (ISDR) and monitors various food chain activities to assess the state of food shortages and security (Jha *et al*., 2010). This analysis is used to create early warning systems at country or regional level. In addition, the programme has partnered with the World Food Program (WFP) to assist countries in collecting evidence for the establishment of sound policies and timely responses to disasters (O'Connor *et al*., 2017). The GFDRR is based on building an understanding and evidence that the impacts and costs of disaster can be minimised through early warning systems (Jha *et al*., 2010). Research indicates that early planning and actions help to strengthen capacity and resilience against disasters (Bahadur *et al*., 2016; Becker & Van Niekerk, 2015; FAO, 2019; Ramses, 2020). In the year 2008, the GFDRR developed a programme called the Livelihoods, Early Assessment, and Protection index (LEAP) in Ethiopia. LEAP provides real-time early warning services that enable timely response and effective planning by farmers and residents while supporting resilience building. This has improved the livelihoods and food security of communities, with over 14 million people directly benefiting from this programme (Duguma *et al*.,

2017). The partners who assisted in implementing this programme include the Ministry of Agriculture and Rural Development (MARD), National Meteorology Agency (NMA), World Food Program (WFP), Food and Agriculture Organization of the United Nations (FAO), and the UK Department for International Development (DFID) (Jha *et al*., 2010).

3.7.4 CARE 2020 Programme Strategy: Food and Nutrition Security and Resilience to Climate Change

CARE is an international organisation that applies a comprehensive approach to alleviate hunger and save lives (Frankenberger *et al*., 2014). The CARE 2020 programme strategy was established to enhance food security and build resilience to adverse threats of climate change and disaster risk of over 500 million people by the end of 2020 (Ramses, 2020). The strategy has identified Southern, Central, and Eastern Africa as target regions to improve food and nutrition security and resilience to climate change. CARE also established programmes in South Asia, Latin America and the Caribbean (Frankenberger *et al*., 2014).

The CARE programme strategy is based on three (3) key roles that have an impact on poverty and sustainability; namely: (1) the humanitarian action; (2) innovative solutions for sustainable development; and (3) multiplying impacts (Ramses, 2020). The first role is focused on establishing food security interventions that are timely and effective to save lives, reduce suffering, protect livelihoods, and build resilience. The second role is based on developing sustainable food systems through climate change adaptation and risk reduction. The third role of multiplying impacts is centred on strengthening the capacity of country-level partners (civil society, government, academia, and the private sector) to facilitate community food and nutrition initiatives (Ramses, 2020). The CARE climate and resilience academy is one of the platforms that assist to build capacity by providing skills and tools to help people to effectively address the causes and consequences of disasters (Frankenberger *et al*., 2014).

The CARE strategy emphasises that capacity building cannot be accomplished without integration among communities, government, and relevant role-players. Thus, every strategy or intervention created by CARE calls for integration or mainstreaming (Ramses, 2020). For example, CARE has worked with the government in Peru to strengthen national food security interventions. This has resulted in the reduction of child stunting by 50% between the years of 2007 to 2014 (Frankenberger *et al*., 2014).

The quest to alleviate food insecurity and enhance resilience to disaster risk has contributed to the establishment of another CARE programme called the PROSPER: Promoting a sustainable

and food secure world (Ramses, 2020). This programme was established through the partnership of CARE and Cargill. Cargill is an international producer and marketer of food, financial and industrial products and services which promote sustainable food chains (Ericksen *et al*., 2009). The PROSPER programme engages communities to foster food security by building capacities in key areas of socio-economic and environmental conditions. The four objectives of this programme are: (1) to increase equal access to income and nutritious food; (2) to strengthen capacities and assets to manage climate shocks and risks; (3) to strengthen inclusive governance; and (4) to improve the behaviour and educational performance concerning nutrition. The beneficiaries include Ghana, Central America, Indonesia, and Egypt (Frankenberger *et al*., 2014). In Egypt, 3000 small-scale farmers were able to improve the value of Soybeans and gain market access which contributed to better household income and food security (Ramses, 2020). This programme illustrates the effectiveness and benefits of an integrated approach between the FCV (Cargill) and DRR (CARE).

3.7.5 Cooperazione Internazionale (COOPI)

COOPI is an Italian organisation that was established in 1965 to reduce poverty and enhance capacity skills within vulnerable communities (Nese, 2013a). It operates across the globe (including Africa) to ensure safe and adequate food accessibility while reducing the dynamics of vulnerability to risk and crisis (Nese, 2013b). This organisation promotes risk reduction awareness, active participation of vulnerable communities and the integration of risk reduction into development plans, all of which strengthens the coordination mechanisms of risk management at a national and household level (Nese, 2013a).

COOPI implements multi-sectorial interventions, particularly focusing on sustainable energy, DRR, and food security (Baas *et al*., 2008). The COOPI food security programme is structured based on an integrated approach due to multi-dimensions within food security. These multiple dimensions include the components of livelihoods and the capacity to absorb internal and external pressure (Nese, 2013b). To implement this integrated approach, a framework of vulnerability and resilience is applied. This framework helps the COOPI programme to tackle underlying risk factors and develop capacity against such risks. Such an outcome is also influenced by the participation of various role-players ranging from formal and informal sectors with the community as essential role-players (Nese, 2013a).

This food security programme works with deprived communities to implement policies or programmes that enhance preparedness and resilience to disasters while strengthening production systems to ultimately increase food security (Baas *et al*., 2008; Nese, 2013a). In

Malawi, in the year 2016, COOPI improved the value of rice through rehabilitation and expansion of farming land for the community of Salima (Nese, 2013a). The programme introduced DRR measures such as the use of flood-resistant rice varieties and the construction of dykes near maize crops to control water flow. Furthermore, the extension of the network from 100 to 182 hectares has led to higher food access and household income which has improved household food security for 3,100 families and improved malnutrition with 30% (Nese, 2013b). Similarly, in Madagascar, risk assessments and vulnerability maps were used to reduce seasonal flooding over riverbanks by reconstructing the riverbed to increase the height of riverbanks, which leads to better water flow and protection against overflowing. This was a work-for-cash initiation that assisted residents with income access (Nese, 2013a).

COOPI has noted the importance of agriculture in ensuring food access and stability, particularly in developing regions; hence an increased focus on creating sustainable food chains (Nese, 2013b). This programme has adopted a 'chain approach' that provides support through the provision of skills related to food production activities, storage, processing, and sale of produce (Nese, 2013a). All of these add value to the entire food chain. The goal of the programme is to assist communities in developing resilience that can sustain stress and shocks 'from seed to table' in order to promote resilient food systems. This consists of proving training on agri-business, DRR, and securing land ownership (Nese, 2013b). In Sierra Leone, North-East Africa, COOPI assisted 400 small scale farmers to enhance food security through sustainable FCVs (Nese, 2013b).

All the international programmes discussed in the section above, demonstrate multi-sectorial interaction which should be the driving force of programmes or policies that aim to address complex issues such as food insecurity. The discussed international programmes apply a holistic approach of integrating the FCV and DRR to achieve resilient food security at a global level. Moreover, the programmes have commitment towards risk reduction and resilience while supporting and enhancing traditional coping mechanisms used by households. This creates active communities that are less dependent on relief aids for survival (Baas *et al*., 2008). This has paved the way for the development of such programmes at national level. South Africa is one of the regions with significant levels of household food insecurity with increasing disaster patterns (e.g. drought, floods, and foodborne outbreaks), hence the need for a national policy to effectively tackle this challenge (Baudoin *et al*., 2017; De Lange, 2015). Although there is no national policy that effectively addresses food security through an integrative approach of DRR and the FCV, there are however programmes that apply this integrative approach in South Africa.

3.8 National programmes with integrated FCV and DRR

The following section discusses the prominent frameworks and programmes that improve food security through an integrated FCV and DRR approach in South Africa. These are the Food and Agriculture Organisation (FAO), World Food Programme (WFP), Global Environmental Facility, and the Malabo Declaration.

3.8.1 The FAO Disaster Risk Reduction for Food and Nutrition Security Framework Programme

The Food and Agriculture Organisation (FAO) was established in 1945 and is considered as a leading global humanitarian agency (FAO, 1996). The FAO is rooted in creating efforts to assist vulnerable people to build resilient livelihoods and enhance food and nutrition security with over 130 countries (including South Africa) as member stakeholders (FAO, 2017). In 1974, the FAO responded to the famine crisis in Africa through the first World Food Summit that aimed to address hunger and food insecurity eradication (FAO, 1996). This summit resulted in a proclamation that 'every man, woman, and child have the inalienable right to be free from hunger and malnutrition to develop their physical and mental faculties'. The proclamation proved to have had positive outcomes on the issues of hunger and the target of the vulnerable group. To date, the right to food is incorporated into national policies or/and constitutional bills across developed and developing countries globally (Baas *et al*., 2008; FAO, 1996).

The FAO assists governments to coordinate tasks and activities that improve the state of nutrition and food insecurity. Additionally, the FAO conducts research, technical support, data collection on food production and related issues, and operates educational and training programmes (FAO, IFAD & WFP, 2006). This is important because the issues contributing to food and nutrition are not always obvious and these issues differ according to communities. Thus, the FAO framework intends to build an understanding and interest regarding the complexity of food security which stimulates proper actions of risk reduction for food and nutrition security (FAO, 2017).

The FAO established a framework that is explicitly focused on integrating DRR and food chains which is referred to as FAO Disaster Risk Reduction for Food and Nutrition Security Framework Programme (DRR for FSN) (FAO, 2014). The FAO recognises DRR as a necessity for achieving food security and Millennium Developmental Goal 1 i.e. to end extreme poverty and hunger (Baas *et al*., 2008). This framework aims to facilitate DRR measures in the food chain through an inter-disciplinary approach that integrates issues around food productions with the natural resource management sector for resilient livelihoods and food security (FAO, 2013). Furthermore,

emphasis is placed on increasing investment for agriculture and rural development through the establishment of sustainable development policies and programmes (Baas *et al*., 2008). Several changes and outcomes have been observed across developing countries. For instance, the FAO for DRR programme was established to enhance the role of conservation agriculture in food security and DRR across South African rural areas (FAO, 2018). This programme raised awareness and advocacy for climate change and DRR integration. In addition, knowledge sharing was supported through the regional meeting held in South Africa in November 2015 in response to the 2015/16 El Nino event. As a result, households were able to harvest even through drought conditions (FAO, 2018). This and several other successful cases are mainly due to the collaboration of multiple stakeholders which include the Comprehensive Africa Agriculture Development Programme (CAADP), WB, WHO, and United Nations Development Programme (UNDP) (FAO, 2016).

The DRR for FNS framework calls for communication and active participation between countries and national governments to effectively address the threats to food security (FAO, 2019). The occurrence of hazards, climate change, and food chain emergencies of trans-boundary threats are some of the key threats identified by the framework (FAO, 2017). This is aligned with the research study in the manner that both the research study and FAO framework aims to reduce and prevent risks associated with food insecurity. The DRR for FNS proposes four (4) integrated pillars to address the transboundary threats in food and nutrition security: (1) “enabling the environment”; (2) “watch to safeguard”; (3) “applying measures of prevention and mitigation”; and (4) “preparing effective response” (FAO, 2014).

Pillar 1: “*enabling the environment*” is centred on strengthening institutional arrangements and good governance for food productions in DRR (FAO, 2013). This pillar intends to provide support for legislation, policies, and frameworks that create an enabling environment for food and nutrition security. In South Africa, the FAO office supports the Department of Rural Development and Land Reform (DRDLR) to raise awareness on guidelines for responsible governance of Tenure of Land, Fisheries, and Forests in the context of National Food Security (FAO, 2018). As a result, governance in frameworks and initiatives has significantly improved, which is in line with the level of international practices (FAO, 2017). This indicates a sense of collaboration that leads to better food security policy integration in South Africa. Furthermore, this collaboration should be supported by information management and monitoring mechanisms to keep track of any changes (FAO, 2018).

Pillar 2: “*watch to safeguard*” is focussed on improving information and early warning systems to food security and associated risks. This pillar aims to enhance the monitoring approach to multiple

threats while informing decision-makers to implement effective preparedness, response, policy, and advocacy which will harmonise information and early warning systems (FAO, 2013). Knowledge and skills development are also promoted in the fight against hunger and malnutrition. This is one of the key gaps in developing countries including South Africa (De Lange, 2015). To address this gap, the FAO has collaborated with the Census of Commercial Agriculture and Statistics South Africa to improve information and survey data through technical assistance and training on the incorporation of the Food Insecurity Experience Scale (FAO, 2018). This information can be used as guidance for designing mitigation strategies.

Pillar 3: "*applying measures of prevention and mitigation*" is about promoting and diversifying livelihoods. It seeks to address underlying risks that influence food and nutrition security while establishing preventative and mitigation approaches through the use of technology, practices, and measures across the agricultural sector (FAO, 2013). For instance, the FAO assisted agricultural personnel with training during the Fall Armyworm crisis in Southern Africa. In addition, technical assistance has covered surveillance and monitoring of the Fall Armyworm and other invasive pests on crops (FAO, 2018).

Lastly, Pillar 4: "*prepare to respond*" is focused on strengthening capacity in preparedness and response to future threats while limiting adverse impacts on livelihoods (FAO, 2013). The four pillars of DRR for FNS are inter-dependent to each other, which promotes an integrated approach to maximise synergy of critical links between risk reduction and food security (FAO, 2017).

3.8.2 Group-Global Environment Facility

The Global Environment Facility (GEF) was established in 1992 at the Rio Earth Summit to address global humanitarian and environmental issues (Swartzendruber, 2014). The GEF is an international programme which includes partnerships with international institutions, civil society organizations, and private sector from 183 countries. South Africa became a member of GEF in 1994 (Chesterman *et al*., 2016). Partnerships and collaboration are at the centre of this facility with 18 implementing partners such as the Food and Agriculture Organization of the United Nations (FAO); International Fund for Agricultural Development (IFAD); United Nations Development Programme (UNDP); World Bank (WB); and World Wildlife Fund-US (WWF-US) (Swartzendruber, 2014). GEF is working closely with the Department of Environmental Affairs in South Africa to facilitate joint efforts towards sustainable development capacity building against unemployment and poverty (Chesterman *et al*., 2016)

In the mission to expand partnerships for food security, the GEF is creating public-private partnerships between major FCV (e.g. rice, soya beans, and groundnuts) stakeholders in Nigeria (Swartzendruber, 2014). The private stakeholders in these partnerships include the Dantata Foods and Allied Products Limited, Al-Hamsad Rice Mill Limited, and Jaiz Bank (Chesterman *et al*., 2016). This public-private partnership contributes to sustainable structures with benefits for the commodity chains that in turn benefits businesses and consumers. In the pursuit to create a food secure world and sustainable food chains, a programme of Integrated Approach Pilot (IAP) called 'Fostering Sustainability and Resilience for Food Security in Sub-Saharan Africa' was established (Swartzendruber, 2014). This programme is designed to tackle threats to food and nutritional security, which enables safeguarding natural resources. In addition, the framework integrates priorities and investments for enhancing the FCV and smallholder agriculture by promoting long-term sustainability and resilience of the food chain (Chesterman *et al*., 2016). GEF promotes the review of food security policies and programmes, including environmental and agricultural policies to identify overlaps and complementary features that ultimately harmonise and enhance food security policies (Swartzendruber, 2014).

The programme is a platform for community practice, which means active learning and empowerment that enables communities to implement resilience strategies (Swartzendruber, 2014). Employment opportunities are some of the major benefits resulting from this programme and this can be observed in Ethiopia where a total of 7, 300 jobs were created in 2019. Out of this, the jobs created within the food chain are 1, 056, with over 1, 774 jobs particularly in smart agriculture (Chesterman *et al*., 2016).

Overall, the GEF programme provides an all-inclusive perspective that strengthens livelihoods while reducing climate change and disaster risk (Swartzendruber, 2014). GEF makes continuous integrated investments to transform food security, sustainable production, and consumption to reduce food insecurity threats through partnerships with several organisations such as the International Fund for Agricultural Development; Food and Agriculture Organisation; and the World Food Programme (Chesterman *et al*., 2016).

3.8.3 The World Food Programme for DRR policy

The World Food Programme (WFP) established a policy that particularly focuses on addressing food and nutritional security challenges and eliminates vulnerabilities to disaster impacts. This policy was approved in 2011 with the aim of building resilience and capacity of the vulnerable group by working to ensure food and nutrition security while reducing disaster risk and protecting

lives and livelihoods (FAO, 2017). In the year 2010, the policy assisted more than 80 million people worldwide (including in South Africa) in reducing the risk of disaster occurrence and the adverse impacts on food security (O'Connor *et al*., 2017). The WFP for DRR policy helps the government to enhance the capacity of preparedness, assessments, and response to hunger and nutrition loss that result from disasters (WFP, 2012). More than 20% of the WFP for DRR assist in emergency response while 70% assist in the establishment and enhancement of post-disaster resilience programmes (O'Connor *et al*., 2017).

The WFP policy seeks to invest in measures for disaster preparedness and mitigation such as early warning systems that help the government to prevent and respond to crises (FAO, 2017). It supports the implementation of the international framework for DRR at community and national levels. Furthermore, the WFP is working with governments to improve preparedness for assessing and responding to hunger and to develop strategies that reduce the negative impacts of disaster on nutrition (O'Connor *et al*., 2017; WFP, 2012). According to the WFP (2012) resilience measures are cost-effective on two counts: they reduce the need to spend on cyclical crisis response while helping overcome a legacy of development gaps.

In 2011, the WFP assisted over 23 million people all around the world by eradicating barriers in food accessibility, building resilience and reducing risk through programmes and training (O'Connor *et al*., 2017). The programmes promote resilience and reduction risk through nature conservation, rehabilitation of infrastructure and training communities on protecting livelihoods and DRR (WFP, 2012). The policy boosts the national disaster preparedness by employing integrated systems of finance, early warning and contingency planning (FAO, IFAD & WFP, 2006). In addition, the integration of innovative approaches into traditional risk management is crucial for managing risks and moving towards development growth. Von Bormann from WWF says that progress in food security should be cross-sectorial and requires all levels to act simultaneously (Scholtz & Von Bormann, 2016).

3.8.4 The Malabo Declaration

In 2014, the Heads of State and Government of the African Union gathered at the African Union Summit in Malabo, Equatorial Guinea to adopt a programme with specific principles and goals to improve commodity chains and food security through resilience building (Benin *et al*., 2020). The Malabo programme aims to end hunger, enhance the resilience of livelihoods and production systems and to develop triple intra-African trade in agricultural goods and services by the year 2025 (De Pinto & Ulimwengu, 2017). This programme is called the Malabo Declaration on

Accelerated Agricultural Growth and Transformation for Shared Prosperity and Improved Livelihoods. It is a recommitment to the key principles and values set out by the CAADP process (Benin *et al*., 2020). The Malabo Declaration programme has acknowledged the importance of agriculture in ensuring food security, however, it also recognises that increasing agricultural productions alone will not enhance food security. One of the priority areas of this programme is strengthening the resilience of livelihoods and food systems to extreme weather and disasters. Therefore, emphasis is placed on addressing and improving food chains that influence livelihoods and food security through multi-sectorial engagement and coherent inter-sectorial coordination (De Pinto & Ulimwengu, 2017).

South Africa has shown progress in implementing data management systems within the agricultural sector and executing the CCADP principles concerning agro-value chain performance. Nonetheless, more work needs to be done with regards to communication and partnerships that will reinforce investment in resilience building (Benin *et al*., 2020).

The Malabo Declaration raised concerns regarding the food systems' dependence on external factors (e.g. climate risk and stress) and the vulnerabilities to these external factors. In addition, it stressed the need to enhance conservation and sustainability within food chains through institutional arrangements and coherent policies (De Pinto & Ulimwengu, 2017). This accentuates that there is a need for policy integration to make the FCV resilient and sustainable given the vulnerability of food systems to environmental conditions.

The frameworks and programmes that were discussed above have succeeded and are still succeeding due to the strong communication and cooperation among stakeholders. This is due to the fact that the stakeholders have clear and defined roles in the achievement of the set goals and objectives. Although the mentioned integrated policies have several challenges, they have characteristics of good policies that enable them to conquer challenges. On the other hand, policies designed by the South African government illustrated positive impacts, but this is not sufficient to ensure sustainable FCVs and food security for all citizens (De Lange, 2015). Furthermore, it was observed that most of these policies focus extensively on agriculture rather than the entire food chain (i.e. from production to consumption) (Candel, 2018; Scholtz & Von Bormann, 2016).

According to De Lange (2015) even though food production may be high the important thing is that food should reach consumers in a safe state. This is supported by Ramses (2020) and Scholtz and Von Bormann (2016) who indicate that a disaster may occur at any stage of the food chain, thus, DRR cannot be separated from the FCV. One of the frequent disasters to occur in

the food chain is food contamination which leads to foodborne outbreaks (Duguma *et al*., 2017). Overall, this emphasises the need for collaborated efforts in enhancing food security (Candel, 2018).

3.9 Conclusion

Chapter 3 provided an analysis of the global policies that led to the emergence of DRR from the 1990s to the year 2020. These policies are the YSPA (1994); ISDR, HFA (2005-2015); and SFDRR (2015-2030). Integration and coordination are the primary agenda in all these policies in order to address developmental issues including poverty and food security. However, these policies do not specify the guidelines for integrating DRR and the FCV to improve the state for food security. This calls for national governments to transform international policies to accommodate the citizens and their conditions. South Africa has shown a positive progress in establishing national DRR legislation and structures such as the DMA, the NDMC, and the NDMF. Despite this progress, there are several gaps in the implementation of DRR legal frameworks and policies such as institutional arrangements, inadequate resources, mainstreaming DRR with developmental planning, and lack of benchmarks for action. Overall, these gaps can be addressed through collaborative relationships among other line departments.

The national policies of food security in South Africa were discussed to investigate the integration with line departments, particularly disaster management. These national policies are the Integrated Food Security Strategy, Zero Hunger Programme, Food Security and Nutrition Policy, and the Fetsa Tlala Production Plan. All these policies recognise the impacts of climate change and disasters in food security, however, attention is mainly limited to improving agriculture rather than focusing on addressing issues within the entire food chain. The prominent international frameworks that promote the integration of DRR and food security that were discussed are as follows: the United Nations Disaster Risk Management Framework; DFID disaster resilience framework; Oxfam Strategic Framework; and the CARE strategic programme. The prominent national programmes in South Africa are the Food and Agriculture Organisation; World Food Programme; Global Environment Facility; and the Malabo Declaration. The success of these programmes is mainly based on strong collaboration and integration among various but relevant role-players. Overall, the lack of multi-sectorial integration in the national food security policies in South Africa indicates a need for institutional arrangements and coordinated efforts within the food industry and disaster management since environmental risks threaten the state of food security. The next chapter investigates the occurrence of Listeriosis and its impact on food security in South Africa.

CHAPTER 4: LISTERIOSIS AND ITS IMPACT ON FOOD SECURITY

4.1 Introduction

The previous chapter discussed the collaboration gap in integrated food security and the DRR legislation structure in South Africa. This is important because disasters threaten food security that is a global humanitarian right. As such, collaboration among the value chain and all related stakeholders is vital to promote food security and safety. Chapter 4 focuses on Listeriosis and its impacts. This chapter aims to address research objective 3, i.e. to investigate the effects of Listeriosis on food security in South Africa, and the effectiveness of emergency response measures for this outbreak.

Firstly, the chapter provides a brief background about the L. monocytogene which is the bacterium that causes Listeriosis. Secondly, the Listeriosis outbreak in both animals and humans is explored. The South African case study of the Listeriosis outbreak is discussed as the third section, followed by an investigation of the impact of this outbreak on food security that includes the health and economic implications. Lastly, the effectiveness of the response measures to contain the outbreak is investigated.

4.2 The L. monocytogene bacterium

Listeriosis is a type of food-borne disease that results from a gram-positive bacterium called Listeria monocytogene (L. monocytogene) (Smith *et al*., 2016). A gram-positive bacterium is a thick structure that is homogenous and surrounds the cytoplasmic membrane but without the appearances of gram-negative bacteria outer membrane (Soni *et al*., 2011). Murray *et al.* (1926) were the first authors and researchers to describe this bacterium and they named it Bacterium monocytogenes based on the monocytosis characteristic, which was detected in a production laboratory of pigs. In 1927, Pirie renamed the bacterium Listerella hepatolytica, but then he changed the name to L. monocytogene in the year 1940 (Gray & Killinger, 1966). The first Listerioisis infection in humans was confirmed during the 1980s (Murray *et al.*, 1926). Since then, several Listeriosis cases have been recorded worldwide (Smith *et al*., 2016). The first outbreak experience in Boston was caused by contaminated vegetables (lettuce, celery, and tomatoes) and resulted in twenty-three (23) cases with five (5) mortalities in 1979 (Gray & Killinger, 1966). Soft cheese also caused an outbreak in California, 1985 with 142 recorded cases and 48

mortalities (Farber *et al*., 2011). Consequently, a rapid interest in the bacterium and disease developed among food manufacturers and governments (Jongman & Korsten, 2016). The L. monocytogene bacterium can manifest and survive in the soil, water, vegetables, meat, and processed foods. The type and measures used to prepare soil when planting vegetables can cause contamination of the produce (Allam *et al*., 2018). Soni *et al.* (2011) goes on to say that even the use of fertilisers can lead to this kind of contamination. Some parts of animals, especially bowels of mammals carry this bacterium, and it may end up in the meat or dairy consumed by humans. Processed foods such as dairy products, packed salads, cold meat-cuts, and other ready-to-eat products can become contaminated during the processing stage (NICD, 2018). This bacterium can endure various food processing conditions such as extreme pH, refrigeration temperature, and low water activity (Strawn *et al*., 2013). Soni *et al.* (2011) indicates that the L. monocytogene bacterium is complex as it has a long incubation period of seven (7) to sixty (60) days, which makes it challenging to trace the source.

4.3 The occurrence of the Listeriosis outbreak

The concept of an outbreak is an acute occurrence of illness that happens suddenly and in excessive numbers (Jongman & Korsten, 2016). Soni *et al.* (2011) goes on to say that four or more incidence cases of the same illness can be regarded as an outbreak. The first-ever Listeriosis outbreak to be experienced by humans was recorded in 1983 in Canada (Farber *et al*., 2011). This outbreak was caused by a cabbage that was stored in the cold storage during the winter period, and it became contaminated with the L. monocytogene through exposure to the sheep fertilisers (Allam *et al*., 2018; Farber *et al*., 2011).

Listeriosis is considered as one of the largest foodborne illness due to its ubiquitous impacts. Despite the rapid growth of foodborne disease cases in developing countries (including South Africa), only limited research papers report these cases (Kayode *et al*., 2019). Unlike other bacteria, the Listeria bacterium (L. monocytogene) is known to be resistant to several stress conditions (such as heat, refrigeration, high pH level, and disinfectants) (Allam *et al*., 2018). Olaniran *et al.* (2015) indicate that it is of great importance to understand the characteristics and conditions of the L. monocytogene, as this will ultimately assist in the prevention of hazards and potential disasters of food contaminations.

The L. monocytogene bacterium is a well-known human pathogen however, animals are also infected by this bacterium (Allam *et al*., 2018). Kayode *et al.* (2019) say that as much as human infections are more devastating and characterised as major public health implication as opposed

to animal infection, animal infection also consequently contributes to human outbreaks through meat consumptions and other cross-contaminations. Thus, animal and human infections are discussed in the section below.

4.3.1 Animal infections

Listeriosis infects a variety of animals with mammals as the common susceptible group (Murray *et al*., 1926). Animals can acquire Listeriosis through intraperitoneal infection or intragastric inoculation. Both the intraperitoneal and intragastric are lethal, however, the intragastric infection causes animals to perish quicker (Fiedler, 1988). The incubation period of Listeriosis differs among animals, however, it usually ranges from ten (10) days to three (3) weeks. The symptoms of Listeriosis include facial paralysis, irritation, ample salivation, diarrhoea, turning of the head to one side, and loss of appetite (Soni *et al*., 2011).

Murray *et al*. (1926) conducted a study in the 1950s to investigate the symptoms and characteristics of Listeriosis using rabbits and the results revealed that gram-positive bacillus led to the death of numerous rabbits. During that time, a gram-positive bacterium was also discovered among veld rodents in Johannesburg (Kayode *et al*., 2019). This bacterium was called the Listerella hepatolytica, which was named after Lord Lister (Farber *et al*., 2011). In 1975, in Western Cape, South Africa, 70 goats were infected with Listeriosis, where eight of these goats were then reported dead. In addition, another breakout in the above-mentioned region led to the death of ten sheep with 275 cases reported (Meredith & Schneider, 1984). Sheep and goats have short survival period of two (2) to three (3) days while cattle can survive four (4) to fourteen (14) days (Dhama *et al*., 2015). Birds can also be infected but the infection is commonly seen in young birds with symptoms of depression, diarrhoea, and listlessness. Dogs and cats rarely acquire Listeriosis, however, if infected the symptoms include abdominal pain, loss of appetite, vomiting, and neurologic signs of rabies (Farber *et al*., 2011). Researchers indicate that animal outbreaks commonly occur during winter rainfall and early spring (Meredith & Schneider, 1984; Murray *et al*., 1926; Strydom *et al*., 2013).

4.3.2 Human infections

Listeriosis in humans tends to be infrequent even though some of its cases may be a result of a single source category (Farber *et al*., 2011). On the other hand, Strydom *et al*. (2013) indicates that humans can consume contaminated food and not become infected with Listeriosis. A study

by Fiedler (1988) reveal that healthy humans can be carriers of the T cell which creates a sense of reactivity to Listeria ssp. and other gram-positive bacteria like L. monocytogene. The amount or number of L. monocytogene cells it takes for a human to become infected with Listeriosis varies for both the normal and high-risk group. It is predicted that this amount or number of cells will differ based on the characteristics of the pathogen strain and the host human (Farber *et al*., 2011). Although consumption is a common way to acquire such an infection, humans can acquire Listeriosis through direct contact with the bacterium, inhalation, and venereal transmission (Dhama *et al*., 2015).

The incidence of Listeriosis is rapidly increasing worldwide in both developed and developing countries. According to Strydom *et al.* (2013), 1,460 people are hospitalised each year in the United States, with 260 cases resulting in mortalities. The number of recorded cases range from 0.35 to 5 cases annually, per million people in developed countries (Dhama *et al*., 2015). Few cases are recorded in developing countries, however, this may be due to limited resources and surveillance of this pathogen (Kayode *et al*., 2019). The main clinical symptoms are primary febrile gastroenteritis, perinatal infection, central nervous system infections, and endocarditis. In addition, research has shown that sporadic cases affect various body parts, which include the liver, brain, knee joints, and hips (Allam *et al*., 2018; Gouws & Liedemann, 2005; Hoffmann *et al*., 2012).

The occurrence of Listeriosis in food products is a resultant of exposure to a certain equipment or source that has been contaminated at some stage of the food chain (Gaul *et al*., 2013).

4.3.2.1 Listeria SPP. within the food chain products

The following section discusses the occurrence of the L. monocytogene bacterium in food products within various food chain stages. These food products include dairy, meat, eggs, and vegetables.

The manifestation of the L. monocytogene bacterium is very common in cheese because the pH effects that causes the growth of bacterium is likely to occur at the maturing phase of cheese (Gaul *et al*., 2013). The L. monocytogene can infect cows leading to mastitis of which the consumed milk causes Listeriosis, and the bacterium can persist to infect various products (e.g. ice cream) that are manufactured using the contaminated milk (Strydom *et al*., 2013). According to Strawn *et al.* (2013) the presence of L. monocytogene in eggs, especially in broken eggs is common due to faeces that contaminate eggshells and the processing facility conditions,

nonetheless, washing them reduces the chances for contamination. Furthermore, various vegetables may be contaminated by the L. monocytogene bacterium, however, potatoes and radishes are known as common targets to this bacterium contamination (Gaul *et al*., 2013). Farmers are faced with challenges of protecting vegetables from the L. monocytogene. On the contrary, pre-packaged salads pose a threat whereby contamination may occur in the preparation phase (Hellberg & Chu, 2016).

The type of common fish products that are prone to L. monocytogene contamination include smoked fish, scallops, lobster meat, frozen fish, and marinated fish (Gouws & Liedemann, 2005). Pre-cooking seafood before freezing reduces the chances of contamination. The growth rate of the bacterium in meat depends on the level of pH, the temperature of meat, the presence and extent of the microflora and the tissue of meat (Van Nierop *et al*., 2005). For example, the L. monocytogene can survive and grow within sterile beef meat which is in a storage room of 4 to 20°C temperature (Buchanan *et al*., 2017). The growth rate of this bacterium appears to be slow in roast beef, summer sausage, and other meat while it is higher in poultry. Van Nierop *et al.* (2005) reveal that fat provides favourable conditions for the L. monocytogene growth than lean meat due to shorter lag phase. Olanya *et al*. (2019) indicate that farmers in South Africa experienced a profit loss of 20-40% due to a rapid drop in demand for pork meat (primarily used for ready-to-eat products) during the 2018 Listeriosis incidence.

4.4 The Listeriosis outbreak in South Africa (2017-18)

In South Africa, the first recorded Listeriosis outbreak was reported in August 1977 to April 1978 (Allam *et al*., 2018). This breakout resulted in a total number of 14 cases experienced in the Gauteng province, Johannesburg. In 1999, cattle and sheep were infected with L. monocytogene as a result of low-quality feeds that ultimately caused the Listeriosis outbreak in the Mpumalanga province (Opperman & Bamford, 2018). During that period, Listeriosis was not given much recognition, and as a result it was not a notifiable disease. Since then, the number of breakouts in South Africa has been on the rise (Allam *et al*., 2018). For example, seven (7) cases were confirmed in 2015 in the Western Cape (Smith *et al*., 2016). In 2017, in Cape Town, a 34-year-old man with HIV was infected with Listeria and died after seven days of diagnosis (Opperman & Bamford, 2018). Thus, the National Institute for Communicable Diseases and the Department of Health has officially declared Listeriosis a notifiable medical disease in South Africa since the year 2018 (NICD, 2018). Table 4-1 below provides examples of Listeriosis incidences which were experienced in South Africa.

Table 4-1: The prevalence of Listeriosis in South Africa

Food samples	Location	Isolation method	Prevalence of Listeria species by sample type	Overall prevalence	Reference
A total of 99 samples of frozen chicken carcasses from the supermarket and street vendors	Gauteng Province, South Africa	USFDA, modified	19.2% L. monocytogenes	19.2%	Van Nierop *et al*., 2005
A total of 21 samples of cheese, ready-to-eat chicken and meat, raw meat/fish products, dried fruit mixtures and spices	South Africa	ISO11290-1	Lean mince, Hamburger patty, Salad, fish products, Cutting board L. monocytogenes	37%	Gouws & Liedemann, 2005
A total of 25-floor mops and 39 cleaning cloths, 20 disposable plastic gloves	Johannesburg, South Africa	ISO11290-1	Plastic gloves (0%), cleaning cloths (10.27%) and one-floor mop sample (4%) Listeria monocytogenes	6%	Christison *et al*., 2007
A total of 140 environmental samples from a food processing facility (conveyor belts, equipment, floors, food processor's hands, drains, boots, storage rooms and cleaning facilities)	South Africa	ND	64% L. monocytogenes	64%	Strydom *et al*., 2013
Plankenburg and Eerste Rivers	Stellenbosch, Western Cape	SABSISO11290-1,1996)	L. monocytogenes	53%	Kikine, 2011
Wastewater and river samples	Durban KwaZulu-Natal, South Africa	Standard membrane filtration methods (incubate at 37 degrees for 20h rand 35 degrees for 24–48hr on Listeria chromogenic agar; Oxoid, UK	L. monocytogenes	44%	Olaniran *et al*., 2015

In December 2017, South Africa experienced an unexpected outbreak of this fatal food illness called Listeriosis (Allam *et al*., 2018). The first patients were recorded by the medical personnel at the Chris Hani and Steve Biko Academic hospital which then communicated with the National Institute for Communicable Diseases (NICD) (Kayode *et al*., 2019; Tambo *et al*., 2018). Medical

authorities conducted interviews with infected patients who indicated the consumption of ready-to-eat meat. The source was only traced in mid-January when nine (9) children (aged 5 years) from Soweto were hospitalised at Chris Hani hospital (Tambo *et al*., 2018). Thereafter, laboratory tests of the samples were taken from a Day Care that the children were attending. The cases were confirmed as Listeriosis, caused by traces of the bacterium called Listeria monocytogenes strain ST 6 (WHO, 2018). Deli processed meat also known as "polony" was identified as the main source of this outbreak. The contaminated polony products were traced to processed meat products manufactured by the Tiger Brand Company under the Enterprise unit at Polokwane and Germiston with a few traces in the Rainbow products manufactured in the Free-State province (NICD, 2018; Tambo *et al*., 2018). The NICD reported that 134 of 189 (71%) isolates belonged to a type known as L. monocytogens sequence type 6 (ST6) (NICD, 2018).

Microbiological tests were conducted to confirm the presence of this bacterium in the faulted food facilities using various tools such as QIAamp DNA Minikit, Nextera XT DNA library kit, and 2X300-bp sequencing on a MiSeq platform (Allam *et al*., 2018). It took sixty (60) weeks to find the source of this bacteria and to declare an outbreak (Child, 2018). On the 04th of March 2018, the then Minister of Health released an official media statement confirming that the production facility of Enterprise in Limpopo was the cause of this outbreak (NDoH, 2018). In addition, an official recall of Enterprise ready-to-eat meat products was released, and continued mid-June 2018. In addition, exports of these products from South Africa to other countries was banned (Allam *et al*., 2018). This resulted in heightened disaster risk within the food chain because the food processors as the food chain stakeholders failed to notice the contamination within the equipment in the faulted facilities at an early stage (Kayode *et al*., 2019). Thus, this became the largest recorded case of a Listeriosis outbreak.

Previously, the largest recorded cases of Listeriosis were in the United States followed by Italy in the years 2011 and 1997 respectively (Allam *et al*., 2018). The United States' incidence was caused by contaminated cantaloupes from Jensen farms in Colorado and resulted in 147 infections and 33 mortalities. The Italian outbreak was caused by cold corn and tuna salad leading to 1500 cases (Tambo *et al*., 2018). The South African Listeriosis outbreak resulted in the mortality rate of 180 and caused 967 infections within three (3) months (Child, 2018). This highlights a sense of negligence from the Enterprise Company whereby their products ended up reaching other food chain stakeholders, retails, and then consumers without Enterprise noticing the contamination. On 27 April 2018, 1019 laboratories confirmed that the cases of Listeriosis were reported to the NICD (Allam *et al*., 2018). The outbreak had spread across the country with the Northern Cape having experienced the least cases and Gauteng as the leading province with

most infection rates (NICD, 2019). Table 4-2 below demonstrates the reported cases and mortalities of this outbreak from January 2017 to July 2018.

Table 4-2: The number of Listeriosis cases and mortalities confirmed by laboratories in South Africa (1 January-17 July 2018) (Kayode *et al*., 2019; NICD, 2019).

Province(s)	Outcome available (% of available outcome)	Number of deaths (% of death)	Number of cases (% of cases)
Eastern Cape	40 (4.96)	13 (6.02)	53 (5.0)
Free State	32 (3.40)	9 (4.17)	36 (3.4)
Gauteng	393 (57.93)	108 (50.00)	614 (57.93)
KwaZulu-Natal	76 (7.83)	21 (9.72)	83 (7.83)
Limpopo	51 (5.19)	11 (5.09)	55 (5.19)
Mpumalanga	47 (4.53)	11 (5.09)	48 (4.53)
Northern Cape	6 (0.57)	3 (1.39)	6 (0.57)
North-West	27 (2.74)	8 (3.70)	29 (2.74)
Western Cape	134 (12.38)	32 (14.82)	136 (12.83)
Total	**806**	**219**	**1, 060**

The outbreak cases were recorded and categorised according to age groups which ranged from less than 28 days to older than 65 years. According to the NICD (2018) neonates of less than twenty-eight (28) days experienced the highest infection case and death cases while children aged 1 month to 14 years experienced the least death cases (Kayode, 2019). Table 4-3 below provides detailed ages of Listeriosis fatalities.

Table 4-3: Age distribution of Listeriosis cases in South Africa (1 January - 17 July 2018) (Kayode *et al*., 2019; NICD, 2019).

Age composition	Discharge (% of death)	Outcome pending available (% of available outcome) Number of deaths (% of death)
≤28 days)	242 (41.02)	108 (42.52)	93 (43.06)
1 month–14 years	44 (7.46)	16 (6.30)	9 (4.17)
15–49 years	201 (34.07)	81 (31.89)	52 (24.07)
50–64 years	48 (8.14)	23 (9.06)	30 (13.89)
≥65 years	47 (7.97)	16 (6.30)	29 (13.43)
Age unknown	8 (1.36)	10 (3.94)	3 (1.39)

The outbreak has led to the questioning of the food safety regulations and standards in the South African food sector, thus, the government aims to tighten the regulations (WHO, 2018). The challenge lies in the lack of implementation and practice of a multi-disciplinary approach to enhance food systems and safety since the food chain is influenced by a vast number of factors which may go beyond the capacity of the food sector (Drimie & Pereira, 2016; Tambo *et al*., 2018).

Although several efforts were made to reduce adverse public impacts such as the large recall of contaminated products, closure of contaminated processing facilities, and restructuring food processing facilities and safety regulation standards, the issue of climate change as a contributing factor was and is still being investigated (Hellberg & Chu, 2016). Several environmental conditions are associated with the increase of foodborne illnesses like Listeriosis. Microbiological characteristics of the L. monocytogene bacterium make it sensitive to climate conditions even though the bacterium is ubiquitous (Buchanan *et al*., 2017). Extreme hot conditions enhance the replication cycle of L. monocytogene which implicates the food cooling chain and ultimately increases the quantity of the bacterium (Hellberg & Chu, 2016). The occurrence of extreme rainfall versus drought influences the transmission of L. monocytogene. In the case of water scarcity, intensive cleaning within the food environment may be compromised, especially in hard-to-reach sites (e.g. cracks, drainages, and niches). In addition, hand sanitizers have become a common method of practicing good hygiene during dry seasons, however, Jongman and Korsten (2016) revealed that washing hands with water and soap is more effective in eliminating bacteria and food contaminations.

The issue of water scarcity has hit the agriculture sector tremendously whereby most farmers have resorted to using surface water for irrigation (Hellberg & Chu, 2016). The challenge is that surface water is a susceptible L. monocytogene carrier which can contaminate crops and livestock (Buchanan *et al*., 2017). In addition, water from drainage ditches is also a source of harbouring bacterium. The trend patterns of roof-harvesting crops and roof-harvested rainwater possess a risk for contamination as well. A research investigation by Jongman and Korsten (2016) revealed that bird faeces and roof debris caused L. monocytogene contamination of rainwater tanks in South African villages. According to Hellberg and Chu (2016) short burst rainfall (5-10 minutes) that is usually caused by climate change causes L. monocytogene to disperse into the soil while lengthy rainfall washes away the bacterium from the soil and crops. Overall, climate change adds to the increase of various food-borne illnesses which causes health and socio-economic implications (Jongman & Korsten, 2016).

4.5 The impacts of the Listeriosis outbreak

Listeriosis brings about several impacts that may have lasting effects even long after the incidence. These impacts may be hospitalisation, sickness, productivity loss, food recalls profit loss, litigation costs, and mortality in severe cases (Olanya *et al*., 2019; Tambo *et al*., 2018). The following section discusses such impacts.

4.5.1 Health

Listeriosis' adverse health consequences in humans can be categorised into hospitalised individual cases, individuals who did not seek professional medical assistance, and individuals who were not hospitalised but visited physicians (Kayode *et al*., 2019). However, only hospitalised patients were analysed because of the limited available information (Olanya *et al*., 2019). Over (160) people were hospitalised across South Africa (Kayode, 2019). This is the highest number compared to previous hospitalisation cases due to Listeriosis worldwide, which indicates a wide spread of the infection and a sense of pro-longed food recall (Olanya *et al*., 2019). In addition, the high rate of immunocompromised individuals in South Africa such as HIV/AIDS, tuberculosis, and diabetic patients increases the vulnerability of Listeriosis infection. A study conducted by Cokes *et al.* (2011) in the USA revealed that people who are infected with AIDS are prone to Listeriosis with 150 higher case rates than the general people. The L. monocytogene bacterium causes mild febrile or gastroenteritis in individuals who are regarded as healthy with strong immune systems.

This is regarded as a non-invasive form of Listeriosis while an invasive form is likely to infect individuals with weak immune systems such as the elderly, pregnant women, and infants. The incubation period for the non-invasive Listeriosis is one (1) to ten (10) days, while the incubation period for the invasive form ranges from ten (10) days to three (3) months (Jongman & Korsten, 2016).

Once the bacterium reaches the intestine then it can spread all over the body including the cytoplasm, liver, placenta, or hematoencephalic barrier (Dhama *et al*., 2015; Hoffmann *et al*., 2012). This bacterium can replicate once it is inside the cytoplasm and it is then transmitted to other host organs through the blood. Moreover, women can transfer the L. monocytogene bacterium to the fetus through the cervix, amniotic fluid, and placenta (Gouws & Liedemann, 2005). However, it is worth noting that healthy pregnant women who are carriers of this bacterium can give birth to healthy babies (Cokes *et al*., 2011). The L. monocytogene bacterium infection leads to preterm labor in pregnant women. There are two kinds of neonatal Listeriosis; namely, early and late onset (Strydom *et al*., 2013). The neonatal Listeriosis constitutes of several symptoms that should not be underestimated and these include rash, shortness of breath, hematologic abnormalities, pneumonia, cramps, shock, hyper-excitability and vomiting (Dhama *et al*., 2015; Smith *et al*., 2016; Soni *et al*., 2011).

The elderly and immune-compromised group are prone to meningitis which is a common manifestation of Listeriosis in adults older than 50 years (Dhama *et al*., 2015). The L. monocytogene infection of the central nervous system includes symptoms such as headache, fever, and vomiting (Smith *et al*., 2016). The renal transplant recipients or leukemia patients can suffer from brain abscesses once infected with this bacterium (Cokes *et al*., 2011). Pneumonia and shortness of breath are the dominant causes of mortality in the elderly and neonates. Thus, early diagnosis and antibiotic treatment are key to save the infected (Buchanan *et al*., 2017). Besides these adverse health implications, the L monocytogene bacterium creates a sense of economic stress for the public and the food industry (Soni *et al*., 2011).

4.5.2 Economic implications

The total economic costs of food-borne illnesses including Listeriosis are difficult to quantify, mainly in developing countries where some cases are not reported or diagnoses are not recorded properly in medical centres (Hoffmann *et al*., 2012). Nonetheless, the severe impacts of Listeriosis cause significant economic concerns (Soni *et al*., 2011).

The large food recalls as a result of contaminations tend to lead to product re-branding and internal rejections of products (Soni *et al*., 2011). In South Africa in 2018, recalls of the contaminated processed meat products were 4,000 metric tons which led to a production loss of US$ 52.9 million, excluding other disposal or incineration costs (Olanya *et al*., 2019). Kayode *et al.* (2019) indicate that losses in the value chain because of this incidence is likely to be higher. Furthermore, the Johannesburg Stock Exchange reveal that because of the outbreak the Tiger Brand's stock price dropped significantly by 7% which is equivalent to R5.7 billion (438.69 million US$) total value loss (Olanya *et al*., 2019).

The large food recall caused by contaminations leads to the pro-longed closure of food production facilities, and this means productions stop and people are left jobless (Hoffmann *et al*., 2012). During the outbreak in South Africa, the company of Enterprise closed for three (3) months without any food productions taking place (WHO, 2018). According to Olanya *et al*. (2019) this outbreak resulted in total productivity losses of US$ 184,276 for maternal adults while other adults' productivity losses amounted to US$ 415,740. The cost of litigation is a major threat to the faulted company. For instance, Kenya and other countries followed a lawsuit due to the L. monocytogene contaminated ready-to-eat products that were imported by the South African Enterprise Company in 2018 (Olanya *et al*., 2019).

Damage control and reputation re-building of products that were associated with a foodborne outbreak are costly (Hoffmann *et al*., 2012). This is mainly because it is difficult for consumers to regain the trust of the food brand and company linked to pathogens. For example, after the 2017-2018 Listeriosis outbreak in South Africa, several countries (e.g. Kenya, Malawi, Zambia, and Namibia) stopped importing Enterprise products and this disrupted the import and export relations among South Africa and other countries. South African Trade Think Tank indicate that trade among Kenya and South Africa decreased tremendously after this outbreak (Whitworth, 2019). As a response mechanism, Enterprise then began emphasising that all products were checked twice using the seven steps of quality check to ensure high quality and safety standards (Kayode *et al*., 2019).

4.5.3 Food security

The food security policies established by the South African government tend to focus more on increasing the availability and accessibility of food while side-lining the aspects of food quality (Hunter-Adams *et al*., 2018). The underprivileged are often blamed for making poor choices on consumption patterns and dietary factors. However, it is unfair to only blame the underprivileged

while they have limited options in terms of the ability to afford healthy food and maintain well-balanced diet (Christison *et al*., 2007). Research shows that foodborne diseases are mostly observed in deprived communities, however, this does not necessarily mean that the high-class groups do not experience such diseases (Kayode *et al*., 2019).

Ready-to-eat products are known for improving food access and security in poor rural areas through the supply of cheap food products (Gaul *et al*., 2013). In addition, food companies have promoted these products as an affordable source of vitamins and protein. Conversely, these cheap ready-to-eat products are susceptible to pathogens including Listeria; which is of major concern. Food safety management is centred on reducing any risk within food production stages that have negative consequences on consumers. This means that continuous risks have an influence on food adequacy and stability and this ultimately influences food security (Olanya *et al*., 2019).

It is evident that food processing facilities must close once contamination is detected and this may take long to re-open. During this period, several people become temporarily unemployed and this threatens livelihoods and food security of families, especially those who are dependent on one source of income. The processing facilities of Enterprise Company at Polokwane and Germiston terminated 2000 workers and these workers revealed that they had no back-up income to support their families (Maqhina, 2018). This means that household income was compromised which in turn threatened the accessibility and availability of food within their families (Hunter-Adams *et al*., 2018).

The incidence of Listeriosis in fresh crops and livestock causes stress to producers and consumers (Kayode *et al*., 2019). It is the responsibility of producers to dispose the contaminated produce because such produce cannot be consumed nor sold. Business owners were instructed to remove all Enterprise ready-to-eat processed meat products so that consumers do not purchase and consume those contaminated products (Child, 2018). Although this was very necessary to stop the spread of the outbreak, proper storage and safekeeping of those infectious products was a challenge (De Villiers, 2018). Most small retail stores in rural areas did not have adequate refrigeration space or any other space to safely quarantine the recalled products. Thus, people resorted to dumping these products in local landfill sites (Tambo *et al*., 2018). This created another challenge whereby food insecure people could access these products when scavenging for food around landfills. In addition, people who collect various recyclable products at dumping sites or landfills to generate income were be exposed to those contaminated products which then posed as a high risk for human infection (De Villiers, 2018).

The South African Listeriosis and its consequences caused the illness to be ranked as the seventh (7th) global burden when it comes to food-borne pathogens (Kayode *et al*., 2019). Furthermore, the outbreak revealed that there is a lack of transparency and alignment of food security policies with health conditions or prevention of health implications (Hunter-Adams *et al*., 2018). Using the South African Listeriosis outbreak, the purpose of this discussion is to indicate the relationship between food security and disaster risk, and thus, the need for sectorial integration.

4.6 The response to the outbreak in South Africa

The overall coordination, auditing, and management of national food safety is controlled by the National Department of Health (NDoH). In addition, the NDoH is responsible for import and export regulations (Tambo *et al*., 2018). However, the NDoH does not conduct inspections in food facilities but rather performs the periodic audits conducted by inspectors under local authorities. The DAFF is responsible for agricultural inspections to ensure that plant and animal diseases are controlled and do not reach consumers to cause harm (Hunter-Adams *et al*., 2018). Therefore, the effectiveness of this approach depends on the food inspectors under local authorities in terms of their skills, uniform inspections, and timely audits (Whitworth, 2019). The municipal governments have the mandate to conduct regular food inspections however, this poorly carried out and hence companies conduct self-monitoring approaches to maintain safety (Hunter-Adams *et al*., 2018).

In the case of the South African Listeriosis outbreak, a lot of confusion and delayed response were observed (Tambo *et al*., 2018). The outbreak began early in 2017, however, the first case was only reported to the NICD in July 2017 (Hunter-Adams *et al*., 2018). Moreover, the product recall was only officially ordered on 4th of March 2018 as indicated earlier (NICD, 2018). The number of cases had already reached 940 with 180 death rates by then (Whitworth, 2019). Therefore, this was a state of emergency that required urgent and full attention to prevent further damage (Tambo *et al*., 2018). However, the CEO of Tiger Brands (Enterprise unit) initially denied that the company was linked to the outbreak (Pijoos, 2018). The NDoH revealed that Enterprise had not been complying with the health and safety regulations for quite some time and was requested to provide samples from the processing facility. Unfortunately, the samples were never received and the NDoH did not act upon such a serious matter (Hunter-Adams *et al*., 2018; NICD, 2018). To make matters worse, a report by Sowetan Live on the 7th of March 2018 revealed that no regulatory agency had been appointed to investigate this outbreak (Whitworth, 2019). This placed emphasises on the loopholes within the food safety system (Pijoos, 2018; Whitworth,

2019). Kayode *et al.* (2019) indicate that foodborne illnesses are likely to increase due to the consumption of uninspected products, especially in low and middle-class areas within Southern Africa. According to Whitworth (2019) there is a need to implement strict and clear regulations that would create a culture of food safety obligation and accountability.

Although the response actions took time to be implemented, some positive actions were observed at a later stage of the outbreak (Tambo *et al*., 2018). These actions helped to contain the spread of Listeriosis and the impacts thereof. A regional meeting with sixteen (16) countries from Southern African and internationally was conducted with the aim to exchange knowledge and experiences regarding the management of the Listeriosis outbreak in South Africa (WHO, 2018). The scope of this outbreak influenced a range of stakeholders to work in collaboration for the establishment and implementation of emergency response actions (Hunter-Adams *et al*., 2018). The stakeholders included the NDMC, DAFF, the Department of Trade and Industry (DTI), South African Local Government Association (SALGA), the National Consumer Commission (NCC), and the National Regulator for Compulsory Specifications (NRCS) (NICD, 2018; Tambo *et al*., 2018).

A multi-sectorial team of the Incident Management Team (IMT) and the Listeriosis Emergency Response Plan (ERP) were established to enhance the actions for emergency response and contain the outbreak, while strengthening the health and food safety systems to ensure such incidences are never to be repeated (Tambo *et al*., 2018). The IMT established five objectives of the response plan:

- Enhance multi-sectorial partnership and coordination through the establishment of multi-sectorial management teams;
- Strengthen the capacity of health systems by improving surveillance and laboratory functions for Listeriosis detection;
- Facilitate and promote food safety monitoring and recall of the contamination;
- Review and update existing regulations in the food industry to ensure safety is not compromised; and
- Enhance risk communication through public information and awareness regarding food safety and facilitate food safety practices among food manufacturers (WHO, 2018).

This response plan is important because the impacts of the South African Listeriosis were devastating with the loss of human lives as the worst and non-reversible consequence. The response plan was based on the WHO ‘Emergency response framework’ approach which consists of three phases that are in line with the South African incidence of Listeria (NICD, 2018). The phases in the response plan are as follows:

Phase 1: investigating and detecting the contaminated food processing facilities and those at risk. And to facilitate proper training of staff members to effectively support inspections in the facilities;

Phase 2: conducting inspections of facilities that are identified as high-risk and strengthening health and safety practitioners; and

Phase 3: reporting of the implemented activities in the health system and review of the aftermath (WHO, 2018).

The success of this emergency response plan requires continuous surveillance of cases, risk communication, and the review and update of food safety regulations (Tambo *et al*., 2018).

As part of the response mechanisms the Department of Health released various tips and measures for preventing and minimising the Listeria infection (Buchanan *et al*., 2017; NICD, 2018):

- Always ensure to store the raw and cooked foods separately and thoroughly cook raw food products, especially beef and poultry.
- Keep food at the relevant temperature according to the storage instruction on the food product to minimise the growth of microbial in food.
- Always wash hands with soap after going to the toilet, before preparing food, and before eating.
- Regularly decontaminate kitchen spaces including utensils and counters, especially after preparing meat, poultry, and eggs.
- Always rinse raw fruits and vegetables before consumption.
- Cook food thoroughly using sufficient heat, especially eggs, meat, and seafood as this helps to reduce the presence of the L. monocytogene pathogen.

People who fall under the category of high risk for Listeriosis were also advised to avoid: soft cheese; refrigerated pâtés; unpasteurised milk or dairy products that contain unpasteurised milk; and foods from delicatessen counters that have not been heated/reheated adequately such as cold meats and prepared salads (WHO, 2018).

Effective treatment and prevention methods and guidelines hold a great role of minimising an incidence of Listeriosis whereby public awareness, firm biosecurity procedures, appropriate trade policies and hazard risk assessments are critical control points that need to be incorporated into all stages of food processing (Aalto-Araneda *et al*., 2019; Dhama *et al*., 2015).

Although there are numerous studies based on Listeriosis worldwide, only a few detailed studies are based on developing countries such as South Africa (Kayode *et al*., 2019). According to Aalto-Araneda *et al.* (2019) and Tambo *et al.* (2018) proper documentation concerning the epidemiology of Listeria is missing and this is a serious problem since the incidence of Listeriosis is on the rise within developing countries (Opperman & Bamford, 2018). Dhama *et al.* (2015) indicate that this increase is partially due to poor living conditions with poor access to basic water and sanitation. Thus, more research and awareness on Listeria and other foodborne diseases needs to be conducted in the context of developing countries such as South Africa (Kayode *et al*., 2019).

4.7 Conclusion

Listeriosis is a type of food-borne disease that results from a gram-positive bacterium called Listeria monocytogene (L. monocytogene). This bacterium can persist in adverse and stressful conditions including high pH level, refrigeration and heat temperature as well as sanitation treatment. The L. monocytogene bacterium can infect humans and animals. The common food that are susceptible to the L. monocytogene bacterium include dairy, eggs, vegetables, seafood, and meat products. The 2017/18 Listeriosis outbreak in South Africa is the largest outbreak to be experienced globally with 1, 060 cases and 216 mortalities. The impacts of the outbreak included hospitalisation cases, loss of revenue and jobs, and land contamination/pollution; all of which have a negative influence on food security.

The emergency response of this outbreak was slow and poorly conducted whereby Enterprise and the food inspectors delayed taking actions. The official recall of the contaminated products was implemented long after the Minister of Health announced the outbreak. Nonetheless, the Department of Health released various tips and measures for preventing Listeria infection. This outbreak exposed the loopholes within the food safety regulations which is of major concern.

The next chapter focuses on the discussion of the findings obtained from the interviews and questionnaires which connects the literature review. The methodologies that were used to acquire and analyse data were discussed in Chapter 1. The main purpose of Chapter 5 is to explore the relationship between the food chain stakeholders and disaster management officials and whether there are policies or strategies that integrate DRR and FCV.

CHAPTER 5: DATA ANALYSIS AND INTERPRETATION

5.1 Introduction

The previous chapter (Chapter 4) focused on the Listeriosis outbreak and the impacts thereof in South Africa. Chapter 5 aims to address research objective 5, i.e. to explore how the integration of the FCV and DRR can enhance food security. Chapter 5 focuses on the collected data from a questionnaire, document review, and the data analysis thereof. This chapter highlights the connection and divergence from the previous chapters to the research findings in order to establish a holistic discussion and a conclusion of these findings. The methodological approach that was used to acquire this data was already discussed earlier in Chapter 1. However, a brief review of data collection methods and the data analysis techniques are given again first before moving the discussion of the chapter to the findings.

5.2 Data collection

This study consisted of a literature review which formed the basis of this research as indicated in Chapters 2 to 4. For the empirical investigation of this research study a qualitative research design was applied where a questionnaire was designed as the main source of data collection tool. The questionnaire was sent to participants through email and hand delivered for participant to self-administer, while other participants opted for a telephonic interview (mainly food chain stakeholders who preferred telephonic interviews over self-administered questionnaire). The researcher also resorted to conducting face-to-face interviews following the poor response received from the food chain stakeholders, particularly retailers and the preference of these participants. The Coronavirus regulations and restricts were adhered to by the researcher which included, but not limited to, the wearing of mask and safe social distancing of 1.5 meter. The questionnaire contained open-ended with few closed-ended questions (see Annexure A). The recruitment of participants was based on prominent stakeholders of the food chain (such as Pick ‘n Pay, Shoprite, farmers, and Enterprise), the DAFF, and the NDMC. These recruitments were conducted using purposive and snowballing sampling techniques. Most of the participants were recruited through purposive sampling (i.e. Pick ‘n Pay, Shoprite, Spar, Enterprise and the DAFF), while only a few were recruited through a snowballing sampling technic (the NDMC).

The questionnaire attached as Annexure A, is titled *‘The integration of DRR and the FCV in order to enhance food security in South Africa’*. The questionnaire was divided into five (5) sections

which included questions aimed at obtaining answers linked to the research objectives of the study. The first section (Section A) focused on the respondent's background information (Questions A1–A4). Section B, was based on exploring the relationship between the FCV and DRR and comprised of questions B1–B4. The third section (Section C) mainly focused on the influence of the FCV on food security (Questions C1–C4). The impacts and the response to the Listeriosis outbreak comprised the fourth section, Section D (Questions D1–D4). The last section (Section E) focused on the DRR legislations that incorporate the FCV to enhance food security and comprised of Questions E1–E6.

5.3 Data analysis

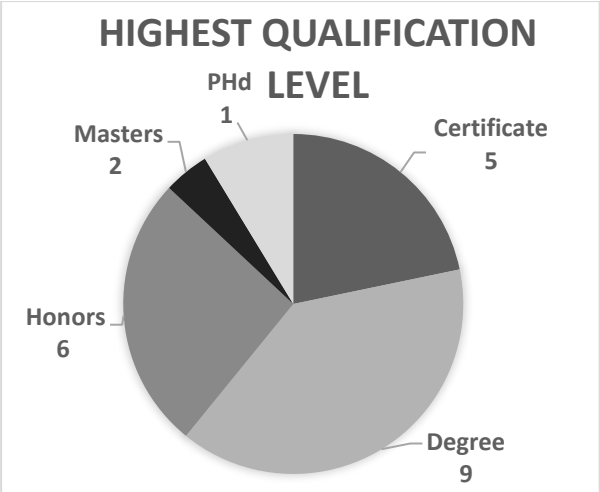
Data analysis is a process of interpreting, transforming, and modelling of data in order to draw useful conclusions and recommendations (De Vos *et al*., 2012). According to Braun *et al.* (2014) data analysis is important because it assists the research to process the collected information to make sense of the data while comparing or integrating it with the desktop study from the literature review. This provides building blocks that can be used to establish a substantial argument about a topic. Therefore, the aim of this section is to present the findings by providing understandable and useful information through thematic patterns as indicated in Chapter 1.

An Excel spreadsheet was used as one of the tools to analyse the findings, particularly the graphic information that illustrated diagrams to represent information for easy analysis. Thematic analysis was used to analyse the information results into codes which were then categorised into themes. These findings were presented as narratives in order to present the data according to the way participants perceive the relationship of food security and DRR while taking into account the existing theoretical research. This is in line with the phenomenological research design. The phenomenology is an approach that explains a situation or phenomena through the perception of a participant (De Vos, 2012). The value for this approach towards this study is that the findings will contribute to the development of effective policies and theories that integrate the issues of food insecurity. The names of the participants were not revealed to protect their identity and privacy as mentioned in section 1.6.9. Therefore, the respondents have been coded as PR1 in a numeric order to protect the identity of participants while simplifying the process of data analysis and presentation of findings. These codes are arranged numerically such as PR1, PR2, PR3 and so forth. Section A of the questionnaire focused on the background information of respondents which guided the researcher in terms of applying relevant probing questions during interviews.

This further assisted the researcher to expand upon the key concepts of the study that were not initially regarded as the main focus of the paper.

5.3.1 Section A: Participants demographic background (Questions A1–A4)

Section A of the questionnaire was based on the background information of participants and this was important to build an understanding about the respondents and their level of exposure regarding the topic at hand. This section consisted of four questions (Questions A1–A4). The respondents were asked to indicate their occupational field, specify sector or unit, qualification and their years of occupational experience. The first question (A1) asked the respondents to indicate their highest level of qualification (Figure 5-1). The short-course certificate (A. Certificate) was indicated as the lowest qualification level that respondents had, while most (18 of 23) of the respondents had degrees with “PhD” as the highest level. This suggests that the respondents have basic to good educational background that enables participants to understand their respective line functions. The second question (A2) focused on the occupational field of the research participants (i.e. food chain, disaster management, food safety regulations) (Figure 5-2). This information was used to categorise the questionnaires and analyse data accordingly. The researcher realised that this questionnaire requires the respondents to have a certain background because the questions are based on FCV, food security and DRR thus, the purposive and snowballing techniques were used as indicate in Chapter 1. The results from the respondents outline that the respondents have the relevant educational background and working experience. Furthermore, the respondents revealed various background and experience level according to their sectors, which was important because food security is a cross-cutting issue. The number of respondents from each sector is represented in Figure 5-2 below.



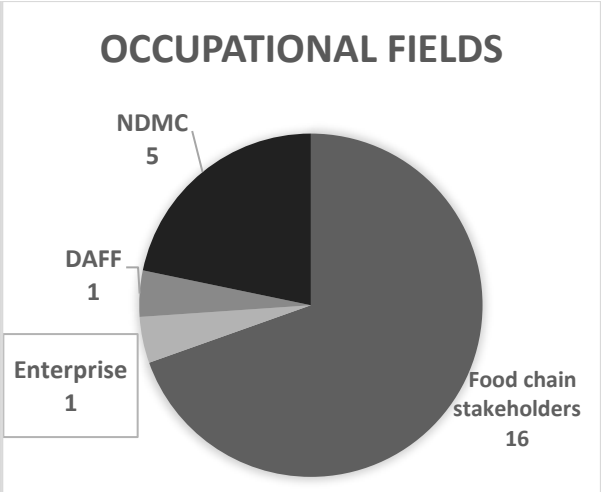


Figure 5-1: Highest educational level (QA1)

Figure 5-2: Occupational fields (QA2)

The third question (A3) enquired about the specific sector/unit that the respondents are employed under. The respondents were provided with options of selecting from with an additional option of 'other' in case the respondent felt that the provided options were limited. The respondents were provided the option to elaborate on their sector or unit. As can be seen from Table 5.1 below, the majority of the participants (16 of 23) indicated that they are in the retail sector, while some indicated that they are from NDMC (5 of 23) with 1 participant from Enterprise and DAFF respectively. It is fitting to highlight the sectors that respondents belong to in order to understand and identify the gaps or strengths in the FCV and DRR legislation.

Table 5-1: The respondents' specific sector.

Participant	Sector or unit	Number or respondents
Food chain stakeholders	• Retailers	• 12
	• Manufacturers	• 2
	• Farmers	• 2
Enterprise	• Risk manager	• 1
DAFF	• Subsistence farming	• 1
NDMC	• Response & recovery	• 2
	• Legislation framework	• 1
	• Capacity building	• 1
	• DRR & planning	• 1

The fourth question (A4) focused on the number of years the participants had been working in in the above-mentioned occupation. The question was raised because the researcher wanted to acquire data from participants who understand their function lines extensively in order to avoid confusion and unreliable data. Most (14 of 23) of the respondents indicated that they have minimum 6-10 years working experience, and this was reflected is a positive indication wherein most of these respondents are highly knowledgeable and experienced within their respective fields. On the other hand, few respondents (9 of 23) indicated that they have 1-5 years minimum working experience as can be seen in Figure 5-3. This information was further used to highlight the level of sectorial integration or collaboration as basis for analysing the context of multi-sectorial approach towards ensuring food security. This study emphasises the importance and need for an integrated approach to promote resilience against food insecurity, hence, the need to ask questions that show direct and indirect link to the respondent's sector/ unit.

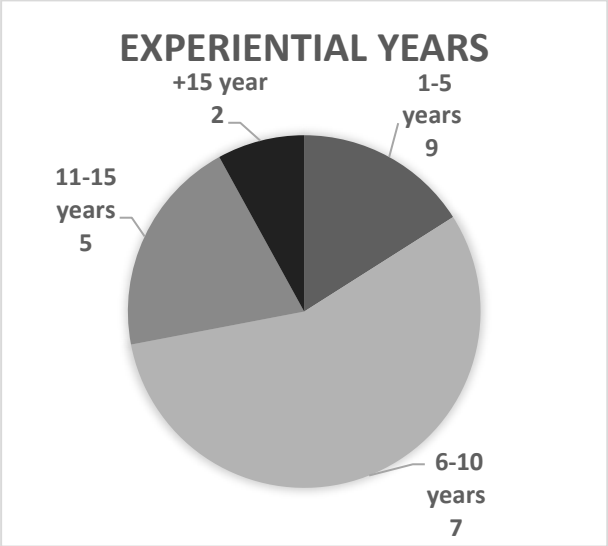


Figure 5-3: Number of experiential years (QA4).

5.4 Thematic patterns

The questionnaire was developed in line with the research objectives which also contributed to the thematic patterns. These thematic patterns were predetermined by the researcher based on the questionnaire and were further shaped by the responses received from the participants. The background of participants is captured in Section A of the questionnaire which was used to determine the eligibility and appropriateness of respondents while the questions in Section B to Section E were formulated to address the research objectives. Thematic analysis as a method was used for data analysis and the themes were grouped into five (5) as presented in Table 5-2

below, namely: (1) key study concepts; (2) the relationship between food security, FCV and DRR; (3) food security and DRR legislative structures; (4) Listeriosis impacts and response; and (5) integrated policy towards food security. A summary of the thematic patterns and the related questions from the questionnaire is illustrated in the table below.

Table 5-2: Thematic patterns and the contributing questions from the questionnaire.

Thematic patterns	Questions from the questionnaire
Key study concepts	**B1** What is of your understanding of the term the "Food Chain Value (FCV)"?
	B2 What is your understanding of the term "Disaster Risk Reduction (DRR)"?
Relationship between food security, FCV, and DRR	**B3** According to your understanding, do disasters affect/ influence the food chain value?
	B4 In your opinion, does DRR strengthen the food chain value?
	C1 In your opinion would you say the food chain is able to keep up with environmental risk factors like, climate change and disasters?
	C2 According to your understanding how does the food chain value influence food security?
	C3 In your opinion, what are the key challenges faced by the food chain?
	C4 In your opinion, how do the mentioned challenges in question C3 influence food security?
Legislative structures of food security and DRR	**E1** Do you know policies or initiatives that reduce or/and manage disasters in South Africa?
	E2 Please name policies and programmes that reduce food insecurity in South Africa that you know
The impacts and the response effectiveness of the Listeriosis outbreak	**D1** Are you familiar with the Listeriosis outbreak in South Africa (2017-18)?
	D2 In your opinion, how did the Listeriosis outbreak affect citizens?
	D3 In your opinion, would you say that this outbreak had an influence on household food security in some way?
	D4 According to your opinion, do you believe that there was anything that could have been done by the Department of Health or Enterprise Company to minimise the adverse impacts caused by this outbreak?
Policy integration towards food security	**E3** Do you know legislation or programmes that address both food insecurity and disasters in South Africa?
	E4 In your opinion, please rate the effectiveness of the above legislations from a scale of 0 to 3
	E5 Kindly indicate if your department/ unit play in enhancing food security
	E6 Kindly indicate if your department/ unit play in reducing disaster risks

5.5 Research findings

The demographic information and the thematic patterns mentioned above have formed the basis for the following section. The following section provides a discussion of the findings in the form of the five (5) themes as indicated below.

5.5.1 Theme 1: the key study concepts (Questions B1–B2)

The first theme is based on Section B of the questionnaire which consists of two questions (B1 and B2) that asked respondents to define the concepts FCV and DRR. It is of great importance to understand these concepts as they form the foundation of this study. A detailed discussion of these concepts was provided in Chapter 1 (sections 1.1.1-1.1.3). The following discussion is focused on the level of knowledge and understanding that the respondents have regarding the key concepts of this study. The participants responded well to the questions about the key concepts of the study which are food security, the food chain value (FCV), and disaster risk reduction (DRR) (Question **B1-B2**).

The concept of the FCV (Question B1) was well understood by respondents whereby they provided the definition and examples. The keywords that were used by respondents to define the FCV include "*process, various stakeholders, interlinked, producers, processors, suppliers, consumers, quality, nutrition, affordable, and sustainable*". The FCV was explained as "*the process that involves growing, processing and selling food by various stakeholders*" (PR22). PR5 went on to say that the FCV is about "*food productions that is based on balancing consumer demands and environmental sustainability to ultimately boost food security*" (PR5). This respondent stressed the issue of meeting the consumer demands while avoiding stock stacking. PR11 indicated that "*the retail store orders and receives stock from various suppliers (e.g. Tiger Brands, Coca-Cola, Uniliver) weekly to avoid stock piling, however; the challenge is that this is costly and risky should anything happen that suppliers fail to deliver*". Section 2.3.3 talks about the importance of food distribution and the challenges thereof which tend to impact on food accessibility. According to PR13 "*the FCV is a process that involves four interlinked stages which are production, manufacturing, supply, and consumption to deliver sustainable food products*".

PR18 defined the concept of FCV as "*an approach that is necessary to assist consumers to acquire healthy and environmentally safe food at an affordable price*". Similarly, PR4 emphasised that "*the FCV promotes healthy lifestyles by offering nutritious, quality, and convenient, and affordable food*". This was further accentuated by PR19, PR20, and PR23. PR17 used the Eat

Well, Live Well initiative as an example that support nutritional well-being "*by offering consumers easy to read labelling system on all product packs through the 'Eat Well Live Well' symbol and Guideline Daily Amounts table*". According to PR7, "*the FCV offers a range of products are value-added through nutritional value and affordability*". PR1 defined the FCV as "*the process to ensure to improve the efficiency of food production with less inputs costs by producers to deliver safe and convenient food to consumers*". Furthermore, PR2 indicated that they have observed a pattern of purchasing foods that cost less, but not necessarily healthy which is a major challenge for the poor (perceived by PR1, PR2, PR5, PR12 and PR15).

Overall, the findings entail that all the respondents have a good understanding about the FCV and its functional activities and that gave the researcher confidence in proceeding with the questionnaire. Most of the respondents included the concept of food safety and nutrition which was highlighted as critical challenges for the poor people. This is a major problem given that the rate of obesity and heart disease is increasing in South Africa. Furthermore, food accessibility was identified as one of the key issues in food security. PR2 went on to say that "*the FCV activities are influenced by various factors that may reduce the state of household food accessibility*". This is aligned with the literature review (see section 2.5.2) which revealed that the FCV consists of activities that are interconnected; all of which shape the way households access food and achieve stability and thus, the state of food security.

The concept of Disaster Risk Reduction (DRR) (Question B2) was well defined, however, there were some gaps observed from some respondents (PR19, PR20, PR21, PR22, and PR23). DRR was defined (PR 19) as "*the application and implementation of policies, frameworks, and practices reduce vulnerabilities, prevent and mitigate adverse impacts through proper preparedness and mitigation strategies that save lives and the environment while creating resilience against disasters*". Another respondent (PR20) indicated that "*DRR involves a series of steps or interventions that aim to reduce the risks or the level of damage caused by any type of disaster, either natural or manmade*". These respondents stressed that failure to apply good risk reduction mechanisms could result in irreparable damage both to the environment and infrastructure. According to PR17, DRR is "*the process to manage the damage caused by natural hazards like earthquakes, floods, droughts, and cyclones, through an ethic of prevention. Disasters often follow natural hazards*. *Each decision and action make us more vulnerable to disasters - or more resilient to them*". This broad definition shows that there is a need for a deeper understanding and knowledge regarding DRR. The researcher noticed that the respondent interchanged between the concept of DRR and DRM which entails that there is a bit of confusion of the two concepts. This was further observed among PR1, PR2, PR3, PR6, PR10, and PR12 whereby DRR receive little attention as these respondents were not able to provide a proper definition of the concept of

DRR. This is of major concern because the food chain is becoming fragile to climate change and disasters (see Chapter 2). These respondents explained DRR merely as a practice that aims to reduce hazards. In this regard, the researcher noticed a need for better awareness and education about the benefits of using the DRR approach. An integrated approach of DRR and the FCV would assist to close this knowledge gap.

Overall, it was observed that not all respondents had sound knowledge and understanding about the concept of DRR while other respondents interchanged between DRR and disaster management. These findings outline that there is a confusion and knowledge gap regarding DRR. Respondents who were unable to define this concept were those whose daily functions do not directly relate to disaster management activities. Nonetheless, this is worrying because evidence-based research shows that disasters can be unpredictable and have the power to change or destroy all types of systems (Caldecott *et al*., 2013; Carabine, 2015; FAO, 2019; GFDRR, 2007). This places emphasis on the fact that disaster preparedness is everyone's responsibility. Therefore, identifying and understanding the potential risks is the first step towards effective preparedness that could reduce the total loss of resources and the damage resulting from disasters. The researcher took the opportunity to explain this concept to respondents who were unable to define DRR. This contributes towards closing the knowledge gap while promoting the integrated approach of DRR as outlined earlier in section 3.4.3.

5.5.2 Theme 2: The relationship between food security, FCVs, and DRR (Questions B3, B4, C1–C4)

This theme focused on the perception of respondents in relation to the connection between food security, the FCV and DRR. The findings are discussed below.

The respondents indicated that there is connection between the food chain and the occurrences of disasters and that this is becoming a problem (Question B3). PR16 stated that "*we as food producers depend on environment conditions for productions, for instance, I use to farm sugarcane and ground beans however, due to water shortages I no longer farm sugarcane*". On the other hand, PR4 indicated that "*the quality of fresh produce has significantly reduced due to climate change hence, the increase in genetically modified food*". According to PR17 disasters have detrimental impacts on the processes within the food chain such as agricultural practices (e.g. drought leads to the need for irrigation systems); manufacturing activities (e.g. the rapid rise of food pathogens due to extreme heat conditions); and the supply chain (e.g. inaccessible routes due to drought). Section 2.3 of Chapter 2 discussed the impacts of disasters within the entire

chain i.e. food production, processing, distribution, and consumption whereby the overall findings indicated that disasters influence the FCV in a negative manner, and this is concerning. PR24 and PR26 indicated that disasters and food security are closely related to each other, along with the functions of the FCV such as food productions and supply. Furthermore, these respondents indicated that these aspects should be addressed in an integrated approach, especially since the magnitude and frequency of disasters is rapidly increasing globally and in South Africa. This was accentuated by PR19, PR6, PR23, PR25, PR18, PR9, and PR16. Furthermore, this forms part of the focal point of this study which is to show the impacts of disasters on the FCV and ultimately food security, and thus the need for the integration of DRR and the FCV. PR17 stated that "*disasters affect the whole supply chain in the sense that it reduces yields of both crops and animals that leads to the shortage of supply of raw materials to the processors, which in turn leads to food shortage for consumers*". This is similar to the response from PR7 and PR8 who emphasised the adverse outcomes of disasters on the performance and deliverables of the FCV.

The question about whether the food chain is able to keep up with environmental risk factors like, climate change and disasters (Question C1) was rated between slightly and moderately effective. The following optional answers were provided: (A) none effective; (B) slightly; (C) moderately; and (D) highly effective. Most respondents rated the effectiveness of the food chain to keep up with environmental risks as 'slightly effective' (11 of 23 respondents) which was supported by emphasising on the evident climate change impacts on food production such as crop yield reduction, low quality, and greater food waste. Few respondents opted for 'moderately effective' (8 of 23 respondents) based on the view that technological methods such as cool storage rooms/ trucks, genetically modified food, and processed food enables the FCV to function regardless of unfavourable environmental conditions. Only four (4) of the respondents rating opted for 'highly effective' with emphasis on the increase of skills on food technology and sustainable agricultural practices that are promoted though institutions of higher learning and government initiatives such as CAADP. The literature review revealed that food processing and technology has both positive and negative impacts whereby convenience, affordability, and longer shelf-live are offered while nutritional value and taste may be compromised through food processing. PR9 said "*the FCV has been providing food to consumers since the existence of human beings and it continues to cater for consumer's demands even through the unfavourable environmental conditions through the introduction of innovate measures such as Hydroponics, Aeroponics, and Polyculture*". PR4, PR7, PR13, and PR14 shared similar views. PR12 seconded these respondents to say that "*the FCV provides food throughout the seasons regardless of environmental factors such as all year availability of fruits and vegetables e.g. apples, lettuce, and corn*". PR15 stipulated that "*environmental risk factors such as fire or floods tends to lead to food loss and food waste that*

threatens food availability, access, and stability". PR16 added that "*there is a need to move towards drought resistance and heat tolerant given the adverse impacts of climate change, however, this transformation is happening at a slow pace*". It was pointed out that during the event of a disaster, the demand for food usually increases and this causes a strain on the food chains that may not be able to keep up with these demands, which may in turn cause price increase (PR1, PR4, PR7, PR18, and PR21). The 2018 drought was used as an example whereby water shortage led to the closure of farms and the meat industry suffered tremendously, with a significant reduction of livestock supply and ultimately price increase for both lamb and beef (PR18).

In line with the environmental risk factors noted as threats to the FCV, DRR was perceived as an approach that may improve the capacity of the FCV to cope with disasters (Question B4). Most (14 of 23) of the respondents believed DRR could bring a positive contribution to the FCV, especially in the production stage (i.e. farming) that is threatened by climate change. Few (9 of 23) respondents were of the view that DRR does not bring about significant outcomes on the overall functions of the FCV because the FCV stakeholders have sufficient and vast knowledge regarding food production activities. According to PR11 "*most practitioners in the FCV have background or specialise in areas of soil, animal and plant studies; food technology; food safety etc*." It was revealed that DRR is an approach that can strengthen the functions of the FCV by identifying, assessing, and reducing the disaster risks and vulnerabilities within the chain (PR19-23). This is aligned with the literature review of this study that also indicated the practical benefits of integrating DRR into the FCV through evidence-based cases in developing countries (section 2.4). PR17 stated that "*the DRR can strengthen the FVC through mitigation measures that will curb the shortage of raw materials while promoting resilient food chains. This will enable sustainability of organizations to operate at lower costs and enhance profitability and stability food chains which is essential for improving food security given the issues of climate change and rapid population growth*". Similarly, PR18 went on to say that "*knowledge and expertise of the disaster management officials contribute towards building food security and ultimately sustainable food chains though capacity building of food chain stakeholders for example, sustainable farming practices that are disaster adaptive or disaster-proof to ensure continuous production of food which will eventual be delivered through the value chain*".

The key challenges that most respondents (17 of 23) highlighted regarding food chains (Question C3) are the issue of balancing demands and supply, food safety, profit loss, food waste, climate change, rapid population growth, access to market entry, decreasing land and water accessibility, and increasing energy prices. PR6 mentioned that "*climate change, quality of food, shelf life of food, and pathogens are key challenges that the FCV face*". Furthermore, it was indicated that

these challenges contribute to food insecurity in the sense that they disrupt food productions and distribution of food security (PR4, PR10, PR20, and PR21). PR2 raised the issue of consumer's demand for high-end product (standard priority) that is becoming a pattern whereby consumers are demanding products that are of high standard at affordable prices. PR1 supported the above statement by saying that *"Although the FCV seeks to provide high quality products but the challenge is that this may at times require the FCV stakeholders to apply measures that are costly such as importing tomatoes and green chillies since consumers want to consume the fruit all year round*". Consequently, PR6 and PR8 stressed the issue of food waste within food chains. PR8 pointed out that "*food waste is a serious challenge that requires attention since many people go hungry while more than 30% of the food being produced goes to waste before even reaching consumer*". Section 2.3.2.4 of Chapter 2 discussed the issues around food waste in the midst of household food insecurity and limited production resources in South Africa. PR13, PR17, and PR23 pointed to "*water shortages, limited land availability, high energy prices, lack of institutional support such as regulatory frameworks, and low human capacity*" as the main challenges. The frequent drought conditions in South Africa were used as an example to indicate the reality of the food chain's challenges. According to one of the respondents, "*agriculture depends on climate conditions to thrive and this is a challenge given that South Africa is a semi-arid region*" (PR5). According to respondents, all the above-mentioned challenges have negative influence on the state of food security (Question C4). This accentuates that the FCV is influenced by several factors that not necessary fall within the food system. Thus, the study proposes an integrated approach to effectively address all challenges within the chain. PR18 outlined that "*the above-mentioned challenges put strain on the state of food security. Thus, achieving and sustaining food security and FCV prosperity will need significant efforts to promote the country's' agriculture through the integration of climate change adaptation and DRR mechanisms. The challenge to boost the FCV remains an issue*". The respondent went on to say, "*South Africa needs a paradigm shift to industrialise and commercialise the agriculture sector while initiating risk reduction mechanisms in order to enhance food production and income*".

The participants responded to the question about the influence of the FCV on food security (Question C2) by stating that the functions of the FCV are all interlinked towards ultimately ensuring that food security is achieved. PR8 indicated that "*the FCV is a key system that can either promote or decrease the level of food security*. *For example, if the performance of the FCV decrease and leads to failure of food supply then people would not be able to access food which may further cause food insecurity*". All respondents shared the same view that the FCV has a paramount influence on food security. PR13 stated that "*the disconnection of food chains may increase food insecurity for example, if maize production were to stop in the country then the food*

security of several households would be threatened since maize forms part of daily staple food". Similarly, PR4 indicated that "*the FCV has strong connection with food security; when a FCV performs well then food security is likely to increase and vice versa*". This shows that it is important to consider the functions of food chains when addressing the issues of food insecurity. PR16 said that *"if the suppliers fail to meet the needs and demands of consumers then food insecurity can be reduced*". Although PR16 is correct, it was noted that food security is not merely dependent on high food productions which can be observed in South Africa where there is adequate food production with the existence of household food insecurity.

According to respondent's PR17 and PR18 the FCV has a major influence on food security, which is mostly positive, however, the FCV can also have a negative influence. PR17 indicated that the FCV is known to produce and supply food to consumers and this directly correlates with food security i.e. availability, accessibility, utilisation and stabilisation. This respondent stated that "*food productions from domestic production to commercial imports is linked to the level of food availability. The FCV provides convenience, affordability, and nutritional value that promote food accessibility where consumers acquire healthy food at an affordable price. The FCV promote healthy diets through organic products. The FCV works to provide consistent food production and supply through sustainable initiatives which in turn stabilises food availability and accessibility to ultimately enhance food security*". PR18 pointed out that "*the activities of the FCV are interlinked to ultimately ensure that consumers have adequate food access to the food that is already available. Although food availability is critical it is not equivalent to food access*".

PR16 indicated that the approach of the FCV works to identify the causes of food insecurity to ensure sustainability through leveraged market forces that promote long-term influence. This means that the FCV is market-driven because it links households to emerging markets in order to strengthen household's income for better food accessibility. This further contributes to diet diversity and reduce the risk of relying solely on limited income for food security. Section 2.5.2 of the literature review revealed that food access and lack of or limited income are major barriers to food security in South African households. PR1 and PR6 shared the opinion that the FCV approach is directed towards protecting the environment while promoting a socio-economic balance; which is an efficient way to achieve desired sustainable food security. PR16 was in agreement with the above respondents by saying that "*the FCV lens helps to identify the potential impact of activities on food security and develop mitigation strategies for any possible negative impacts. Moreover, this helps to create effective programmes and policies towards understanding strategies that produce positive food security outcomes*". PR2 added by pointing out that "*the FCV ensures that healthy and safe food reaches the consumer by interrogating the quality and safety standards from stages from production, transportation, storage, and processing parts of food*

chain". PR13 said that "*An optimal FCV improves food security which contributes to the betterment of society*".

It was revealed that food insecurity tends to shape the behavioural patterns of households and the success or failure of the FCV initiatives in such a way that food insecure households are often less likely to take risks regarding future investments to upgrade the standard of living (PR10). On the contrary, PR20 and PR23 noted that the FCV provide a range of healthy products to consumers. However, it is also important to note that the FCV does not always also address the underlying causes of food insecurity. The case of organic food products that are expensive and limited to certain locations was used as an example to indicate the gaps of the FCV in addressing food insecurity issues. This is aligned with the problem statement that emphasised on the lack of an integrated approach towards food security given the complexity of food security which requires an integrated approach to identify and address the root causes of food insecurity in order to reach the level of household food security in South Africa. The literature review (section 2.5) indicates that the FCV activities have beneficial and negative impacts on food security. For instance, food availability may be significantly reduced through the promotion of cash crops cultivation, while the nutritional value may be reduced through food processing and storage tactics (Caldecott *et al*., 2013; Hill & Pittman, 2012).

The second theme (i.e. the relationship between food security, FCVs, and DRR) covered the first and second research objective i.e. (1) to explore the relationship between the FCV and DRR and (2) to investigate how the underlying factors of the FCV influence food security. The findings demonstrate that all the respondents recognise and acknowledge disasters as threats to the FCV activities whereby productivity loss and revenue loss were identified as common disaster impacts. According to the respondents, the key challenges faced by the FCV stakeholders include climate change, ever-changing consumer demands, food safety, production costs, profit loss, and food waste. These challenges were noted as negative influencers towards food security. The findings highlighted a sense of mixed responses about whether the FCV is able to keep up with the environmental risks or not. The responses were rated from slightly effective to highly effective with most respondents rating it as slightly effective. The results demonstrate the need for better risk management and integrated approach to improve the coping capacity of food chains against disaster risks.

5.5.3 Theme 3: Food security and DRR legislation structures (Questions E1–E2)

Theme 3 investigated the respondents' awareness and knowledge regarding food security and DRR legislation and the integrated policies thereof in South Africa. This analysis is important given that the knowledge gap was identified as one of the key challenges towards sustainable food systems (see Chapter 3, Section 3.3.3).

The overall background about the food security policies in South Africa was average. The respondents (PR5, PR15, PR16, PR17, PR18, PR19, PR20, and PR23), were able to mention Food Security and Nutrition Policy (FSNP), the Integrated Food Security Strategy (IFSS) and the Zero Hunger Programme (ZHP). The food security programmes of school feeding schemes and social grants were also explained under the section of food security policies (Question E2). Fifteen (15) of 23 respondents were not able to identify food security legislations, which is of great concern. Nonetheless, programmes such as school feeding schemes and Gift of the Givers were mentioned in this section. In essence, it was observed that most respondents need a deeper knowledge about the legislation that addresses food security in South Africa because food security is a serious issue that requires vast knowledge and skills from a range of disciplines other than the food chain stakeholders. PR20 mentioned the food programmes such as the World Food Programme, Gift of the Givers, Food, Agriculture Organisation, and Red Cross under the section of food security policies. PR1, PR5, PR7, and PR9 indicated school feeding schemes, social grants, and community food parcels as initiatives that promote household food insecurity. According to PR18 the Integrated Food Security Strategy (IFSS) was identified as the policy that laid the foundation for addressing food insecurity issues in South Africa. The respondent stated that "*the IFSS increased attention to the challenges of food emergency and safety nets against food insecurity in South Africa*". PR23 was able to identify three food security policies namely: The Food Security and Nutrition Policy (FSNP), Zero Hunger Programme (ZHP), and the Integrated Food Security Strategy (IFSS). The FSNP was said to be based on promoting the state of food security at national and household levels in South Africa. The ZHP was defined as "*a policy that initiates to end hunger, achieve food security, and reduce malnutrition*" (PR16). The respondent stated that "*the IFSS intends to ensure socio-economic access to adequate food that is nutritious for all citizens so that they meet their dietary for healthy lifestyle*". Although, these policies were poorly defined by the respondent, the response is commendable. PR18 mentioned several policies i.e. the Zero Hunger Programme (ZHP); Food Security and Nutrition Policy (FSNP); Integrated Food Security Strategy (IFSS); and the Fetsa-Tlala are the core policies that were mentioned. The following programmes were mentioned in addition to the national policies namely: The Food and Agriculture Organisation (FAO); Comprehensive Agricultural Support Programme (CASP); and Illima/Letsema which are some of the major programmes established

or/and managed by the DAFF. The question of DRR legislation received little response from the respondents (Question E1). Only a few of these respondents knew about DRR and its purpose. Those who responded indicated that they heard about disaster management which is focused on identifying and reducing the occurrence of disasters (14 of 23). This revealed that although there is a knowledge gap about food security and DRR legislation within FCV stakeholders, there is a sort of interest in DRR which in turn means an opportunity for learning. PR19 and 23 mentioned the Disaster Management Act (DMA) and the National Disaster Management Framework (NDMF) as the main legislative structures that promote DRR. PR23 went on to mention that "*the NDMF is based on the four (4) key performance areas (KPA) of which the second KPA is focused on identifying and assessing hazards/ disaster risks which is an important aspect when it comes to addressing disasters which is a contributor to food insecurity*". It was emphasised that if various departments and state entities (including DAFF) were to conduct and review disaster risk assessments regularly, effective policies and initiatives would be implemented to address food insecurity and disasters (PR20 and PR21). Furthermore, the KPA 3 is focused on the aspects of integrated planning among the processes of developmental plans (PR23). These respondents (PR20, PR21, and PR23) emphasised the fact that DRR is multidisciplinary in nature and they went on to cite other legislations that go hand in hand with DRR such as the Conservation of agricultural resources Act (No 43 of1983) and the Land reform programmes. It was PR20 who noted that "*the challenge is that these departments tend to work separately, and this has slowed the progress towards sustainability and resilience*". Overall, this means that disasters are likely to continue threatening food security in South Africa. This response is aligned with section 3.4.1 that focused on the lack of institutional arrangements within DRR legislation.

Theme 3 contributed towards addressing the third research objective that related to the DRR legislation which incorporates food security aspects. The major challenge noted from this section is the lack of awareness and the knowledge gap among the respondents regarding the national food security and DRR policies. Nonetheless, respondents were familiar with programmes and initiatives that contribute to improve food security in South Africa. On the contrary, most respondents were not able to identify DRR policies and this suggest that there is limited policy integration; meaning that the process of policy contributions by external parities in policymaking is poorly practiced. This tends to slow down the progress of effective policy structures and a shared contribution towards food security. The findings demonstrate that the inability to customise international food security policies to the South African context remains an obstacle. This can be seen in the ZHP which operated for seven (7) years (2005-2012) because the programme was not focused on the socio-economic issues of South Africans, but it was rather based on the issues of Brazilians as it originated from Brazil. Lack of collaboration was highlighted as a leading cause

for failure of the ZHP. The discussion about issues relating the implementation of DRR legislation in South Africa was offered earlier in section 3.4 of Chapter 3.

5.5.4 Theme 4: The impacts and response of the Listeriosis outbreak (Questions D1–D4)

This theme investigated the impacts of Listeriosis on household food security which emphasised the close correlation between food security and disasters. A detailed theoretical research discussion on this topic was provided earlier in Chapter 4.

All the respondents were familiar with the Listeriosis outbreak that occurred in 2017-18 in South Africa (Question D1). Furthermore, the respondents recognised the influence of disasters on production systems, income profit, and consumer satisfaction. According to PR1 "*the food stakeholders are connected whether directly or indirectly, so this means when one stakeholder suffers from the impacts of a disaster then the others are more likely to suffer as well*". In terms of the Listeriosis outbreak, the respondents indicated that the outbreak caused a lot of damage with a significant reduction in revenue, consumer anxiety, health risk, and food waste (Question D2). PR1 said that "*During the outbreak, I observed a pattern of anxiety related to all processed meat products including the store brand products which had not been contaminated*". Similarly, PR16 indicated that *"consumers lost trust in both Enterprise and retail stores which only serve to supply food to consumers*". This highlights the interconnection of stakeholders within the food chain as indicated by PR1. On the other hand, PR18 was of the opinion that the impacts of the Listeriosis outbreak were not severe mainly because the contaminated products were recalled, and the information was communicated to the public at an early stage. The respondent stated that "*the NICD had conducted investigations in partnership with other stakeholders as soon there were suspicions of the L. monocytogenes, thereafter, the contaminated products were removed from the shelves and quarantined in a safe area*". It was further pointed out that the well-established food safety procedures that consist of effective tracing and tracking mechanisms contributed in minimising the impacts. The only issue that was raised by this respondent (PR18) was "*the negative effects on the generation of revenue for local small businesses (Tuckshops) that sell products with processed meat such as local sandwich called sphathlo/ kota*". PR1 and PR9 shared similar views that the outbreak had minimal impacts because of the product recall. PR9 went on to say that "*Enterprise and the Department of Health took timely measures to recall all the contaminated products and notify the public about the outbreak where consumers were refunded upon returning the contaminate products at retail stores*". On the contrary, research shows that that the outbreak impacted several people with 1, 060 recorded cases in South Africa

(see Chapter 4, Table 4-2). In addition, section 4.5.3 revealed that most people purchase processed meats as part of the monthly grocery, however, during the outbreak people were advised to avoid such products. This caused changes in consumption patterns and budget spending for some households, especially in low-income households where processed meat is a priority. PR19-PR23 revealed that the Listeriosis outbreak had adverse impacts on people which included changes in consumption patterns; budget spending since processed meat are affordable and convenience; loss of profit (especially for local tuckshops); loss of jobs (Enterprise staff); health implications; and mortalities. PR18 pointed out that "*although fresh pork was not directly linked to the outbreak, false information was distributed through social media which created confusion and panic among consumers whereby the sale of pork dropped significantly for that period*". In this regard, PR20 said that "*people whose livelihoods depend on selling processing meat where unable to do so*". PR22 stated that "*the outbreak had a negative influence since lots of money was spent on hospitalisation and food recall (waste control to safely dispose the contaminated products) which could have been used for promoting food security*". PR17 pointed out that "*the outbreak was not anticipated nonetheless, the outbreak might have affected households' budgets in that, those of low income who were surviving mostly on the affordable cheap commodity had been affected in the sense that they might have been forced to look for alternatives that might be beyond their budget*".

All these impacts had a negative influence on household food security (Question D3). The majority of the respondents' (17 of 23) believed that food security was threatened by this outbreak whereby consumers could no longer use ready-to-eat products for everyday consumption. The example of townships and informal settlements was used to say that "*these people highly depend on ready-to-eat products mainly because of less preparation time and requires less electricity in terms of cooking hence, small packages are usually bought for daily consumptions for those without refrigeration, electricity and insufficient finance*" (PR6). PR5 outlined that "*household food security became negatively affected in way that livelihoods of some families threatened in terms of loss of income either through profit loss or loss of employment from Enterprise*". In terms of the effectiveness of the outbreak response (Question D4), most respondents (15 of 23) believed that the recall was delayed. PR23 emphasised that "*the outbreak began in December 2017, but the Minister of Health only made an official announcement on the 04th of March 2018*". The problem was that the people continued to purchase the contaminated products since there was a lack of communication to warn consumers. The respondents from the NDMC therefore emphasised the importance of establishing feasible preparedness and contingency plans that enhance preparedness and response for disasters. In addition, this respondent went on to say that "*emphasis should be placed on the aspect of better education and more awareness for both the*

staff members and the consumers to assist in reducing health implications and mortalities". PR2 went on to say that "*there was nothing else that could have been done at that time since the outbreak was unexpected. Furthermore, the implications could have been worse if the recall was initiated at a later stage*". Nonetheless, research shows that this outbreak was the largest on a global scale, which indicates that the South African response was not effective. PR17 said that "*the company acted quickly and decisively once they realised that the operation facility could jeopardise the health of consumers*". The actions that were taken included the closure of the Polokwane and Germiston Enterprise factories on the 4th of March 2018 to conduct risk assessments. These factories remained closed while undertaking efforts to understand how LST6 came into our factory. The respondent indicated that all the Enterprise ready to eat meat products were recalled (PR17). The literature study in the previous chapter (Chapter 4) revealed that the outbreak occurred in December 2017 but an official announcement by the Mister of Health was only made on the 04th of March 2018, which means that the consumers' health was placed at risk for a period of three (3) months. According to PR17 new protocols (e.g. the 7-step quality check process) were put in place and the cultural transformation of all stakeholders was reinforced. The respondent went on to say that "*Enterprise takes pride in their business, quality, and food safety and these are not just established standards, they are entrenched in every function – from farm to fork*". This means that the safety of consumers is at the heart of every decision taken by the company. This response from PR17 however does not match the desktop investigation (Chapter 4) which shows the high number of mortalities and hospitalisations due to the outbreak which was caused by health safety issues that risked consumers' lives. It was further publicised that post the Listeria outbreak, several regulations and standards were amended and/or introduce on processed meat (PR17, PR18, and PR23). "*The Department of Health amended the regulations of HACCP (hazard analysis and critical control points) and the criteria of various microbiological foods, including processed meat*. *In addition, regulations for the certification of food premises were amended after the outbreak. The new regulations require all food manufactures and processing site to re-apply for an acceptability certificate. This certificate is only awarded if basic hygiene requirements are met and the person in charge of the site has adequate knowledge of food safety, amongst other requirements*" (PR6).

Overall, some of the respondents were of the view that the response measures taken by Enterprise to contain the outbreak were effective. Nonetheless, the impacts of this outbreak were noted as significant. It was revealed that the food and safety regulations have been reviewed and updated in response to strengthening food safety. This accentuates the fact that there were some loopholes in these regulations and the outbreak had exposed these weaknesses. Furthermore, PR20, PR21, PR22, and PR23 indicated that the outbreak had adverse impacts which could have

been minimised through effective preparedness and contingency plans and early dissemination of information to the public (public warnings). Theme 4 addressed the fourth research objective which aimed to investigate the impacts of the Listeriosis outbreak on food security in South Africa.

5.5.5 Theme 5: Policy integrating of food security and DRR (Questions E3–E6)

The respondents' level of policy integration between DRR and the FCV was investigated in the last theme in order to indicate the level of synergies or gaps among these stakeholders.

Most of the respondents (19 of 23) revealed that they were not aware of any DRR legislations or frameworks that integrate the FCV and DRR (Question E3). PR9 responded by saying that "*the Department of Health is responsible for the establishment of food related regulations and to ensure the implementation and compliance thereof that is facilitated through food inspections*". PR16 highlighted the Department of Agriculture, Forestry, and Fisheries (DAFF) as a line department, and said that "*according to my understanding there is a lack of direct communication and coordination between the DAFF and the food chain stakeholders, particularly, the manufacturers and retailers*". In addition, the respondent revealed that "*they know about the programmes that are aimed at improving food productions and food security such as the Fetsa-Tlala programme; Comprehensive Agricultural Support Programme (CASP); and Illima/ Letsema*". PR13 indicated awareness that the "*DAFF has established measures to assist them to cope with environmental issues that threaten their food productions, for instance, the early-warning systems and the relief grants*". However, the integrated DRR and FCV legislations were not known by these respondents. The Disaster Management Act (DMA) was identified as a policy that integrates DRR and the FCV by PR17, PR18, PR19, and PR23. These respondents rated the DMA at the scale of 3, meaning that the DMA is 'highly effective' in integrating DRR and FCV (Question E4). PR22 mentioned the Food and Nutrition Security Policy (FNSP) as an integrated policy which was rated at the scale of 2 in terms of its effectiveness, meaning that FNSP is regarded as 'moderately effective'. The FNSP recognise climate change as a threat to food security hence, risk management is one of the approach methods for the policy. From overall findings, it can be noted that there is a gap when it comes to coordination and practice regarding the integrated DRR and FCV legislations. PR18 voiced an opinion which supported the view of PR23 that "*there is no need for the practical integration of the FCV and DRR*. *The development and assessment of the Disaster Management Plans and contingency plans is one of the effective approaches to promote DRR across the food chains*".

All the respondents have noted the importance of actively contributing to food security through the implementation of measures that reduce environmental degradation and risks through sustainable initiatives to promote sustainability and reduce disaster risk (Question E5 and E6). PR6 and PR8 revealed that they have implemented approaches to decrease the level of food loss and waste by up to 50% in the year 2025, which is an approach to enhance food security while reducing disaster risk. PR3 and PR11 used the example of recyclable products (e.g. grocery plastic bags) as one of the measures that is used to reduce disaster risk and promote food security. PR7 pointed out the "*the regular sale promotions and markdown on various food items especially products with limited shelf-life gives consumers an opportunity and allowance to purchase various products*". PR15 went on to say that "*I am initiating indoor (vertical) farming which involves controlled-environment agriculture, where less water and pesticides are required*". This was said to be inspired by the recurrent drought events in the country. It is worth noting that providing consumers with value for money products and regular sales on food items are ways to improve food access and security. PR18 indicated that their department is focused on increasing the level of food security in South Africa through the establishment of policies, frameworks, programmes, etc. The respondent also outlined that "*the department has established a foundation for integrated food policies as a way to enhance food security and the IFSS is one example of such. The IFSS consists of several role-players such as the Social Services Department (social grants) and the Department of Education (school feeding Programmes)*". Moreover, "*the CASP and Illima/ Letsema provide agricultural support and financial assistance to farmers to help farmers increase food productions while promoting food security*". Furthermore, projects, research entities, awareness campaigns, and training workshops were also established in line with the National Climate Change Framework and the National Disaster Management Framework. In this regard, the respondent pointed out "*the early-warning systems that sends out emergency messages and advice to farmers through forecast readings; recovery; and rehabilitation plans that assist farmers to cope with disasters*". The challenge is that most of the respondents were not familiar with this directorate nor the related projected established by DAFF. This stresses the point that was raised earlier in Chapter 1 under the research problem/gap i.e. lack of communication and coordination among various but related departments. The respondent stressed that "*there is a need for a multidisciplinary approach and application of diverse technics to ensure food security*". PR23 and PR21 went on to say that they "*acknowledge the two areas of disasters and food chains as closely related to each other hence, the efforts to mainstream DRR into food security legislation and programmes by partnering with several food chain stakeholders in providing guidelines and assistance regarding disaster risk assessments and developing disaster contingency plans that can be tailored for specific unit or division (i.e. farmers, manufacturers, retailers)*". Similarly, PR22 indicated that "*they work in partnership with various*

role-players to prevent and reduce disaster risks which is a requirement according to Section 5 of the DMA that is facilitated by the National Disaster Management Advisory Forum (NDMAF)". PR20 shared the same view and said "*the NDMC supports farmers by providing framework guidelines for DRR, for instance, the development of a drought plan that is currently underway*". PR19 stated that "*disaster grants are disbursed to boost farmers during disasters and to address any risk associated with disasters impacts and recovery*". On the contrary, PR12 believed that "*each department has a different focus area and expertise thus, each role-player should stick to their function line*". The researcher agrees with these respondents to a certain extent, however, the complex and multidimensional issues related to food insecurity requires joint efforts. PR17 stated that "*currently, CSI programmes provide daily food packages to 30 000 people, including 4 500 university students*. *Moreover, the company is working in partnership with organisations such as Food Forward to provide food parcels to disadvantaged citizens*. *The Tiger Brands Foundation offers nutritious meals to 80 000 children in order to minimise child hunger and malnutrition*". It was further revealed that these programmes have continued to operate during the Coronavirus pandemic with additional hampers created to assist workers on the frontline, especially health practitioners. "*Programmes such as Plates4Days were also created to support university student throughout tough times of the pandemic*". In terms of disaster reduction PR17 said that "*at Tiger Brands, we are passionate about long-term sustainability*. *Tiger Brands and DAFF partnered in 2015 to support smallholder farmers, where Tiger Brands is focused on establishing programmes for crops and sustainable farming practices. In the 2017, Tiger Brands was able to secure 23 000 tons of fresh produce sourced from black emerging smallholder farmers*". This respondent went on to say that "*the company has developed Standard Operational Procedures (SOP) that promote environmental sustainability*".

This theme was based on the third research objective i.e. to explore how DRR legislations and statutory frameworks integrate the FCV for improved food security in South Africa. The findings revealed that most respondents were not able to mention policies that integrate DRR and the FCV. In this regard, the researcher identified the knowledge gap as one of the core barriers towards building sustainable FCVs that would ensure food security. This places emphasis on the need for synergy among the food chain and disaster management role-players, which is the main objective of this study. Section 3.5 of this study discussed the challenges of policy integration and these are in line with the answers that were received from the study respondents. The results obtained from the respondents indicate that there is a gap in the integration of food security and DRR in South Africa where departments work in silos. This is aligned with the problem statement and the literature review of this study that emphasises the aspect of departments working as separate entities. In this regard, the researcher observed that the issue of power tends to

influence departments where each role-player wants to be in control, thus, the lack of collective ownership. It is worth noting that there is a need for better awareness and education on policy integration and its benefits. This will also contribute to the effective use of resources and it will reduce costs while avoiding duplication of policies or programmes that may in the end be ineffective. The issue of having lack of resources (particularly human and financial resources) was raised by most respondents, which is consistent with the literature review. This challenge has been discussed in detail under Section 3.3.2 to accentuate that without resources departments are unable to optimally perform their functions and bring long-term positive change.

Suggestions and recommendations

The following section is based on the recommendations made by the respondents after partaking in the study questionnaire.

PR23 posits that there is a need for the approach of DRR to be integrated into the business contingency plans of food chain stakeholders since climate change weakens food chains. Most respondents used the example of the Coronavirus pandemic and panic buying as reference to highlight the close link between disasters and food chains. These respondents further indicated that this integration does not entail that food chain stakeholders need to change their contingency plans; however, this integration is about knowledge sharing and alignment with the DMA to build capacity should a disaster occur. Therefore, policymakers need to be cognisant of the fact that there is “no one size fits all” when it comes to policy or strategy development.

PR18 stated that there is an urgent need to strengthen the communication and coordination among various role-players of food security. This was based on the fact that departments tend to develop and approve policies without consulting other relevant departments. According to the respondent, line departments are responsible for raising their concerns or recommendations to other department such as DAFF. Nonetheless, this approach appears as a limitation to communication among various departments whereby ideas and knowledge sharing are not the central part of policymaking. The policymakers need to establish a structure that will facilitate public participation to proactively involve other departments in the process of establishing and implementing strategies and policies towards sustainable food security. PR20 said that “*the challenge is that at times the department may reach out to other role-players however, the response may be low or even no response in most cases*”. The example of the Food Security and Nutrition Policy (FSNP) was used to highlight the challenge of coordination. The FSNP was called for a review after it was published, and this was due to a lack of consultations with other role-

players. Although the policy was reviewed, it does not reflect the integration of DRR. The data analysis shows that consultations with relevant role-players are essential, but this is not carried out in practice and is a major concern.

A joint forum was suggested by the respondents where ideas and knowledge are shared among all the relevant food security stakeholders. This is important because food security is a cross-cutting issue that requires vast attention and knowledge. PR18 and PR20 posit that although this integration holds so much potential, there is also a need for cautious steps when implementing this. According to PR19 the need for monitoring and evaluation will be required to ensure that such an integration is effective in theory and practically. All the respondents believe that this integration can be implemented, however, commitment and active participation from all role-players will be required for successful results.

5.7 Conclusion

Chapter 5 discussed the analysis of data which was collected through a questionnaire from the participants of food chain stakeholders, DAFF and NDMC. The researcher analysed the data using a method of thematic analysis whereby five (5) themes were created. These themes are aligned with the research objectives and in conjunction with the literature review.

The first theme was focused on investigating the level of understanding held by the respondents regarding food security, the FCV and DRR. The findings revealed that all respondents have a basic understanding of the concept of food security with other respondents having a deeper understanding. Overall, the analysis indicates that there is a need for better education and knowledge about the basic concepts that relate to food security. The second theme was on food security and DRR legislative structures. The policies mentioned under food security were IFSS, ZHP, and FSNP while the DMA and NDMF were mentioned under DRR legislation. Some of the respondents were unable to identify food security policies, nonetheless, programmes such as the Gift of the Givers, school feeding schemes, social grants, CASP and Illima/ Letsema, were identified as programmes that reduce food insecurity. It was observed that respondents mainly focused on their functions, while disregarding the other aspects that relate to or influence their function lines. The level of integration among various, but related food security stakeholders is low as indicated in the third theme. The fourth theme focused on the impacts and responses of the Listeriosis outbreak. According to most respondents, the outbreak had significant impacts because of the delayed response. The investigation of the gaps and synergies in the integration of DRR and FCV was the fifth theme in data analysis. In this theme, the issue of poor

communication/consultations and coordination were identified as key barriers to policy integration. Overall, there is an urgent need for policy integration of DRR and FCV in South Africa to address the cross-cutting issues of food insecurity.

Chapter 6 offers an overall conclusion of this study by providing a summary of the remarks on the major findings and key messages. The chapter also provides recommendations and point out possible approaches to address the identified gaps and challenges in Chapters 2–5.

CHAPTER 6: CONCLUSION AND RECOMMENDATIONS

6.1 Introduction

The previous chapter offered a discussion on the findings that were collected through questionnaires and semi-structured interviews. This chapter provides a summary of the chapters in this study i.e. chapters 1, 2, 3, 4 and 5. In addition, this chapter addresses the fifth research objective, i.e. to make recommendations that will enhance food security where a range of food products can be value-added in South Africa through the perspective of DRR.

6.2 Chapter reflections

Chapter 1 offered an introduction to the study where the main concepts were defined i.e. food security, FCV and DRR. Food security was defined as the ability for everyone to attain healthy food that is adequate at all times. In addition, these foods must be of the individual's preference, safe, culturally acceptable and good quality. The four pillars of food security were discussed to establish a deeper understanding of food security, namely; availability, access, utilisation and stabilisation. Food availability is about having adequate nutritious food; accessibility is the ability to acquire sufficient and nutritious food or produce own food; utilisation is about the amount, type, reasons why people eat a certain food, and how these foods are used/prepared; and stabilisation relates to the state of food and nutrition within households whereby there is a constant level of the food supply in the long-term. All these pillars are influenced by the performance/functions of food chains that in turn influence food security, whereby household food production can increase due to the cultivation of cash crops while the nutritional value can reduce due to processing and storage techniques.

Food chains were defined as complex networks with non-linear interactions that link different stakeholders who produce, process, sell and those who consume the food. The chapter highlighted that a food chain should offer value to consumers i.e. affordable nutritious food that is environmentally friendly and produced sustainably. It was revealed that most food chain stakeholders have an interest in building sustainable food chains, however, several challenges hinder this sustainability. These challenges include rapid population growth, lack of collaboration and climate change effects. It was also highlighted that disasters threaten food security which in turn contributes to resource exploitation and degradation, with climate change as an additional catalyst. Thus, the urgent need to reduce the adverse impacts of disasters on the environment

and food systems. According to the FAO (2019), the integration of DRR into food systems has a positive influence on food security. DRR was defined as a conceptual framework that focuses on minimising vulnerabilities, creating prevention, mitigation and preparedness against adverse impacts of disaster events within the context of sustainable development. It was emphasised that DRR is flexible and multidisciplinary, which means that the approach can be tailored into food chain activities while maintaining some of the positive functions rather than transforming the operational measures within food chains. DRR is rooted in eliminating risks through prevention and minimising the adverse hazard impacts rather than providing disaster relief. This is important because although food chain stakeholders have been coping with climate change for years, the challenge is that the frequency and extent of climate change is rapidly increasing.

The problem statement (section 1.4) indicated that although several researchers have investigated the issues of food security, FCV and DRR only limited research is focused on the integration of these aspects, especially in the context of South Africa. The food chain stakeholders face many uncertainties, especially when it comes to weather-related hazards, climate change and food safety (contaminations). The current policy structures and frameworks in South Africa offer limited support for greater uptake of this integration. Furthermore, there is a lack of communication and collaboration within various but related stakeholders which serve as a barrier for sustainable development and resilience against poverty and food insecurity. Thus, the study aimed to close this research gap by exploring the relationship between food security, FCV and DRR. Chapter 1 revealed that food chains have become susceptible and fragile to disasters, thus the need to strengthen the capacity of these chains and protect them against disaster risks. The South African government established several national policies to ensure food security, however, 6,8 million citizens experienced hunger in 2017 (Stats SA, 2019). The primary reason for ineffective food security policies is the poor integration of risk reduction.

The research aim and objectives were indicated in Chapter 1. The research discussed the methodological approach used to achieve the aim and objectives. The processes such as research design, sampling and data collection were discussed to show the steps that were applied for the empirical study. These processes were executed in Chapter 5 which provided the findings and results from data collection. The study followed the qualitative research design to indicate the need for integration of the FCV and DRR towards strengthening food security. This was based on exploring the relationship between food security, FCV and DRR through the perceptions of food chain stakeholders and disaster management officials. The four (4) research objectives served as the foundation for the study to guide Chapters 2-4.

The first and second objective was focused on the relationship between food security, FCV and DRR which formed Chapter 2. These were core for the literature review which revealed that the

FCV is strongly shaped by disasters whereby climate change disrupts the functions of food chains - from production, manufacturing, distribution to consumption level. The first objective publicised that the integration of DRR into FCV will assist to minimise and/or prevent adverse hazard impacts while reducing the risks hindering the optimal function of the FCV. The case study examples which show the benefits of integrating DRR into the FCV were provided to highlight the need for such an integration. The second objective further revealed that the FCV has a significant influence on food security. To realise this, the relationship between food security and the FCV was demonstrated through the four pillars of food security. In terms of *food availability,* it was noted that South Africa takes pride in being a net exporter of value-added food. On the contrary, there is a lack of balance when it comes to food availability between the wealthy and the poor whereby poor households tend to face challenges in terms of sufficient food availability. *Food accessibility* is influenced by several factors such as income and food prices, crop failure and household capacity to deal with climate shocks. The fact that South African is food secure at the national level but insecure at the household level further highlights that the problem does not necessarily lie in inadequate food but rather lies in insufficient accessibility to the available food. In terms of *food utilisation*, the products offered by the FCV tends to increase convenience and nutrition through a range of ready to eat products such as canned fish which is high in omega 3 and other vitamins. In addition, some FCV stakeholders offer health guidance or receipts on the product package. These products are easy to use with minimum effort and time required nonetheless, some consumers do not to practice good hygiene when preparing food. It was noted that *food stability* depends on the FCV to carry out the function of delivering a constant level of nutritious and affordable food in the long-term. This constant food supply promotes food security where instability tends to threaten food security.

Chapter 2 provided a discussion on the key challenges for sustainable food systems in South Africa. These challenges include the role of business, research and multidisciplinary approach, culture and religion, changing food consumption patterns and the agricultural sector. It is worth noting that there is a need for research and a multidisciplinary approach in the food system to understand the root causes and risks within the food chain so that the food system can be reshaped into resilient systems. Furthermore, the multidisciplinary approach is essential since the food system consists of multiple dimensions. The changing consumption patterns were highlighted as another challenge whereby South Africans have been shifting from the traditional diets towards Western diets and this is indicated in several food-related studies. The FCV stakeholders have to keep up with these changes to ensure food accessibility and ultimately food security while applying sustainable methods.

The third objective was covered in Chapter 3. This chapter focused on exploring the context of DRR legislation that integrates FCV to enhance food security in South Africa. According to RSA (2005) and Van Wyk (2007), the South African disaster risk legislation is considered pioneering in Southern Africa. Various institutional arrangements and structures were developed to support the implementation of disaster management and this includes the NDMC, NDMAF, NDMF, and DMA. All these structures emphasise the collaboration and coordination of all states of organs which includes the Department of Agriculture Forestry and Fisheries. Nonetheless, there is a lack of institutional arrangements and clear definition of roles and responsibilities; inadequate skills and knowledge; and limited DRR mainstreaming into development planning. It was also important to discuss the national food security policies to indicate the policy gaps or strengths whereby it was revealed that the common and biggest gap in most of these policies is the lack of integration with other line departments or entities. It was noticeable that the FSNP policy aims to provide guidance for the coordination of different food security policies, frameworks, initiatives and civil society for effective partnerships. In addition, emergency nets against disasters were seen as barriers to food security. However, the lack of a DRR approach limits the FSNP's ability to reduce or plan for emergency nets. The Fetsa Tlala programme was commemorated as it was established based on partnerships with various line departments such as DAFF, DSD, DoH and DBE. Furthermore, the policy recognises climate change as an issue for food productions and posits the need for strategies towards preparedness, mitigation and resilience of disasters. The limiting factor in the Fetsa Tlala program is the extensive focus on agriculture while undermining other food chain stakeholders who all play a vital role in promoting food security.

Chapter 3 went on to provide the prominent international legislative programmes and frameworks that integrate DRR and FCV i.e. DFID Hunger and Vulnerability Programme; Oxfam Strategic Framework; GFDRR; CARE 2020 Programme Strategy; and COOPI. These policies are centered on partnerships and integration towards resilient food chains. Although there is a gap in the integrated national food security policies, there are integrated food security programmes in South Africa i.e. FAO DRR for NSFP, GEF, WFP, and the Malabo Declaration. The effectiveness of these programmes is based on strong communication and coordination within role-players. Moreover, the programmes stress the need to enhance sustainability within food chains through institutional arrangements and coherent policies.

The fourth objective focused on the impacts of the Listeriosis outbreak on food security in South Africa. This objective formed Chapter 4 which indicated Listeriosis as one of the largest foodborne illness due to its ubiquitous impacts. In addition, the ability of the L. monocytogene bacterium to persist in harsh (e.g. heat, high pH and freezing) conditions makes it challenging to prevent and control this pathogen. It was revealed that the first Listeriosis outbreak in South Africa was

reported in August 1977 to April 1978. Although there have been several Listeriosis cases in the country, the 2017/18 outbreak was regarded as the biggest Listeriosis outbreak globally with 180 mortalities and 967 cases within three (3) months. One key reason for this was due to the delayed response with which the products were recalled; on the 04th March 2018 since December 2017. The chapter further investigated the impacts of this outbreak which included hospitalisation, sickness, productivity loss, profit loss, litigation costs and mortality in severe cases. The Enterprise Company had to lay-off 2000 workers due to the Listeria (Maqhina, 2018). This meant that those families became financially stressed and ultimately reduced their food security through impaired food accessibility. Overall, this chapter puts emphasis on the interconnection between FCV and DRR.

The four (4) above-mentioned objectives formed the basis for Chapter 5 which aimed to explore how the integration of the FCV and DRR can enhance food security in South Africa. This chapter was focused on interpreting and understanding the perception of food chain stakeholders and disaster management officials regarding the integration of FCV and DRR in order to strengthen food security. The qualitative research approach was applied to conduct this investigation through the use of a questionnaire (see chapter 1). The respondents indicated that disaster risk disrupts the FCV, which in turn impend food security. The findings from this chapter were in line with the literature review to accentuate the significance and need for integrated FCV and DRR. An in-depth discussion was provided in the previous chapter (Chapter 5).

6.3 Data collect challenges

The purpose of a research study is to explore or investigate real life dimensions/ issues in order to develop solutions and close the knowledge gap thereof. As a result, challenges are likely to be experienced when conducting research. The following section reveals the challenges that were experience during the process of data collection.

As indicated earlier in the study, the global Coronavirus pandemic had significant impacts on the methods and approaches of data collection. On the 29th of March 2020, an official lockdown was implemented with restrictive regulations as a way to curb the spread of the pandemic. These restrictions prohibited citizens from leaving their homes unless under urgent and strictly controlled circumstances such as to seek medical care and to purchase food, medicine and other supplies, or for the collection of social grants and other financial sources. All of this took a toll on data collection. It became difficult to access and recruit participants since most people were working from home. In this case, the NDMC and DAFF are participants who were mostly out of office. It

was revealed that the NDMC was working under pressure as key role-players in coordinating and monitoring the state of disaster. This meant that most workers were over-working with minimum time to participate in the questionnaire. The researcher sent 15 invitations to the mentioned participants through email, however, only 5 responded. Another method was through phone calls where only a few respondents responded since most people were working from home. In this regard, snowballing assisted in recruiting other relevant participants within the departments. Overall, 15 participants were referrals from the identified participants, where 5 out of the 15 became respondents and this contributed to increasing the number of respondents. Continuous message reminders were sent to participants after 2 weeks of receiving a questionnaire as a measure to remind participants.

On the other hand, the FCV stakeholders fall under the category of essential workers which meant that these participants were available. The challenge is that the FCV stakeholders were working under pressure with high consumer demands and panic buying. As a result, most of these people were initially reluctant to participate in a questionnaire due to time constraints. Questionnaires were sent to FCV for self-administration but no response was received. The participants outlined that they prefer face-to-face interviews as opposed to self-administrative questionnaire. Thus, one-on-one interviews were conducted with FCV stakeholders in compliance with the Coronavirus regulations as indicated in Chapter 1. The study used the Listeriosis outbreak as an example case study, therefore, Enterprise was identified as a key participant for the empirical study. Enterprise was initially reluctant to respond to the invitation emails and self-administrative question and this is understandable given the sensitivity and extent of the impact of the outbreak. It is however important to note that discussions about Listeriosis are important in order to learn from the outbreak and improve the level of preparedness against future disasters that have the potential to threaten food security. After several attempts through email messages and phone calls, only one participant from Enterprise responded to the questionnaire.

The study focused on participants within the Gauteng province as indicated, therefore, the findings and interpretation of this study may differ if a different sample was to be established. Furthermore, the use of purposive and snowballing recruitment tactics may have influenced the findings in the way in which the questions were answered.

Although the researcher experienced the above-mentioned challenges, the researcher was able to overcome the challenges and successfully continue collecting data with the said methodology and ethical considerations. Therefore, the investigation discoveries are substantial and significant for the purpose of this study.

6.4 Conclusions

The study answered the main research question that was based on how the integration of the food chain and DRR can enhance food security in South Africa. The objectives were addressed according to chapters (1-5) and an empirical study was conducted using a qualitative research design. A total of 24 respondents were recruited through purposive and snowballing sampling technique to participate in a questionnaire via email self-administration and interviews.

Research shows that disasters negatively disrupt food chains. Thus, there is growing evidence for the benefits of the integration of DRR and FCV and its potential towards securing a resilient future. However, the current policy structures of South Africa offer limited application of this integration as indicated through food security policies such as the FSNP, IFSS and ZHP. Disaster Risk Management officials and food chain stakeholders tend to work separately with minimum interaction. This was further confirmed by most respondents' inability to identify such integrated policies in the questionnaire (E3 and E4). The lack of policy integration has resulted in non-effective and duplicated policies such as the Zero Hunger Programme that was a copy of the Brazilian Zero Hunger Model. It was noted that policy integration is not easy and requires stakeholder commitment and partnership which can be a challenge when stakeholders do not have collective ownership due to issues of power. Subsequently, it was noted that the food systems are becoming more fragile to disaster risk, hence the need to protect livelihoods and build resilience. All the respondents outlined that disasters impact the activities of the food chain and that DRR has the potential to strengthen food chains and ultimately food security.

The South African DRR profile shows a positive trend in the establishment of institutional policy frameworks and legislation for DRR and it is considered pioneering in Southern Africa. Nonetheless, several gaps serve as barriers including institutional arrangements, insufficient resources, education, knowledge and skills, mainstreaming DRR into development planning and lack of benchmarks for action. Comprehensive DRR calls for various disciplines, sectors and institutions towards diverse and expanded partnerships that yield better outcomes as opposed to individual or a single specialist. The benefits and challenges of policy integration were indicated.

The issue of food safety within food chains was noted as an area. The fact that the food chain stages are interlinked and interdepend on each other means that there is a need for proper risk assessment which includes prevention and mitigation measures. The Listeriosis outbreak in South Africa (2017/18) emphasised the significance and need for proper risk assessment. The outbreak is regarded as the biggest Listeriosis outbreak to be experienced globally with over 216 mortalities and 1, 060 cases. According to respondents, the household food security became distorted during and shortly after the outbreak in the sense that consumers lost their preference

and convenience; anxiety about processed food; disrupted household budget; loss of income for those who were laid-off from Enterprise; disruption of small local businesses; changed consumption patterns; and increased food waste. Most respondents believed that more could and should have been done by Enterprise to minimise these impacts, namely; regular inspections of facilities, better education within the internal staff, proper risk assessment and disaster planning. Only a few respondents had the perception that the responses such as the official announcement by the Mister of Health, publicised safety tips and product recall were effective and efficient.

6.5 Summary of contributions and recommendations

The following section is focused on the significance of the study which entails the overall importance and purpose that the study provides.

Chapter 2 indicated the aspect of a poor multidisciplinary approach within food systems as a constraint towards sustainability. This was accented during telephone interviews where some of the food chain respondents were not familiar with the concept of DRR and were therefore unable to define DRR and answer other DRR related questions in the questionnaire (B3, B5, E1- E4, and E6). It was only after the concept was explained that these respondents were able to understand and complete the questionnaire entirely. In this regard, the researcher used this opportunity to explain the concept and significance of DRR to food chain stakeholders who were not aware of or/and knowledgeable about DRR to contribute towards closing the education and knowledge gap about DRR. This is the foundation to stimulate the establishment of sustainable and resilient food chains which is regarded as the initial step that requires attention in order to promote food security.

The study draws attention to the need for policy integration of DRR into the food chain to enhance food security by discussing how disasters shape food chain activities. The Listeriosis outbreak was used to highlight the seriousness and reality of the occurrence of disasters within the food chain. Policy integrations assist to coordinate and address risks through a holistic approach that considers various factors that are directly and indirectly experienced within food chains. The question that was raised in the questionnaire about the effectiveness of the response to the outbreak (i.e. *was there anything that could have been done by the Department of Health or Enterprise Company to minimise the adverse impacts caused by this outbreak*) fortified respondents to think about the capacity of food chains to cope with disasters and the future capacity should any other disasters be influencing the performance level. This is to promote future planning and mitigation measures towards safeguarding food chains while strengthening sustainable food systems.

The research study stimulated thoughts that are based on sustainability, especially through the last two questions (E5 and E6) contained in the questionnaire. This posed questions about the respondents' contributions towards food security and the reduction of disaster risks respectively. These questions were developed to poke or stimulate a sense of introspection with the aim to promote pro-activeness, multidisciplinary approach and accountability towards building resilient food chains that increase food security. This is linked to the challenges of building sustainable food systems (section 2.6.3).

The outcome of integrating DRR into the FCV is to improve the overall traditional food chains. These improvements further create benefits for the underprivileged. For instance, (a) sustainable socio-economic gains, (b) minimal vulnerability from disaster risks and hazards and (c) strengthened relief efforts are achieved. The need to integrate DRR into development approaches is recognised, however, these discussions are limited to livelihoods functions as opposed to markets that drive the FCV. It is noted that livelihoods promote household food security but markets go beyond this by providing sustainable economic growth. The establishment of integrated policies and programmes will strengthen food systems and the market where the underprivileged operate. These integrated policies and programmes may be independent of governmental funds; for instance, the use of fish pots (see Table 2-1) to create continuous and sustainable gains. Minimal vulnerability from disaster risk can be achieved through risk assessments and the development of disaster plans or contingency plans that focus on prioritising risks and establishing measures to curb these risks. In addition, relief and early recovery will be enhanced whereby the community's risk profile is well understood leading to better plans and reduced dependency on relief aids.

The main issue of the study is the lack of integration between FCV and DRR, therefore, five (5) recommendations are made to address this issue. Firstly, the study suggests multidisciplinary research that unpacks the gaps in policy integration in South Africa and the need or benefits of addressing such gaps. This will lay the foundation for policy-making processes. Secondly, communication channels and platforms that are specifically focused on building policy integration where various line departments and role-players share ideas and knowledge about strategies to enhance food security through coordinated efforts should be established. This can be done through the establishment of forums that meet regularly (once or twice a year) where institutional arrangements are clearly defined. This is important because it was outlined that departments tend to develop and approve policies without the inputs of other relevant departments which in turn limits the level of knowledge and effectiveness of such policies. Thus, this recommendation can foster and promote dialogue among role-players. Thirdly, development of a concept note through research and stakeholder consultations that will serve as a guiding framework for the practical

integration of DRR into the entire FCV is needed. The concept note should be brief, precise and implementable within the South African context. Fourthly, there is a need for better education programmes and capacity-building workshops on DRR for role-players, especially the food chain stakeholders. This includes carrying out proper risk assessments and implementing disaster management plans which are aligned with business contingency plans of food chain stakeholders. This will assist in minimising and preventing disaster risks within all stages of the FCV. It is worth noting that funds will be required for this to be successfully carried out, however, the rewards for such an initiative are far-reaching and worth investing in. Lastly, the establishment and implementation of the monitoring and evaluation mechanism to track the effectiveness of policy integration is needed. As indicated in Chapter 3, poor policy evaluation is one of the key gaps for policymaking in South Africa.

6.6 Contributions and suggestions for further research

The study contributed to knowledge building and closing the research gap of policy integration towards enhancing food security. The literature review and empirical findings revealed that most food security policies tend to undermine the influence of disasters on food chains. This is a concern given that food security is influenced by various factors. Therefore, this study emphasises the need and benefits of integrating DRR into the FCV which requires collaborated efforts and need for partnerships among the food chain stakeholders, disaster management officials and related stakeholders. In this regard, the study recommends the need for further research focusing on such an integration.

The study suggests that there is a need for further research focused on policy integration in South Africa. Therefore, it is recommended that policymakers need to work together in the process of policy making. Research based on developing a model or framework for policy integration can contribute to practical solutions for improving food security. It is further suggested that more attention focusing on research in the effects and benefits of climate change on food chains is needed because climate change was identified as a catalyst of disaster risk. Additionally, the aspects of political buy-in and institutional arrangements should be incorporated when conducting further research in order to address the challenges that were mentioned in the previous chapters. The study also recommends that a sample size should be increased and expanded to include a range of participants such as qualified food inspectors and a larger sample of Enterprise participants.

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ANNEXURE A: QUESTIONNAIRE

Institution: North-West University

Campus: Potchefstroom

Field of Study: Master of Environmental Science with Disaster Risk Science

Mini-dissertation title: Enhancing food security through the integration of DRR and the food chain value: The case of the Listeriosis outbreak, South Africa

Student Name: Lulamisani Chauke

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Supervisor: Dr. L. Kruger (20768222@nwu.ac.za)

Ethics number: 01506-20-A9

Dear participant,

My name is Lulamisani Chauke and I am a Masters student in Environmental Science, with Disaster Risk Science at the North-West University. You are invited to participate in my study which intends to promote food chains' resilience against disaster risks in order to ensure sustainable food security. The research objectives of this study are as follows:

1) Explore the relationship between the Food Chain Value (FCV) and Disaster Risk Reduction (DRR);
2) Investigate how the underlying factors of the FCV influence food security;
3) Explore how DRR legislations and statutory frameworks integrate the FCV for improved food security in South Africa;
4) Investigate the impacts of the Listeriosis outbreak on food security in South Africa;
5) Explore how the integration of FCV and DRR can enhance food security
6) Make recommendations for enhancing food security through the integration of DRR and the food chains.

The data obtained from participants such as yourself is crucial for reaching these objectives and to build multi-sectorial integration to address cross-cutting issues such as food security in South Africa.

This structured questionnaire consists of 21 open and close-ended questions that are organised around six (6) research topics. The estimated time required to complete this questionnaire is approximately 30-45 minutes.

QUESTIONNAIRE ON THE INTEGRATION OF DRR AND THE FCV IN ORDER TO ENHANCE FOOD SECURITY IN SOUTH AFRICA

Instructions:

- Please use a **X** to indicate your selection
- Please elaborate where necessary
- Kindly complete within 2 weeks
- When completed please send via email at lulamisanil@gmail.com

SECTION A: BACKGROUND OF PARTICIPANT

A.1 What is your highest level of qualification?

A. Certificate	*B. BSc/ BA*	*C. MSc/ MA*	*D. PhD*	*E. Other*

Kindly elaborate on your qualification details:

A.2 What is your occupational field?

A. Disaster risk management	*B. Food chain stakeholder*	*C. Other*

A.3 In which sector(s) are you placed? Select more than one where applicable.

A. DRR (Legislation Policy, Compliance Management etc.)	*B. Enterprise (quality check, health and safety etc.),*	*C. Food producer (farmer, cooperative, private company, etc.)*	*D. Food manufacturer (butcher, stock packer, sorting etc.)*	*E. Food distributor (retailer, transport logistics, etc.)*	*F. Other*

If your answer is F (Other), kindly provide name/s of sector/s:

A.4 How long have you been working in your occupational field?

A. 1-5 years	*B. 6-10 years*	*C. 11-15 years*	*D. 16 years and longer*

SECTION B: THE RELATIONSHIP BETWEEN THE FCV AND DRR

The following questions are related to the connection or link between the food chains and Disaster Risk Reduction.

B.1 What is of your understanding of the term the "Food Chain Value (FCV)"? Kindly provide a brief summary of your understanding.

B.2 What is your understanding of the term "Disaster Risk Reduction (DRR)"? Kindly provide a brief summary of your understanding.

B.3 According to your understanding, do disasters affect/ influence the food chain value?

A. Yes	*A. No*

Kindly elaborate on the reason for your answer.

B.4 In your opinion, does DRR strengthen the food chain value?

A. Yes	*B. No*

Kindly elaborate on the reason for your answer.

SECTION C: THE FOOD CHAIN VALUE

This section focuses on the understanding of how the underlying factors of the food chain value influence food security.

C.1 In your opinion would you say the food chain is able to keep up with environmental risk factors like, climate change and disasters? Kindly rate your answer from the scale of 0-3

A. 0 *None effective*	*B. 1* *Slightly effective*	*C. 2* *Moderately effective*	*D. 3* *Highly effective*

Please elaborate your opinion

C.2 According to your understanding how does the food chain value influence food security (whether positive or negative influence)?

A. Positive	*B. Negative*

Kindly elaborate on your view

C.3 In your opinion, what are the key challenges faced by the food chain? Kindly elaborate on these challenges.

C.4 In your opinion, how do the mentioned challenges in question C3 influence food security? Kindly elaborate on your answer

SECTION D: LISTERIOSIS OUTBREAK

The Listeriosis outbreak in the year 2018 in South Africa was declared the largest Listeriosis outbreak experienced globally.

D.1 Are you familiar with the Listeriosis outbreak in South Africa (2017-18)?

A. Yes	*B. No*

D.2 In your opinion, how did this outbreak affect citizens (e.g. health, consumption patterns, and household finances/budget etc.)? Kindly explain your reasoning.

D.3 In your opinion, would you say that this outbreak had an influence on household food security in some way? Kindly elaborate further on your view.

D.4 According to your opinion, do you believe that there was anything that could have been done by the Department of Health and Safety or Enterprise Company to minimise the adverse impacts caused by this outbreak? Kindly elaborate on you answer.

SECTION E: DRR LEGISLATION AND FRAMEWORKS

Understanding the legislative integration concerning DRR and food chains in order to improve food security.

E.1 Do you know policies or initiatives that reduce or/and manage disasters in South Africa that you know?

C. Yes	*D. No*

Kindly provide a brief summary of each (1 sentence for each answer if possible).

E.2 Please name policies and programmes that reduce food insecurity in South Africa that you know.

Kindly provide a brief summary of each policy.

E.3 Do you know legislation or programmes that address **both** food insecurity and disaster risk in South Africa?

E. Yes	*F. No*

Kindly provide a brief explanation of the abovementioned legislation.

E.4 In your opinion, please rate the effectiveness of the above legislations from a scale of 0 to 3 (with 0 as None effective and 3 as Highly effective)

E. None effective (0)	*F. Slightly effective (1)*	*G. Moderately effective (2)*	*H. Highly effective (3)*

Kindly elaborate your view.

E.5 Kindly indicate if your department/ unit play in enhancing food security?

A. Yes	*B. No*

Kindly elaborate on your answer.

E.6 Kindly indicate if your department/ unit play in reducing disaster risks?

A. Yes	*B. No*

Kindly elaborate on your answer.

---Thank you for your participation---

ANNEXURE B: ETHICS APPROVAL LETTER

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Senate Committee for Research Ethics
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Email: nkosinathi.machine@nwu.ac.za

ETHICS APPROVAL LETTER OF STUDY

Based on approval by the **Faculty of Natural and Agricultural Sciences Ethics Committee (FNASREC)**, the Faculty of Natural and Agricultural Sciences Ethics Committee hereby **approves** your study as indicated below. This implies that the North-West University Senate Committee for Research Ethics (NWU-SCRE) grants its permission that, provided the special conditions specified below are met and pending any other authorisation that may be necessary, the study may be initiated, using the ethics number below.

Study title: Enhancing food security through the integration of DRR and the food value chain: The case of the Listeriosis outbreak, South Africa.
Study Leader/Supervisor: Dr L Kruger
Student: L Chauke

Ethics number: N W U - 0 1 5 0 6 - 2 0 - A 9
Institution Study Number Year Status
Status: S = Submission; R = Re-Submission; P = Provisional Authorisation; A = Authorisation

Application type: Single **Risk Category:** Minimal

Commencement date: 01/02/2020
Expiry date: 01/04/2021

Approval of the study is initially provided for a year, after which continuation of the study is dependent on receipt and review of the annual (or as otherwise stipulated) monitoring report and the concomitant issuing of a letter of continuation.

Special in process conditions of the research for approval (if applicable):

- The following documentation are archived by FNASREC and should be complete and kept up to date:
  - Research proposal
  - Signed approval from the scientific committee indicating the proposed risk category
- All researchers involved in the study should submit signed NWU code of conduct statements annually.
- All researchers of low risk studies should submit proof of relevant ethics training every two years.
- All researchers that take part in activities that pose a safety and security threat to the researchers or the environment should submit a risk assessment form annually.
- All research involving human interaction should follow best ethical practise and keep documents as proof. This includes informed consent, questionnaires, incorporation of risk-benefit, and responsible data management.
- Any research at governmental or private institutions, permission must still be obtained from relevant authorities and provided to the FNASREC. Ethics approval is required BEFORE approval can be obtained from these authorities.

General conditions:
While this ethics approval is subject to all declarations, undertakings and agreements incorporated and signed in the application form, the following general terms and conditions will apply:

- *The study leader/supervisor (principle investigator)/researcher must report in the prescribed format to the FNASREC:*
  - *annually (or as otherwise requested) on the monitoring of the study, whereby a letter of continuation will be provided, and upon completion of the study; and*
  - *without any delay in case of any adverse event or incident (or any matter that interrupts sound ethical principles) during the course of the study.*
- *The approval applies strictly to the proposal as stipulated in the application form. Should any amendments to the proposal be deemed necessary during the course of the study, the study leader/researcher must apply for approval of these amendments at the FNASREC, prior to implementation. Should there be any deviations from the study proposal without the necessary approval of such amendments, the ethics approval is immediately and automatically forfeited.*
- *Annually a number of studies may be randomly selected for an external audit.*
- *The date of approval indicates the first date that the study may be started.*
- *In the interest of ethical responsibility, the NWU-SCRE and FNASREC reserves the right to:*
  - *request access to any information or data at any time during the course or after completion of the study;*
  - *to ask further questions, seek additional information, require further modification or monitor the conduct of your research or the informed consent process;*
  - *withdraw or postpone approval if:*
    - *any unethical principles or practices of the study are revealed or suspected;*
    - *it becomes apparent that any relevant information was withheld from the FNASREC or that information has been false or misrepresented;*
    - *submission of the annual (or otherwise stipulated) monitoring report, the required amendments, or reporting of adverse events or incidents was not done in a timely manner and accurately; and / or*
    - *new institutional rules, national legislation or international conventions deem it necessary.*
- *FNAS-REC can be contacted for further information or any report templates via Roelof.Burger@nwu.ac.za 018 299 4269*

The FNASREC would like to remain at your service as scientist and researcher, and wishes you well with your study. Please do not hesitate to contact the FNASREC or the NWU-SCRE for any further enquiries or requests for assistance.

Yours sincerely,

Prof Roelof Burger
Chairperson Faculty of Natural and Agricultural Sciences Ethics Committee (FNASREC)