Food Security and Urban Agriculture in Stellenbosch: a Case Study of Policy Failure

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Declaration

By submitting this thesis electronically, I declare that the entirety of the work contained therein is my own, original work, that I am the sole author thereof (save to the extent explicitly otherwise stated), that reproduction and publication thereof by Stellenbosch University will not infringe any third party rights and that I have not previously in its entirety or part submitted it for obtaining any qualification.

Date: March 2016

Abstract

The surface of the Earth is dominated by human activity placing pressure on biodiversity and its capacity to ensure a safe and stable environment for human food production. At this stage the Earth is dominated by human industry and agriculture in such a way that, for the first time in history, it has a dramatic impact on food security and biodiversity. Increasing pressure to produce more food and unstainable agricultural methods are placing pressure on the natural resources agriculture depends on. The reason for this conflict is as a result of unsustainable human population growth, lack of appropriate development, inappropriate sustainable policies, planning and greed.

Urban Agriculture offers a potential and viable tool to increase food security and biodiversity on a local scale. Urban Agriculture can increase sustainability and urban resilience by addressing complex challenges in a holistic manner. Stellenbosch was selected as a focus area for this case study since the challenges and dynamics are common to other areas in the Western Cape as well in South Africa. This paper motivates for Stellenbosch as a pilot area to determine what form of urban agriculture provides a holistic combination that increases food security and sustainability. This paper identifies key resources available within Stellenbosch to ensure such a projects success.

Policies have been critically analysed and local development plans were found to be inadequate and inappropriately focused. Local development plans do not focus on the critical issues, specifically food security, as informed by the Millennium Development Goals Report or the Sustainable Development Goals. These gaps are highlighted within the ambit of this thesis.

In this light, Stellenbosch is aiming and working towards a goal of becoming the greenest municipality and the innovation capital of South Africa. The findings in this thesis address the shortcomings and inadequacy of policy or the total lack thereof. The main aim is to analyse a variety of urban agriculture projects identifying similarities in order to formulate a solution to urban food crises and to move towards true sustainable innovation within an urban space.

Opsomming

Die bruikbare oppervlak van die Aarde word nou deur mense-aktiwiteit oorheers, wat ’n impak op sowel biodiversiteit as voedselproduksie het. Tans word die Aarde sodanig deur mensebedrywighede en landbou oorheers dat dit vir die eerste keer in die geskiedenis ’n dramatiese impak op voedselsekerheid en biodiversiteit het. Dit bemoeilik die mens se kapasiteit om voedsel te vervaardig, wat tot vernietiging van biodiversiteit lei. Die redes vir hierdie uitdaging is onvolhoubare groei van die mensebevolking, gebrek aan geskikte ontwikkeling, ontoepaslike volhoubaarheidsbeleide en beplanning, en gulsigheid.

Stedelike landbou bied potensiale en lewensvatbare oplossings vir uitdagings verbonde aan voedselsekerheid en biodiversiteit. Stedelike landbou kan volhoubaarheid en stedelike weerstandigheid laat toeneem deur komplekse probleme in ‘n omvatbare manier op te los. Stellenbosch is as die fokus van hierdie gevallestudie gekies, aangesien die uitdagings en dinamika in hierdie dorp soortgelyk is aan dié in ander gebiede, in sowel die Wes-Kaap as in Suid-Afrika. Hierdie tesis motiveer Stellenbosch as ‘n gevallestudie om te bepaal watter vorm van stedelike landou ‘n holistiese kombinasie bied vir ‘n toename in voedselsekerheid en volhoubaarheid. Hierdie studie identifiseer hulpbronne wat Stellenbosch besit om sulke projekte uit te voer.

Beleide is krities ontleed en plaaslike ontwikkelingsplanne is gevind onvoldoende en sonder die geskikte fokus te wees. Plaaslike ontwikkelingsbeplanning, wat op beleid geskoei is, fokus nie spesifiek op die kritieke kwessies wat ’n impak op voedselsekerheid het soos gerig deur die Millennium-ontwikkelingdoelwitte of Volhoubare-ontwikkelingsdoelwitte nie. In hierdie tesis word hierdie gapings uitgelig.

Stellenbosch se doel en strewe is om die groenste munisipaliteit asook die voorstaander van innovasie te word. Die bevindinge van hierdie tesis is daarop gemik om sowel die tekortkominge, onvoldoendheid en gebrek van geen beleide aan te pak. Die hoofbevindinge is gerig daarop om verskeie stedelike voedsel projekte te analiseer met die doel om ooreenkomste te identifiseer en ‘n oplossing te formuleer vir stedelike voedselkrisis as ook ware volhoubare innovasie in ’n stedelike ruimte.

Acknowledgements

Foremost, I wish to thank my supervisor, Mr. Dave Pepler, for his constructive comments, contribution and support. I was indeed a privilege to have worked under such an inspirational and dedicated individual.

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I would like to thank my mother and sisters for their immense encouragement and support throughout the duration of this thesis.

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List of Acronyms and Abbreviations

BAT	British American Tobacco
CSIR	Council for Scientific and Industrial Research
FAO	Food and Agriculture Organisation of the United Nations
IDP	Integrated Development Plan
IFSS	Integrated Food Security Strategy
MDG	Millennium Development Goals
MTSF	Medium-Term Strategic Framework
NDP	National Developmental Plan
NFSD	National Framework for Sustainable Development
SDF	Spatial Development Framework
SDG	Sustainable Development Goals
SM	Stellenbosch Municipality
SU	Stellenbosch University
UA	Urban Agriculture
UN	United Nations
UNDP	United Nations Development Programme
UNSD	United Nations Sustainable Development
UPA	Urban and Peri-urban Agriculture
WFS	World Food Summit
WHO	World Health Organization of the United Nations
WCED	World Commission on Environment and Development

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Chapter 1: Introduction

1.1 Background

The human population depends on natural resources extracted from the biosphere. The health and functionality of ecosystems ensure human capacity to produce food for the growing urban population. The Anthropocene Era (Rockström, Steffen, Noone, Persson, Chapin, Lambin, Lenton, Scheffer, Folke, Schellnhuber, Nykvist, De Wit, Hughes, Van der Leeuw, Rodhe, Sörlin, Snyder, Costanza, Svedin, Falkenmark, Karlberg, Corell, Fabry, Hansen, Walker, Liverman, Richardson, Crutzen & Foley, 2009:33) requires sustainable alternatives to ensure that humans can continue to function "as normal" without destroying the natural ecosystems. The Anthropocene refers to an era where the human population dominates the planet and their actions influence the Earth System (Rockström *et al.*, 2009:33). The salient question is therefore: How can we design and plan urban space to function sustainably and decrease the destructive effects of the natural ecosystem?

Most importantly, fundamental transformation is required specifically within the agriculture industry to ensure that this destruction will cease. Conventional agriculture enabled humans to restructure the physical and morphological surface of the Earth, thereby altering ecosystem functionalities which humans depend upon for survival (Bergamini, Blasiak, Eyzaguirre, Iachikawa, Mijatovic, Nanao & Surbarmanian, 2013:9). Over time the agriculture industry expanded into sensitive natural ecosystems, making use of water and soil in an unsustainable manner. Despite the use of advanced technology for agricultural production, the current food system has failed to ensure food security for the growing global population (Foley *et al.*, 2011:337). It is clearly stated in Agenda 21 of the United Nations (UN) (UNSD, 1992:32), as well as the Constitution of South Africa (Republic of South Africa, 1996:1255), that basic health needs such as clean water, safe food and sanitation are a basic human right.

Conventional agriculture does not ensure constant food security for the growing population and based on the negative effects that conventional agriculture has on the ecosystem, alternative methods of food production should be further explored (Viljoen, Bohn & Howe, 2005:21). As a solution to a cultivated planet Foley *et al.* (2011:339) address the ineffective use of existing

agricultural land and the opportunity for increasing crop yield as a result of underperforming agricultural landscapes. Although existing underperforming agricultural landscapes are addressed, urban landscapes are also currently an underdeveloped resource where increasing productivity can take place (Woolley, 2003:51). Urban space should be redesigned to incorporate space for food production in order to increase food security (Viljoen & Bohn, 2005:15).

The Food and Agriculture Organization (FAO) motivates that urban policies should address "food dimension of poverty in urban areas" (FAO, 2009:1). However, it also warns that many countries and local governments are not developing policies to effectively address food insecurity related issues (FAO, 2009:1). The FAO (FAO, 2009:2) identified a link between Urban Agriculture (UA) and building urban resilience to address food crises.

UA does not replace rural agriculture, but rather compliments rural agriculture "in terms of self-provisioning, marketing flows and market supply flows" (Mougeot, 2000:11). In such cases, UA provides produce that rural agriculture cannot supply easily and can substitute for food imports (Van Veenhuizen & Dason, 2007:10).

Conventional city planning generally leads to the development of unused spaces that are ineffectively managed (Woolley, 2003:51). In order to ensure that cities and towns continue to function, the idea of how the urban space should be designed, and what it should consist of, needs to be changed and innovative solutions should be found to incorporate UA into the current urban spaces. Food production is, and will remain, an intrinsic part of urban life. For this reason the advancement of urban food production needs to provide crops at a level that is functional and contributes to the urban system as a whole.

With urban populations increasing, many cities cannot keep up with providing sufficient resources for the population growth resulting in "a decrease in urban shelter and security of tenure, backlog of delivery of basic services, increasing inequality and segregation, degradation of the urban environment, and increase in poverty, malnutrition and food insecurity" (Van Veenhuizen & Dason, 2007:12). Although Stellenbosch is not classified as a city, the growth in its urban population exposes the town to similar challenges.

The town of Stellenbosch faces diverse challenges raging from social, economic to environmental aspects. While current policy aims to address these diverse challenges, policy

makers and Non-governmental Organisations (NGOs) fail to provide holistic solutions and continue to implement singularly focused projects.

Urban space is more than just a physical built environment focused on infrastructure, it is a space where people live, culture is formed and sustained, and most importantly, it cannot function without external resources. Woolley (2003:1) highlights the importance of the urban environment by stating that "the quality of that urban environment will have an impact on a wide range of elements of daily life including housing, education, health, crime, employment and leisure, both for individuals and communities or populations as a whole". As Stellenbosch struggles to deal with population growth, limited space and supplying citizens with basic resources, the need to transform and innovate alternative food solutions increases considerably in order to sustain a healthy and resilient urban design environment. Stellenbosch provides an ideal location to pilot change in UA within a developing world context. In addition, Stellenbosch has a high diversity of challenges, high population density, limited space and a variety of underutilised resources. This research study considers UA as a tool to increase sustainability and address some of these urban challenges faced within the Stellenbosch municipal region. The study motivates UA as a tool to increase urban food security and sustainability for challenges faced within this area.

UA has served as an alternative food solution to rural food production with a variety of urban challenges in developed and developing urban areas throughout history (Smith, Nasr & Ratta, 2001:1-2). As highlighted in the forthcoming sections, the challenges urban areas face has led to a rise in UA's popularity in the past and it will continue to do so in the future. Stellenbosch faces several challenges such as food security, poverty and inadequate urban waste management (Stellenbosch Municipality, 2012a:62). This interpretation is reflected in the municipality's Integrated Development Plan (IDP) wherein it advocates becoming the greenest and most "Innovative Capital within South Africa" (Stellenbosch Municipality, 2014:97).

The rising interest and culture of growing crops in urban areas has led to creative UA designs. Current projects either focus on addressing food insecurity of the poor or global environmental challenges (Smith, Nasr & Ratta, 2001:2; Viljoen, Bohn & Howe, 2005:21-22). The first is socially focused and the latter environmentally focused. These perspectives address a singular aspect of sustainability instead of looking at all the complex and depended elements of

sustainable development which include economic, social and environmental spheres. This research study argues that in light of the urban challenges, an innovative framework to address urban challenges need to incorporate all three sustainability spheres that will transform not only food security, poverty and malnutrition, but also environmental responsibility and stimulate the economy.

Rockström *et al*. (2009:33) developed a conceptual framework based on nine planetary boundaries wherein humans need to maintain functionality in order to keep within a safe operating space. The theory of ensuring functionality within the planetary boundaries states that a system needs to maintain resilience. They argue that the planetary boundaries concept "lays the groundwork for shifting our approach to governance and management, away from the essentially sectoral analyses of limits to growth aimed at minimizing negative externalities, toward the estimation of the safe space for human development" (Rockström *et al.*, 2009:32). Within the planetary boundaries framework it is suggested that a total of nine non-linear systems determine the stability which include, climate change, ocean acidification, stratospheric ozone, biogeochemical nitrogen, global fresh water use, land system change, biodiversity, atmospheric aerosol loading, and chemical pollution (Rockström *et al.*, 2009:32).

Although it can be argued that UA can have a direct or indirect effect on the stability or resilience of all nine non-linear systems, the focus of this study is to adopt the resilience theory and apply the theory to the urban environment. It therefore motivates and develops an effective functionality within an urban sphere to ensure that the threshold is not reached and urban resilience is optimised. UA in its diverse form aims to address and highlight the urban limitations to increase food security and production. There are a wide variety of innovative projects globally looking toward finding solutions for this complex topic within highly urbanised cities (Food Ladder, 2014; Gotham Greens, 2015d).

By viewing UA in these terms, it is possible to connect projects with holistic benefits to address the diverse urban challenges that Stellenbosch faces. This research study uses the case study of Stellenbosch to identify the urban challenges they face and connect them to solutions that UA provides. As a solution, UA projects are critically reflected upon to identify and inform the connection to sustainable development. This research concludes with the opportunity for Stellenbosch to function as a pilot project for innovative UA. The aim is to motivate for the

development of a policy to implement projects that envisage to address all the complexities of sustainability. Furthermore, it aims to identify the main concepts which build the foundation of UA practice. These policies need to use these foundational building blocks as a basis to redefine urban development and development in general within a sustainable and innovative manner.

1.2 Motivation

This thesis aims to highlight the potential contribution of UA with regards to food security, sustainability and urban resilience. Furthermore, this thesis aims to provide a comparative analysis of a variety of UA projects in order to identify holistic solutions to urban challenges. My interest in the topic of urban agriculture solutions and food security was stimulated during my post-graduate studies and particularly as a result of attending lectures in Environmental Ethics during 2013. Throughout my undergraduate studies I have volunteered in lower income communities. As a result of extensive time spent within these communities, I have realised that a more practical solution is required to address the immense problem of communities' inability to sustain themselves and ensure a healthy diet. During this time, it was evident that malnutrition was common among the populations and that it is one of the main concerns within areas such as Kayamandi and Idas Valley.

Furthermore, eating healthy and maintaining a balanced diet is an important part of my daily life since becoming a vegetarian at an early age. My need to eat healthy and my love for gardening lead to the implementation my own vegetable garden. During the process I have encountered a variety of challenges including limited space, pest control and access to nutrient soil. Although my home garden yields a small harvest the satisfaction of eating locally increased my interest in alternative urban solutions. The idea was to identify how all income groups found within the urban space can share in the satisfaction of eating locally as well as become more sustainable.

Stellenbosch has been selected as an appropriate case study for this research study to showcase the current urban challenges faced within a South African context, specifically poverty leading to malnutrition. In addition, Stellenbosch is an ideal case study to implement solutions to overcome challenges, since its municipality has access to diverse resource such as financial and educational institutions (Stellenbosch Municipality, 2014:12). With innovative planning and strategy these

resources could be aligned to solving the shortcomings of urban challenges within the Stellenbosch region.

1.3 Proposed Research Questions

The purpose of this study is to investigate UA practices as a tool for addressing urban agriculture challenges. The study aims to inform local and national policy makers about the possibility of utilising UA as a tool for addressing social, economic and environmental urban challenges. In addition, this study highlights and analyses a broad spectrum of projects within UA to address food insecurity. Firstly, this study will address these challenges by analysing urban environments where an increase in UA was practiced and as a result the current motivation for UA practices grew stronger. Secondly, this research study will provide a holistic overview of the identified global industrial and community-based UA projects and aims to identify how these innovative projects could present a viable solution for increasing urban food security and sustainability in future. Ultimately, this study wishes to encourage Stellenbosch to focus on resources and to develop policies to address urban challenges in an innovative manner.

Research objectives have been addressed through the following research questions:

1- How can industrial UA or community-based UA contribute to food security and ensure long-term urban sustainability?

   The research question developed as the research purpose aimed to identify which UA project will be most suitable to address urban challenges. The findings provided two different UA types to be found within the urban sphere and their focus and motivation stemmed from different perspectives. Food security among the poor motivates for alternative solutions, however the conventional agriculture threaten food security for more than just the urban poor. For this reason the first research question aims to identify UA that can potentially address both spectrums of development.

2- Why does Stellenbosch provide suitable opportunities to achieve sustainability through the establishment of UA?

This research aims to identify how UA can provide the urban sphere with the increase in food sources to ensure long-term sustainability of urban space. As a result, this motivates for UA to

become a permanent part of urban life and thus contribute to a sustainable urban lifestyle. While it is not possible within this study to identify all the urban challenges that Stellenbosch face or highlight the various projects that need to be implemented to ensure diverse resilience, the main focus will be on establishing the key elements of an urban food security policy for Stellenbosch. In addition, this research provides a motivation for conducting a pilot study to address the food security related urban challenges that Stellenbosch faces. This research study will also attempt to highlight and analyse urban food challenges (food insecurity and vulnerability) and investigate opportunities within current UA projects. The lack of a food policy in South Africa and Stellenbosch allows for the development of innovative solutions and structural change rather than to focus only on the current aid-based perspective.

1.4 Significance of the Study

One of the key challenges in the field of environmental management is finding the balance between human development and the protection of ecosystems. This study seeks to provide alternative frameworks that will contribute to existing urban food insecurity. Suggestions to tackling urban food insecurity issues include reusing currently unused spaces, planning new developments or redesigning existing urban structures within the urban environment. This research aims identify different stakeholders with a sustainability agenda and the possible contribution they may have to realising holistic UA projects. This is achieved through critically analysing existing urban frameworks and policies, and by suggesting ways to develop a system that would support long-term sustainability of urban food supply structures.

This research could potentially aid policy makers in establishing sustainable frameworks with clear guidelines to allow for the development of sustainable UA. These frameworks could preserve ecological systems, are sustainable in the long-term, and will contribute in solving issues related to urban food insecurity.

These recommendations could promote alternative and innovative views of sustainable and reliable food systems. Although this study focuses exclusively on Stellenbosch, it seeks to identify key factors for the development of similar systems in comparable urban environments.

1.5 Thesis Outline

Chapter 1 provides an introduction to the research study. The background to the research is discussed, and the motivation for the study, research objectives, research questions, and significance of the study, are elaborated upon.

Chapter 2 discusses the literature review. This chapter presents theories concerning UA with particular focus on the key concepts of UA and reports on the rise of UA in different historic time periods. The food security section describes the element of food security and its link to malnutrition. It concludes by providing the advantages and disadvantages of UA with regards to urban space and proposes UA as a tool for increasing urban sustainability.

Chapter 3 focuses on the policy agenda on food security and how this translates to the local municipality level. This chapter will focus on the local policy agenda of Stellenbosch to address the food insecurity levels in the area. In addition, this chapter presents the link to global and national agenda and how UA contributes to the aims listed in the agendas.

Chapter 4 outlines significant methodological perspectives and discusses the research design used to answer the two research questions of this study. The research will provide a comprehensive background to aid the understanding of the reader on the case study process and why it is appropriate in the particular environment in which the research was conducted. The research method, data collection and process are outlined in this chapter.

Chapter 5 investigates current food insecurity and vulnerability within the Stellenbosch area. Furthermore, it identifies the Stellenbosch sustainability crisis and how the town encompasses the ability to serve as a pilot study for UA to contribute to sustainability. The crises and resources available within the town provide the ideal environment for testing UA and providing a module that addresses the complex system and achieve sustainability.

Chapter 6 analyses existing UA projects in order to identify sustainability links that will guide development and the design of UA projects. Current literature on UA revealed different developmental perspectives between the different UA solutions. The solutions vary between industrial UA and community-based UA. Both of these solutions were analysed to identify their

contributions to urban food security and sustainability by evaluating them against the key concepts of UA (these key concepts have been analysed by means of different literature).

Chapter 7 concludes this research study and summarises findings with reference to the literature review and theories presented in Chapter 3. This chapter also presents a discussion on how the results contribute to building urban resilience as an alternative to conventional agriculture. Lastly, research findings will be brought into context of the overall research and recommendations for future research will be made.

Chapter 2: Literature Review

2.1 Introduction

Creating a productive urban landscape aims to reshape the urban sphere and build internal capacity to supply resources for the growing urban population. Viljoen and Bohn (2005:11) describe how the urban sphere should "be open landscapes productive in economical and sociological and environmental terms". The productive urban landscape theory aims to restructure the urban landscape and incorporates elements to increase economic, social and environmental aspects. Ultimately, the idea is to re-establish the processes required to support the urban landscape by increasing social capital, urban resilience, heat island reduction, water reuse, biodiversity and food production.

The 2012-13 *State of The World Cities* report highlights links between productive urban landscapes and environmentally sustainable cities. This report views productivity and efficiency as coinciding elements to build a prosperous city that will prevent environmental degradation (UN-Habitat, 2013:93). In addition, this report refers to this type of prosperous city as an environmentally sustainable city that is vibrant and "likely to attract the skills and entrepreneurship essential for growth and prosperity, which is necessary to solving urban problems and challenges" (UN-Habitat, 2013:93).

The image of a productive city shaped by Viljoen and Bohn (2005:12) highlights the importance of food production in urban areas. Although food production is listed as a cornerstone for a productive city there are a variety of other aspects contributing to productivity including green space for social and ecological importance, transportation systems connecting areas, redeveloping as well as effective use and reuse of resources (Viljoen & Bohn, 2005:11-12). The idea of a productive urban landscape acknowledges the fact that cities will not reach a full self-sufficiency. Instead, a productive urban landscape is mainly based on urban food production and local consumption, decreasing the total dependency on supply from outside the urban sphere and increasing urban resilience. In order to motivate for an urban food production centre, existing possibilities and projects need to be explored.

The current need for urban food security motivates the drive towards alternative solutions, especially within developing nations, to improve household nutrition (Smith, Nasr & Ratta,

2001:26). Local municipalities struggle to supply growing urban populations with goods and services. Stellenbosch is only one such an example where the urban poor struggle to ensure household nutritional needs (Stellenbosch Municipality, 2012a:39). As a result, a variety of food relief programmes have been implemented by various organisations within Stellenbosch in order to address food insecurity (Haysom, 2011:49). The aid based solutions of addressing urban food insecurity is a short-term aid-based solution (a day-to-day solution). Instead, structural transformation, which includes a "process of moving resources from lower to higher productivity so that the economy can sustain a higher standard of living for the population" is needed (Weaver, Rock & Kusterer, 1997:13). Thus, a productive environmentally sustainable city is of importance, since "food banks and other community assistance programs should only be relied on as emergency measures, rather than being institutionalized as permanent mechanisms for food access. Food banks often serve two goals: to assist low income consumers and to distribute surplus food. To reduce poverty and inequality in access, structural measures need to be undertaken to provide long-term food security." (Koc, MacRae, Mougeot & Welsh, 1999:6).

This chapter aims to identify urban food production as a possible solution to food insecurity and UA's ability to contribute to sustainability. Firstly, the concept of food security is provided identifying the need for alternative solutions followed by UA as a possible tool to achieve a productive and environmental sustainable city. The different variables of UA are identified through evaluating UA definitions followed by a summary of key concepts or building blocks of UA. Secondly, the importance of UA throughout history is explored by examining time periods when cities or towns reached levels of extreme food shortage or where UA surfaced due to certain events. This chapter continues with recognising the advantages of UA within a sustainable development framework, as well as the risks associated with UA. Lastly, this chapter concludes by exploring the different forms UA occupies and the level of sustainability of this practice.

2.2 Food Security an Urban Reality

Food security received international attention since the focus on malnutrition at the 1996 World Food Summit (WFS) held in Rome (Jonathan & Frayne, 2010:8). The 1996 Rome Declaration on Food Security indicated around 800 million people "do not have enough food to meet their basic

nutritional needs" (FAO, 1996a). Since then the 2015 FAO report on *The State of Food Insecurity in the World* classified 795 million people in the world as undernourished (FAO, 2015a:8). Although the number of undernourished population has decreased slightly food security still remains a sustainable development challenge.

The WFS describes food security as follow: "when all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preference for an active and healthy life" (FAO, 1996a). Food security is based on three components. Firstly, the availability of food, specifically ensuring that there are sufficient qualities of food on a consistent basis. Secondly, access to food by having enough resources to obtain food for a nourishing diet. Lastly, food security requires knowledge of nutrition and health (WHO, 2016).

The South African Integrated Food Security Strategy (IFSS) description of the food security components is as follow (Republic of South Africa, 2002:15):

- **Food availability**: effective or continuous supply of food at both national and household level. It is affected by input and output market condition as well as production capabilities of the agricultural sector.
- **Food access or effective demand**: ability of a nation and its households to acquire sufficient food on a sustainable basis. It addresses issues of purchasing power and consumption behaviour.
- **Reliability of food:** utilisation and consumption of safe and nutritious food.
- **Food distribution:** Equitable provision of food to address points of demand at the right time and place. This spatial/time aspect of food security relates to the fact that a country might be food secure at the national level, but still have regional pockets of food insecurity, at various periods of the agricultural cycle.

Food security is a complex sustainable development issue. Global environmental challenges contributing to hunger includes: higher food and energy prices, extreme weather events, natural disasters, political instability, civil conflict, unemployment and economic recession (FAO, 2015a:9). The economic recession during 2007-8 lead to a significant increase in food prices

which correlated with a rise in food insecurity and level of undernourishment people, particularly within urban areas (Jonathan & Frayne, 2010:10).

The 2012-13 UN-Habitat's *State of The World's Cities* report indicates how cities are facing extreme challenges: "Soaring unemployment, food shortages and attendant price rises, strains on financial institutions, insecurity and political instability, among other crises, might well on their own call into question the relevance and even the viability of a report focused on prosperity" (UN-Habitat, 2013:4). The urban environment is not a place of wealth and prosperity as might be perceived, for in realty the urban space is crowded with social and economic challenges. The price of food and the income of households are seen as economic barriers to food security whereas the price of transport and distance to the market are classified as physical challenges (FAO, 2008:18).

Southern Asia and sub-Saharan African countries accounts for a large portion of global undernourished (FAO, 2015a:11). More specifically, one in every four people in sub-Saharan Africa are estimated to be undernourished in 2014-2016 (FAO, 2015a:12). Figure 2.1 illustrates the trend of undernourished and show that sub-Sahara Africa accounts for the highest level undernourished population. Population increase in this region is high and the reaction to hunger is slow. Food security is intrinsically liked to health and nutrition (WHO, 2016). Whereas hunger is measured by two indicators: the occurrence of undernourished and the incidence of children underweight under the age of five years (FAO, 2015a: 12).

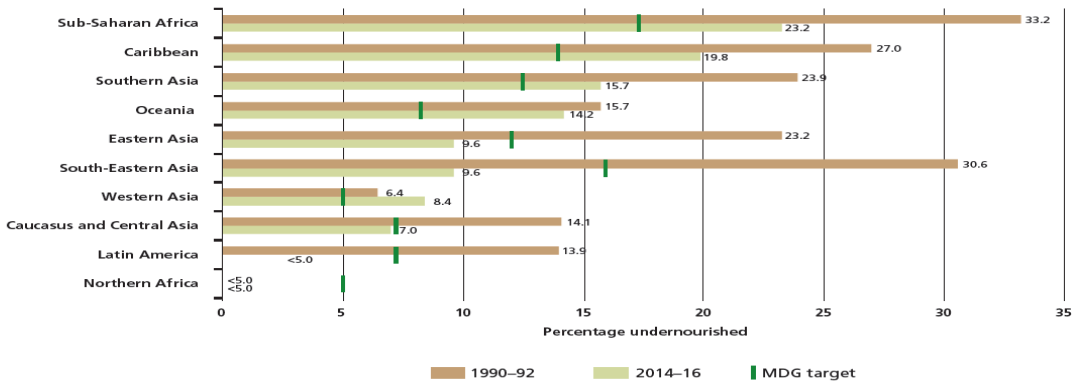


Figure 2.1: Undernourishment trends: progress made in almost all the regions, but at very different rates

(Adopted from FAO, 2015a: 14)

The sub-Saharan African region has the highest urban growth in the South (Jonathan & Frayne, 2010:20). The urban population is becoming increasingly vulnerable to food insecurity (Jonathan & Frayne, 2010:20). South Africa is experiencing a high urban population growth (Jonathan & Frayne, 2010:17). The urban populations' food security levels are mostly dependent on households buying power and income (Jonathan & Frayne, 2010:17). Population increase in South Africa's urban areas is caused by natural increase, migration from rural to urban as well as immigration from bordering countries (Lesotho, Mozambique, Swaziland and Zimbabwe) (Jonathan & Frayne, 2010:22). Due to the high urban population increase in the sub-Sahara African region effective policy and holistic solutions are becoming all the more important.

The increase in urban food insecurity requires food interventions for the urban vulnerable population. Jonathan and Frayne (2010:19) identified gaps in existing food security strategies with focus on rural areas. Urban food insecurity is regarded as invisible to policy makers due to multiple urban challenges that require solutions (Jonathan & Frayne, 2010:35). In rural areas food insecurity is addressed on a community level, whereas in urban areas food insecurity is dealt with on a household level limiting the policy's focus on this urban challenge (Jonathan & Frayne, 2010:35).

Although the urban sphere encounters diverse challenges, sustainable and prosperous cities can be realised. "Prosperous cities can operate efficiently and productively without necessarily damaging the environment" (UN-Habitat, 2013:93). UA can positively influence the physical and economic urban challenges by making food and income available to households (FAO, 2008:18). Although UA has different forms, subsistence type UA "is sometimes advocated as the "key" to greater urban food security" (Jonathan & Frayne, 2010:6). This chapter explores the various types of UA and its contribution to the urban sphere. Thus, UA is proposed in this study as a viable tool for addressing food insecurity, increase productivity and efficiency, ultimately contributing to a prosperous and environmentally sustainable city.

2.3 Defining Urban Agriculture

UA consists of multiple concepts and in order to understand UA in its totality, these key concepts need to be explored. The FAO documents the reasons for the diverse classification of UA and states that a definition only highlights parts of what UA consists of, and that there is also

a “lack of clarity and differences between regions or cities” of what UA is charactarised as (Van Veenhuizen & Dason, 2007:15). Dividing UA into smaller parts allows for the identification of key concepts in order to analyse UA’s multi-dimensions. This process is essential to understand UA and identifies the opportunities it offers to the urban space. UA has evolved over time, from literature referencing the use of UA in ancient cities to the development of UA in the Twenty-First Century. The next section highlights multiple interpretations and definitions of UA in order to identify key concepts within this urban phenomenon to ensure a clear understanding of UA.

Van Veerhuizen (2006:2) defines UA as “the growing of plants and the raising of animals for food and other use within and around cities or towns, and related activity such as the production and delivery of inputs, and the processing and marketing of products”. This defenition does not indorporate all aspects of UA. However Van Veerhuizen (2006:2) continues to discuss other characteristics of UA such as the distance to the market, the location of UA, competition for land and limited urban space, the reuse of urban resources, mentions the degree of a farmer’s organisation, and lastly, discusses aspects of socialisation.

Food insecurity within developing countries expands our understanding of UA. Altieri *et al.*’s (1999:132) study on UA during the 1990’s food crisis in Cuba, highlights the importance of the practice for urban survival and defines UA “as all agriculture and animal production that occurs within cities or peripheries that receive direct influence from cities, so that the productive process is intimately linked to the urban population”. In addition, Mougeot (1994:1) identifies alternative concepts of UA which includes “food supplied from rural areas, urban storage and transportation, processing and marketing, distribution and consumption of food in urban areas”. Although multiple interpretations of UA exist, Smith, Ratta and Bernstein (1996:1), provides a simplified definition of UA as “food and fuel grown within a city or peri-urban area, producing directly for the market and/or household use”.

Mougeot (2000:4) identifies UA concepts as conceptual building blocks based on the current definitions of UA. Based on Mougeot’s building blocks and additional literature, the following key concepts of UA have been identified:

1- There are various types of production which include plants, animals or fuel (FAO, 2008:18). The production consists of food or non-food categories and sub-categories

which include food production for human or livestock consumption, which can either be cultivated or raised. Production includes different types of activities such as horticulture, aquaculture, livestock production and the establishment of forests (Smith *et al.*, 1996:1). A sub-category consists either for ornamental or agro-industrial production of plants (Mougeot, 2000:5).

2- The location of UA is described by Smith *et al.* (1996:2), as being "located where land is either not suitable for building or is waiting for development, rather than land that is particularly suitable for farming". The location of UA includes areas in or around cities or urban areas, whereas those located in the cities are labelled as 'intraurban' and those located on the outskirts of the cities as 'periurban' (Mougeot, 2000:6). More specifically, UA is often located in the core(s) and corridors within cities, wedges between corridors of high-density developments, or on the fringe of cities (Smith *et al.*, 1996:2). Mougeot (2000:8) distinguishes between location and "types of areas where UA is practiced". The types of areas include the type of residence (located on a plot or off-plot), the type of site (situated on an open-space or a built-up area), as well as the official land use of the area (residential, industrial or institutional).

3- Although the market and the product destination differ for this study, the type of market allows for either self-consumption or trade which influence the product destination (Mougeot, 2000:5).

4- UA enterprises function either in the formal or informal economy where the use of technology differs greatly (Smith *et al.*, 1996:4). Pearson, Pearson & Pearson (2010:8) make use of UA production size classification that can either consist of meso, micro or macro scale gardens. Meso scale gardens include community gardens, individual collective gardens and urban parks. Urban gardens of this size are typically owned and managed by private, corporate and public entities. Micro scale gardening includes green roofs, walls, courtyards, backyards and street verges typically owned and managed by private or corporate owners. Macro scale gardens, on the other hand, include commercial farms, nurseries and greenhouses that are generally owned and managed by private and corporate entities.

5- The type of farmer or producer ranges from low income farmers (individual farmers that usually farms part-time with the aim of increasing income levels and food security),

middle and high income farmers (farms are run as profitable farming enterprises), agribusinesses (national and international corporations with specialised production), farmers associations and corporations, and lastly, special groups of farmers (consisting of women, immigrant farmers and crisis farmers) (Smith *et al.*, 1996:4).

6- Types of economic activities of UA include production, trade and processing (Mougeot, 2000:5). Economic activity may include a commercial, subsistence or multifunctional type UA. Multifunctional type UA applies specifically to the social sphere of sustainable development and includes a combination of diverse functions such as organic and diverse agriculture, forestry as well as recreational and educational functions (Van Veenhuizen & Dason, 2007:24). Subsistance UA focus on self-production with some processing, local selling and exchange. Subsistance farming forms part of livelihoods statergy for the urban poor (Van Veenhuizen & Dason, 2007:24). Commercial type UA applies to market-orientated production of small to large scale enterprises (Van Veenhuizen & Dason, 2007:24).

7- Linking UA to social and ecological systems is crucially important. UA has an important economic, social and ecological contribution to the urban sphere (Mougeot, 2000:8). Open surface space includes public as well as private open space. Woolley (2003:5) categorises urban public space into single-minded space and open-minded space. The former refers to a space that has been designed, planned, built and used with a single activity in mind, while the latter refers to where a variety of buildings provide a context of mixed use where the space is usually allocated for social activities (Woolley, 2003:4). Currently, public parks within urban and suburban areas of developing countries is linear focused and aims to contribute mainly to the social sphere of sustainability. The need for a holistic sustainable garden that contributes to all three spheres of sustainability.

Allotment gardens, another form of urban gardening, are small land parcels rented out either in rural or urban locations. Allotment gardens' social connection forms an important part of long-term sustainability of urban practice and represent "legacies of traditional household gardening practices where the users' knowledge of gardening has been passed on and socially retained for considerable time, often over several generations" (Barthel, Folke & Colding, 2010:256). The above contributes to the understanding of urban food production and allows for two more key concepts to be incorporated:

8- Ownership of land which differs from private land to municipal public land, leased out based on agreements or owners producing for their own benefit or consumption. Land that is farmed without a formal agreement occurs in areas and can be classified as guerrilla gardening (Posthumus, 2013:14).
9- Social ecological memory consists of learnings about food production in an urban space which has been passed on from one generation to another. Social memory consists of a continuous process of learning and reflection in order to adjust to the changing environment and becoming resilient (Bergamini *et al.*, 2013:16). Lastly, social learning extends to teachings about the ecology on how to be responsible. In addition, by highlighting the importance of species and the benefits of inviting species into the gardens, will increase the knowledge surrounding species and managing these species in gardens known as socio-ecological memory (Barthel *et al.*, 2010:261).

The UA phenomenon continues to exist within cities and takes different forms that are dependent on each area and urban dynamics. The factors contributing to UA development and sustainability form part of what UA encompasses. A variety of factors shaped farming within cities and these include continued practice of UA through history within the urban sphere, urban demand for diverse products stimulating a 'plant and animal domestication', the urban concept of urban space and incorporating the environment, development of industrial agriculture stimulating a niche focus to supply urbanites, learnings of UA as a product of global information revolution, rapid urbanization, settlement patterns, and lastly, the expansion of low income populations (Smith *et al.*, 2001:2-4). With the increase in urban challenges, and the technology used to solve these challenges, UA is evolving and constantly changing.

UA is a multidimensional phenomenon contributing to urban space in a holistic manner. UA forms part of the history of cities and often arises in times of uncertainty and crises. The opportunities UA brings, thus motivates for UA to be incorporated as a permanent part of urban life. The next section showcases periods when UA was of intrinsic value to the survival of the urban population. The aim is to highlight the importance of UA to secure UA as an intrinsic part of urban space in the long-term.

2.4 The Rise of Urban Agriculture

Food insecurity has been, and still remains, a lingering challenge within cities and towns. The reasons for the rise in UA vary from region to region, and are greatly influenced by political, economic or social aspects. It is evident that the contribution of UA to urban space throughout history cannot be overlooked and that the opportunity for increasing sustainability needs to be explored. This section begins by reviewing the practice of UA within ancient cities and the rise of this practice during times of extreme urban challenges.

UA has been practiced within various urban and peri-urban areas throughout history. Some cities have a long tradition of urban farming, and according to Girardet (1996:5), "urban agriculture was an important feature of urban life, contributing to regular food supplies as well as providing security in times of emergency". Ancient cities have either been structured to accommodate UA or experienced certain changes that brought on the UA phenomenon.

2.4.1 Ancient city co-development with UA

It has been theorised that the first cities were formed due to farming and trade, thus cities preceded agriculture (Girardet, 1996:40; Morris, 2003:2). Conversely, Jacobs (1969) cited by Girardet (1996:40) propose that agriculture was not the basis on which cities were founded however, agriculture and animal husbandry within urban space was an outcome of the existence of cities. Jacobs's theory is based on the fact that trade cities existed without the supporting food structures surrounding them. Irrespective, food and urban space form part of a historical partnership, where cities are dependent on food sources, either produced within, bordering the cities or imported into cities, as in the case of Rome (Girardet, 1996:42).

Cities have a tendency to reach a peak and thereafter have a steady or drastic decline. Throughout history this pattern is visible when looking at cities and civilisations. Girardet (1996:38) describes how ancient cities did not reach a level of sustainability either due to the destructive nature of farming practices surrounding the urban space or conflict which led to cities' destruction.

However, ancient civilisations developed innovative UA systems to ensure production of food to feed its citizens. Smith *et al.*, (2001:5) highlight a few of these UA innovations used within

ancient cities, from water supply systems within Iran, intensive raised bed farming in Java and the Indus valley, to the self-sufficient production of fruit, vegetables, and grain in Aztec, Mayan and Inca cities. Within the Mesopotamian delta, flood control and irrigation were used to ensure a steady supply of water for cultivated land surrounding densified populated areas (Girardet, 1996:40). These innovations developed alongside the city, and the city depended on the production of these crops. Each area's innovation differs for it incorporates the surrounding resources into the design. Mougeot (1994:1) indicates how agriculture was a basic function of urban life and states that archaeological findings show "massive and ingenious earth- and waterworks, within and on the edge of urban settlements constructed by ancient civilizations".

Within the Middle East UA was practiced in various forms influenced by the extent of the practice, tradition, needs and resources available (Mougeot, 1994:2). For instance, within Sena walled gardens were cultivated, in Egypt UA was practiced in a plot format bordering the delta, and in Istanbul food gardens could be found along the city's defences (Nasr & Kaldjian, 1997). Although the aforementioned is only but a fraction of the UA practiced during the establishment of ancient cities, it is clear that the establishment or survival of such cities depended on urban food production and supply.

2.4.2 Industrialised urban population boom and the rise of UA

Looking towards the advancement of urban development and the periods of urban growth, the industrialised era is evident of an urban population boom and with this the urban food challenge surfaced. During the 19th century a phase of industrialisation swept over Europe, this stimulated population increase within urban space due to immigration from rural areas for better opportunities. The industrialised urban dynamic spread and with it a population increase, ultimately lead to an increase in urban poor populations living in unfit conditions due to "inappropriate housing, malnutrition and other forms of social neglect" (Drescher & Holmer, 2005:149). Various forms of UA were practiced in Europe during this period with "home gardens for the well-to-do and allotment gardens for the workers" (Smith *et al.*, 2001:18). As in the case of Poland, food gardens grew during this time where "work places and gardens existed side-by-side and cities grew around them" (Bellows, 2004:250).

2.4.3 Political and economic instability and the rise of UA

Multiple examples of political instability in the past influenced key aspects of urban dynamics, specifically food supply. One of the most prominent periods where UA increased in cities was during World War I and World War II. During both World Wars there was a significant increase in UA on both sides of the conflict, with production in urban and peri-urban locations. The increase in food gardens, and the crops it provided to cities, served as a food support system in times when food rations were implemented within the cities.

Woolley (2003:83) describes how the number of food gardens increased considerably during the First World War and reached similar numbers during the Second World War. In the Second World War a campaign 'Dig for Victory' was hosted, motivating citizens to produce their own food. In the city of Birmingham during the peak of the urban garden movement in 1944, a total of 20,417 allotment gardens were actively providing food to the citizens (Woolley, 2003:86-87).

Similar to Europe, UA intensified in North America during the First World War. By the Second World War a movement was promoted to contribute to food security by increasing UA referred to as 'Victory Gardens' where individuals supplemented their own food supply (Victory Gardens for 1943, 1943:370) as graphically depicted in Figure 2.2. The movement was motivated to reduce pressure on the supply of food in times when logistical, production and financial resources were allocated for military defence (Brown & Jameton, 2000:22). Citizens in America were motivated to produce their own food in their backyard and if they did not have the space they were to garden in allotments as part of the 'home-front fighter's front assignment' during the war (Thone, 1943:186). The two World Wars were seen as times of emergency and it is reported that during 1943 a total of 20 million 'Victory Gardens' were cultivated and produced 8 million tons of crops in the United States (Thone, 1943:229).

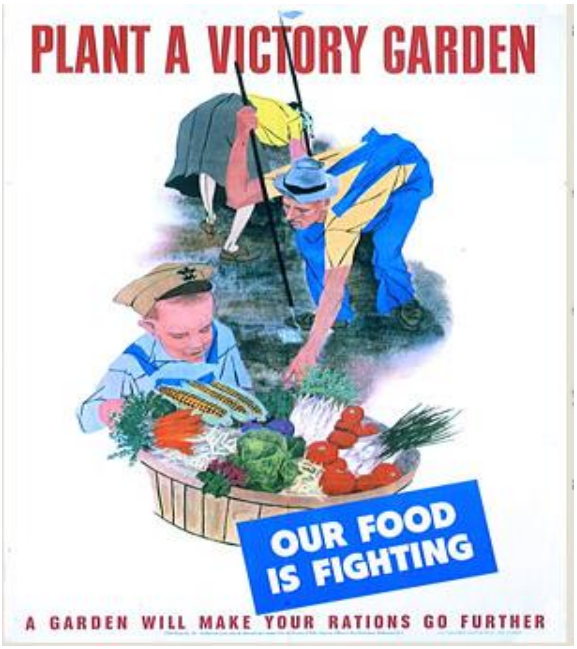


Figure 2.2: Victory Gardens in the United States
(Adapted from Reinhardt, n.d.)

Events leading up to an urban food crisis differ and demonstrate how fragile the urban food security situation can become, as seen in the 1880 economic depression. During this time companies closed down and unemployment increased, leading to food insecurity within cities. Cities realised the threat to the urban populations and motivated the development of relief gardens to combat the hunger (Five Families in Dubuque: The Urban Depression 1937-1938, 2003). As in the case of Detroit, UA was once again motivated as a source of food to address the urban food challenge (Austin, 2015). During the economic crisis of 1882, UA increased in North America with the growing of food taking place on vacant lots within cities and towns.

Political and economic crises merged with the collapse of the Soviet Union, leading to severe food shortages in Cuba. The collapse of the Soviet Union in 1989 affected the economic stability of Cuba, directly impacting upon the food security status of the country (Altieri *et al.*, 1999:132). Cuba is dependent on the import of fertilisers, pesticides and up to 57% of food imports, all of which were affected by the import quota bill (Altieri *et al.*, 1999:132). In reaction to the food insecurity, citizens from cities such as Havana started to cultivate crops within the urban fringe. A variety of food gardens were available during this period with the ‘popular garden’ being the

most common. In a city like Havana during the peak, there were a total of roughly 5000 active food gardens in 1997 (Altieri *et al.*, 1999:132). The political challenges forced citizens to look at the self-production of food for household consumption.

Furthermore, countries that undergo political instability such as war, government instability, or do not have efficient infrastructure and capacity to produce enough food for its citizens, have seen an increase in UA (Smith *et al.*, 1996:12). Political instability during the civil war in Sierra Leone between 1999 and 2001, lead to rural populations seeking refuge in cities, specifically Freetown, where the population increased to nearly 1 million. This contributed to challenges such as food insecurity, poverty and malnutrition to name a few. UA became a source of food security to the unemployed with an estimate of 1800 people employed by the industry (either full-time or part-time) (FAO, 2011:14). Other stimulants of UA in modern cities include "growing poverty, hunger and lack of formal employment, as well as specialised opportunities that a city provides for farmers have stimulated a diversity of agricultural production systems in and around cities" (Van Veenhuizen, 2006:2). A lack of adequate food security is directly linked to urban settings dominated by little income and poor nutrition.

It is also thought that the increase in UA was stimulated by the 2008 economic shock and the economic decline stimulated a newfound interest in the UA phenomenon. Whatever the stimulus for an increasing interest and rise in UA was, the existence of cities and urban space have gone hand in hand with food production. The opportunity UA contain is motivation for urban sustainability based on the sustainability principals as set out in Agenda 21 to "improve social, economic and environmental quality of human settlements" (United Nations Sustainable Development, 1992:45).

Cities and urban space around the globe have seen a steady increase in UA, although the motivation or origin of this increase may differ from city to city, there is a golden thread that needs to be identified. Two mainstream developments have come under way. Firstly, within developed cities the growth in UA within affluent areas, not prone to food insecurity, has seen an increase due to the need for a sense of community, reconnecting consumers with farmers, raising awareness of the environment and human health, and keeping money locally circulated (Bohn, Viljoen & Howe, 2005:57-60). Secondly, in areas with little employment and opportunities, UA is a reaction to poverty and food insecurity (Smith *et al.*, 1996:4; Obosu-Mensah, 2002:24).

Furthermore, social movements' contribution to the development of UA in the 21st century focused on local, fresh grown produce, also looking at alternative solutions for social and environmental challenges (Deelstra & Girardet, n.d.:55-56). The second UA development is linked to food security of the urban poor within and surrounding cities. This can be seen in developing cities or poor income areas within developed cities, as well as areas with informal dwellings and high unemployment. As a way to cope, UA allows for an increase in job opportunities, enhancing food security, recycling or reusing urban waste (Smith *et al.*, 1996:4-8; Madaleno, 2000:74;). The next section explores the advantages and risks associated with UA.

Although the section above is a historical view of UA within urban areas there are linkages to current urban challenges. Urban population increase, political and economic instability and ecological challenges are all part of urban challenges in the 21st century. Thus motivation to incorporate UA into the current urban structure becomes all the more important based on the advantages discussed in the next section.

2.5 Advantages and Risks of UA

What makes UA unique is the link to urban food systems, sustainable urban development, urban food security, urban land management and urban survival strategy. The UA industry provides the opportunity for a productive and environmentally sustainable urban landscape that contributes to the resilience of the urban sphere. Currently, UA does not form part of Stellenbosch's urban planning however, the advantages mentioned below will motivate policy to ensure that UA is properly introduced into the urban structure. In order to motivate policy and other stakeholders to invest into urban practice the advantages and challenges of an UA system need to be explored. UA contributes to sustainable development on an economic, social and environmental level. Multiple advantages will be discussed below however, it is important to note that the size and shape of UA determine the contribution that UA makes to a sustainable urban environment, urban land management and long-term food security.

The advantages of UA can be divided according its contribution to economic, social and environment sustainability:

2.5.1 Economic advantages of UA

On a household level UA increases income and employment. UA supplements poor households' food diversity and can serve as income derived from sales for the unemployed (Smith *et al.*, 1996:4). Furthermore, UA stimulates local economic development by creating employment opportunities (Koc *et al.*, 1999:5). Within a city like Belem, studies show that UA is typically practiced by underemployed and unemployed workers (Madaleno, 2000:74).

On a city or town level UA contributes to the decreasing of municipal burden with regards to waste management, greening and beatification of urban space, as well as providing better nutrition for the urban poor (Van Veenhuizen & Dason, 2007:28). Furthermore, UA has a multiplier effect on urban areas as it interlinks different industries, ultimately generating local economic activity (Smith *et al.*, 1996:4). According to Smit *et al.* (1996:4), UA creates a link between a variety of input supply (fertilizers, seeds, feed, extension serves), output handling (storage, transportation, canning), as well as marketing and food processing industries (canned vegetables, poultry products, milk products). From a market supply perspective UA decreases dependency on off-seasonal imports, allows for fewer levels of trade that increase food prices, and a higher percentage of producers are involved within the market.

Although the production size of UA differs between rooftops, courtyards and strips on the boundaries of cities, it provides the opportunity to transform vacant or degraded sites to the productive use of land (Madaleno, 2000:74). In some cases the opening of community gardens have increased the value of neighbourhoods and increased property prices with the establishment of community gardens (Van Veenhuizen & Dason, 2007:53).

2.5.2 Social advantages of UA

Food security and access to food for the urban poor remain urban challenges. Urban poor populations have limited access to diverse food produce due to a lack of income. "Food production in the city is often a response of urban poor to inadequate, unreliable and irregular access to food and lack of purchasing power" (Van Veenhuizen & Dason, 2007:7). A limited diet contributes directly to poor nutrition and health. UA provides the opportunity for urban poor to increase household consumption and nutrition levels. In countries such as Kenya, urban poor

families grow a variety of crops to improve nutrition and reach self-reliance (Smith *et al.*, 1996:8).

UA provides the opportunity for households to produce their own food to meet their needs. Smith *et al.*, (1996:1) suggest that between 25 and 100 percent of urban vegetables and protein are satisfied through urban food production. Subsistence UA provide livelihood strategies to urban poor by saving money on food and other health expenditures (Van Veenhuizen & Dason, 2007:24). In the 1980's 18 of China largest cities produce up to 90 percent of their own vegetables and half of their own meat (Smith *et al.*, 2001:3). Not only does this increase food security, but it also allows for access to fresh locally produce, available in season and that has not been exposed to storage and transport refrigeration which decrease the nutritional value of the produce (Pearson & Hodgkin, 2010:100).

A survey conducted on 20 community garden programmes in New York reported several reasons for their participation in gardening, namely access to fresh produce, health benefits, and working in nature (Armstrong, 2000:322). Furthermore, the study reveals that the attitude of the community changed towards improving the quality of other properties in the area, and that there was an increase in pride within the neighbourhood (Armstrong, 2000:324).

A study conducted in the United Kingdom on the health levels of the population divided different activities into typical age groups and revealed that gardening is seen as an activity that is practiced by all age groups and genders. Furthermore, the study shows how physical activity increased personal well-being and human capacity development opportunities (Miles, 2007:326). UA in the United States has reported to have a positive effect on personal wellness, community improvement, as well as stress-reduction (Brown & Jameton, 2000:28).

Community development derived from community-based UA includes social interaction, rebuilding a sense of community through revitalising and contributing to the community as a whole. Participants regain self-esteem as a result of having a sense and purpose (Van Veenhuizen & Dason, 2007:49). Urban areas that are prone to illegal dumping and criminal activity are transformed into productive urban space (Howe *et al.*, 2005:57). In addition, UA serves as a recreational opportunity, as well as an educational function (Van Veenhuizen & Dason, 2007:50). Studies have shown the advantages of UA on childhood development and

include an increase in the knowledge of ecological concepts, biospheres, nutrition and many more (Hamm & Baron, 1999:58).

Table 2.1 reflects alternative community benefits of gardening drawn from the survey that was conducted in upstate New York and contributes to the social advantages of UA.

Table 2.1: Description of other social benefits resulting from garden organizations/organizing (Adapted from Armstrong, 2000:324)

Different programs interact through the garden, so more awareness between groups
Community fought to keep a larger supermarket in the area and won; more development stemmed from this victory
Different programs interact through the garden, so more awareness between groups
Children (in a housing project) see it as an actual piece of land that they have control over; they have pride of ownership
(Program Staff) reached out to residents of a lower income housing project to participate in the garden
Better community cohesion; know everyone on the street now
People know who to call to initiate other efforts besides the garden
Surrounding area is very tough, high crime, garden lead to 'neighborhood watch', residents are very involved in watching out for each other
A new sidewalk was put in on the garden side of the street; trees were put in and landscaping done; stray animals were caught
Neighborhood Association was established
Community babysitting developed
Park and playground were developed

Other social benefits include the development of personal skills with regards to gardening, self-nutrition improvements (Madaleno, 2000:77), creating better living conditions in urban slums by establishing green living space (Smith *et al.*, 1996:10), as well as increasing gender equality which forms an important part of social contribution. Women play a major role in the marketing

of products and in poor communities women undertake UA to supplement household needs (Van Veenhuizen & Dason, 2007:87). In cities like Nairobi and Bissau, most of the commercial farmers are females, with areas such as Lagos seeing a drastic increase in women farmers (FAO, 2012:20).

Urban food supply is dependent largely on distant producers. This increases food vulnerability where distant producers are influenced by "weather and market related supply problems" (Koc *et al.*, 1999:5). As previously discussed, political and economic instability increase UA within urban areas. Ultimately, urban food production is used as a buffer against political and economic shocks where households supplement food supply or income (Van Veenhuizen & Dason, 2007:48).

2.5.3 Environmental advantages of UA

The long-term contribution of integrating UA into the urban fabric ensures environmental advantages and long-term urban sustainability. Environmental advantages and the contribution of UA to the urban system include a decrease in municipal waste, reuse of water, and greening of urban space. Municipal waste rises with an increase in urban population. Decentralised reuse of composted urban waste increases sustainability and links to eco-sanitation (Van Veenhuizen & Dason, 2007:24). This urban output leads to environmental pollution and degradation due to mismanagement and excessive nitrogen accumulation. With the increase in urban populations the amount of waste produced, as well as transportation of the waste, contribute to an increase in cities' ecological footprint (Van Veenhuizen & Dason, 2007:50). Forkes (2007:75) discusses the increase in sustainability with the possibility of reusing urban organic waste accumulated from the food system, as fertilizer. In Belem, solid waste, especially household and business organic waste, is used extensively in UA (Madaleno, 2000:76). "When properly managed, UA can safely process and profitably use municipal wastewater and solid waste" (Smith *et al.*, 1996:8). This creates a closed loop system for nutrients.

In order to integrate UA into the urban fabric for optimal sustainability, multiple resources existing within the urban sphere need to be reused. With regards to the reuse of water existing within the urban sphere, wastewater reclamation and reuse for UA irrigation substitute fresh-water resources within urban areas (Smith *et al.*, 1996:8). Furthermore, wastewater recycling is

used by urban farmers in dry climate areas (Cole, Smith & Nasinyama, 2008:7). Another option is to incorporate man-made wetlands into the urban structure or on the periphery, where the wetlands can serve as wastewater filtration which can be re-used within UA (Verhoeven & Meuleman, 1999:6). However, the treatment of the wastewater needs to ensure that precautions are taken. Cases of untreated wastewater caused outbreaks of cholera in countries like Peru and Chile (Smith *et al.*, 1996:8).

The environmental contribution that UA brings to the urban space includes greening of space. Green spaces increase "humidity, lower temperatures and introduce more pleasant odours to the city; capture dust and gases from polluted air through deposition and capture by the foliage of plants and trees, and soils; and help break wind and intercept solar radiation, creating shadow and protected places" (Deelstra & Girardet, n.d.:48). As is the case with other urban green spaces UA decreases the urban heat island and improve air quality with the increase in vegetation within an area (Taha, 1997:101). Furthermore, UA contributes to local natural resource management through urban greening within areas (Van Veenhuizen & Dason, 2007:23), ultimately leading to an increase in biodiversity on a local level (Koc *et al.*, 1999:5).

Other environmental contributions include a decrease in the carbon footprint of food consumed, and when food is produced in close proximity to the market, there is a reduction in greenhouse gases and pollutants that are connected to long distance transportation and storage (Koc *et al.*, 1999:5). As a result, UA allows for the preservation of biodiversity by limiting the industrialised agriculture industry to expand land surface for food production.

Important variables have been identified on how UA contributes to sustainability within the economic, social and environmental sphere. Although these effects are linked to the size and type of food production, the aim would be to create a holistic framework to incorporate as many of these advantages as possible. Although UA has multiple advantages to the urban space, there is a variety of risks associated with it. Ultimately, the aim is to increase sustainability in the urban sphere, and this will require a framework that increases opportunities and decreases risks. The risks of UA are discussed in Section 3.4.4.

2.5.4 Risks associated with UA

Although the integration of UA allows for multiple advantages to the urban sphere, effective regulations need to be implemented to ensure that the risks associated with the practice are minimised. Many of these health risks are similar to that of rural agriculture however, some are specific to UA practices.

Health risks associated with UA includes possible contamination of crops with pathogenic organisms, residues of agrochemicals, heavy metals, as well as health risk from human diseases. In addition, these diseases can be transferred from domestic animals, as well as unsanitary postharvest processing, marketing and preparation (Briley & Lock, 1998:92-101). De Zeeuw (2000:8) reports on different ways to manage the health risks associated with UA and these include a) identification and characterisation of the related potential of hazards, b) assessing of health risk/impacts (exposure assessment, risk assessment) and lastly, c) planning and implementation of risk mitigation measures.

The environmental impact of UA forms part of the risk associated with the practice causing water, soil and chemical imbalance. Water sources are contaminated if large amounts of fertilizers and pesticides or excessive use of nitrate-rich manure are used (Van Veenhuizen & Dason, 2007:10). Intensive use of agrochemicals and heavy metals over a prolonged period also lead to contamination of underground water sources (Tixier & de Bon, 2006:316). Other possible environmental impacts include soil erosion and nutrient mining (Van Veenhuizen & Dason, 2007:51). These challenges can be prevented by introducing and implementing ecological and agriculture control.

The variety of risks and opportunities related to UA can be linked to the type of UA production system implemented and regulated. This requires policy to have a closer look at what framework they should implement, as well as to transcend these risks to other stakeholders and partnerships through engagement. The type of UA stimulated within an area will be linked to the need of the space.

2.6 Types of enterprises and production size: a closer look

The types of UA found in cities differ and is dependent on the need of the area and is either socially, environmentally or economically driven. To ensure that sustainable development is realised all three spheres needs to be embedded in a holistic perspective. The holistic perspective allows for the complex nature of UA to contribute to sustainability. UA need to ensure the economic (financial) viability is rooted within the social sphere (allowing for a resilient society). Both the economic and social spheres are embedded within the environmental sphere; thus UA need to be implemented in such a manner stimulating the environment and increasing resilience.

Bellows (2004:250) distinguishes between urban gardens (located near or in the town or city), kitchen gardens (adjacent to houses for household consumption), allotment gardens (a collection of garden plots either for households, schoolrooms or other individuals or groups located within the areas), community gardens (collective participation from the community) and urban agriculture (production for self-sufficiency, exchange and sale).

Within a city or urban space there is a variety of UAs located on different types of land. Cities and urban space experiencing an increase in population are facing economic and social issues such as housing shortages. With limited space holistic and innovated solutions are needed to ensure that available open space is redeveloped for optimal sustainability. The land available in or surrounding urban space can be divided into Greenfield or Brownfield sites. Greenfield sites are pieces of urban or peri-urban land, typically agriculture or amenity land that has not seen any development. Usually Greenfield sites are areas where urban sprawl will continue to accommodate housing for the urban population (Murray-White, 2015).

Brownfield sites are surface space that has been previously developed and are potential areas for urban redevelopment. Gray (2015) highlights how this urban land surface has not only been redeveloped for housing purposes, but also for "recreation, conservation, woodland and other community areas".

The next section identifies the different types of urban food production sites, aiming to distinguish between the options available in order to implement the appropriate UA in an area to ensure a sustainable productive urban landscape. The types of gardens will be divided into Micro, Meso and Macro scale production drawn from Pearson, Pearson and Pearson (2010:8).

2.6.1 Micro scale production

Micro-gardening is intensive cultivation for a wide range of "vegetables, roots and tubers, and herbs in small spaces. These micro production areas allow low-income families to meet their needs for vitamins, minerals and plant protein" (Baudoin, 2015).

Micro scale urban food gardens include green roofs, walls, courtyards, backyards and street verges. These gardens are cultivated either for leisure or growing of crops, typically vegetable growing and fruit trees. The FAO (2012:18) conducted a survey in 27 Africa countries, out of these 11 countries' home gardens are the most commonly found and cultivated to meet the households' food needs or provide alternative income. The report indicates how 7500 households located in the inner-city of Dakar cultivate micro-gardens to grow vegetables (FAO, 2012:18).

One interesting micro scale gardening practice in urban areas is radical guerrilla gardening. This urban movement is located on unusual locations where the cultivated land is most often not owned by the gardener. The movement may be practiced for a variety of reasons and these include: beautifying urban space, and providing food produce especially in cities where hunger remains a social challenge (Posthumus, 2013:14). In some cases this type of gardening is practiced by local citizens and used as a political or social propaganda either to advocate the need for a crime free areas or local food production (Stone, 2014). In South Central Los Angeles guerrilla gardening is practiced by individuals like Ron Finley to motivate access to healthier food (Howard, 2014). This gardening practice is seen as a type of special intervention that transforms open degraded space and motivates change with the aim of stimulating awareness. A visual and transformative action such as guerrilla gardening can inspire local change and contribute to motivating resilience.

2.6.2 Meso scale production

Meso scale gardens include community gardens, or as in the case of Cuba, popular gardens (Altieri *et al.*, 1999:133), are made up of individual collective gardens and urban parks (Pearson *et al.*, 2010:8). Urban gardens of this size are typically managed and used by communities or neighbourhoods for recreation, education, income, or as a source of food consumed by households (Iles, 2005:83). The location of Meso scale gardens range from areas found in unused or abandoned urban sites, to areas found on the ground of public buildings.

In the United States, Meso scale gardens are typically referred to as community gardens, divided into plots per household for their own use (Brown & Jameton, 2000:21). A FAO study (FAO, 2012:18) shows how almost half of the locally grown produce for Namibian cities was grown in community gardens. The United Kingdom refers to these types of gardens as allotments, typically cultivated for non-commercial production of food or flowers. Allotment gardens are rented by individuals from municipalities or individuals usually clustered together in groups of small plots. Allotment gardens differ from community gardens in the sense that it is cultivated by an individual or family and not an entire group, as it is the case with community gardens (MacNair, 2002:4). Another form of community gardens can be school gardens located on the school grounds as part of the school curriculum (Brown & Jameton, 2000:21).

Meso scale gardens are productive small spaces for small consumption purposes. The long-term sustainability of these gardens relies on the production and the motivation of these communities or neighbourhoods to continue the practice. However, the urban food security of the entire population cannot increase with a few Meso scale gardens as this requires mass urban food production (Macro scale gardens).

2.6.3 Macro scale production

Macro scale gardens, on the other hand, include commercial farms, nurseries and greenhouses that are generally owned and managed by private and corporate entities (Pearson *et al.*, 2010:8). Macro gardens are large producers that focus mainly on the economic side of sustainable development. Production variation is small and usually specialises in a small variety for a specific client.

Large scale UA, also referred to as market/ industrial gardening, focuses on the production of fruit and vegetables for commercial purposes. Market gardens within areas such as Addis Ababa, Bissau and Libreville, supply around half of the leafy vegetables to the city (FAO, 2012:19). The FAO study however, showcases how market gardens in the Sub-Sahara Africa region are low-tech, labour intensive and mainly driven by market opportunity (FAO, 2012:19). The total production and income generated from this type of market gardens differ within certain areas, allowing for little more than subsistence livelihoods compared to areas where the income is well

above the poverty line. Conversely, in cities like Dakar and Nairobi farmers have recorded to have earned more than five times the per capita income (FAO, 2012:20).

In addition to the abovementioned low-tech urban farming practice, there are a variety of urban food producers that make use of modern technologies to produce food. These include, but are not limited to, Hydroponics and Aquaponics. Hydroponics is used as an alternative to soil-based urban agriculture and makes use of water loaded with nutrients supplied directly to the roots of plants (Somerville, Cohen, Pantanella, Stankus & Lovatelli, 2014:1). The Hydroponic farming method requires close control compared to the lower technical UA such as market gardens (Somerville *et al.*, 2014:1). This system allows for nutrients to be better managed, leading to the manipulation of plants' roots. The outcome is higher qualitative and quantitative production, increased water and fertilizer efficiency, and it is possible to produce food in areas that are not suitable for agriculture (Somerville *et al.*, 2014:2).

Another form of highly technical UA on a Macro scale is Aquaponics. Aquaponics is a system that integrates aquaculture and hydroponics in one production cycle, where the waste of fish is filtered into nutrients for plant production. Once filtered through the plant, the water returns to the fish tank purified, and this creates a closed loop system for nutrients (Somerville *et al.*, 2014:4). Although this system of interlinking hydroponics and aquaculture can be used for urban food production, there are a few challenges. These challenges include a high start-up cost, a high degree of knowledge to manage the system, daily management, a high energy demand and a reliable source of electricity, as well as fish and plant seeds (Somerville *et al.*, 2014:6).

Semi-commercial and commercial aquaponics' success stories differ from those where the commercial venture failed due to profit and initial investment requirements not coinciding to large scale and commercially successful projects in Newburg, New York and Hawaii (Somerville *et al.*, 2014:8). Viljoen and Bohn (2014:73) explain that Hydroponics (agroponics) allows for "improved yields, reduces water consumption and minimised use of insecticide for greenhouse-cultivated crops…making them suitable for space that are unable to support the weight of soil, such as certain rooftops or vertical/hung systems". However, this type of food productions requires highly mechanised and monitoring systems with artificial light and temperature controls.

Other forms of UA include Organoponicos, as found in Cuba. These gardens are located in areas with poor soil quality. In an Organoponicos production the seeds are grown in nurseries later to be transplanted into gardens consisting of containers or raised beds filled with an organic mixture and soil mix. In the case study of Cuba in reaction to food insecurity, enterprises or factory gardens are located in urban spaces near factories or businesses for the workers of these enterprises and motivates self-sufficiency (Altieri *et al.*, 1999:133).

The size and type of UA is greatly influenced by the needs, financial capital, knowledge and availability of resources in the urban area. UA has the ability to increase the urban sphere sustainability on an economic, social and environmental level. However, the type of UA production implemented will determine the level of sustainability. When implementing UA in order to increase sustainability, the threats to the success of urban food productions need to be identified to ensure that efficient plans are put in place to combat these challenges.

2.7 Is UA sustainable?

Implementing UA projects within an urban area either for sustaining livelihoods or mass urban food production poses an alternative solution to the urban food crisis, however, the long-term sustainability of these projects needs to be addressed. The FAO's (2012:20) African study on greening cities indicates the importance of UA, specifically Macro or Meso type gardens for its contribution to food security, nutrition and income. The study highlights how these production types hold potential for further development.

Productive urban landscape correlates with environmental sustainable cities and in order to realise these spaces it requires "new arrangements- institutions, technology, financial mechanism, innovation and flexible urban planning process; and above all, tactic commitments and political will to formulate and implement appropriate strategies and policies to drive environmental sustainability, hence prosperity in cities" (UN-Habitat, 2013:93). The abovementioned required arrangements relates to UA and the obstacles UA face. There are a variety of obstacles that need to be addressed in order to ensure the sustainability of UA systems that are implemented. These include land availability, political and social support, stakeholder engagement, market opportunity and access to finance. These obstacles are elaborated upon below.

2.7.1 Urban resource-related obstacles

Land security for UA remains a challenge, for land is mostly rented or borrowed from the owner and rarely owned by those that cultivate the land (FAO, 1996b:49). Agreements on land use are often informal and based on customary law (Mougeot, 2000:16). UA can also be found on underdeveloped municipal open space where no activity has been practiced. One of the main challenges with regards to allocating urban surface for food production is that it is in contradiction to urban development planning.

Alternative development often takes preference for its economic contribution, and the lack of long-term site tenure threatens the sustainability of active UA projects (Kaufman & Bailkey, 2000:57). One solution to this urban challenge is securing temporary permits or long-term leases and registration of growers and groups (FAO, 2015b). However, in certain areas planners recognise the potential contribution of UA functionality within the city, but there is limited information on policy practices to develop effective policies.

Another challenge to securing a sustainable UA practice in cities is access to water for irrigation purposes. Access to water for UA competes with household needs, especially in areas like Tanzania where the National Urban Water Agency is opposed to UA using water resources (FAO, 1996b:50). In Cuba, the government restricted water usage for irrigation for there was little water available to households during the dry season and the quality of the water was also poor (Altieri *et al.*, 1999:134).

2.7.2 Surface-related obstacles

Similar as in rural agriculture, the physical attributes of land production allows for successful food production. Surface-related issues include the contamination of crops due to chemical imbalance of the soil. These challenges vary between areas, for example, in the case of Brownfield sites there is the possibility of contamination due to previous use such as buildings for housing or factories (Kaufman & Bailkey, 2000:55). Although the cost of remediation may be high, time consuming, and legally complicated, the possible solution of UA to produce above the ground, needs to be considered. Solutions might include options such as roof top gardens, or as in the case of Cuba, Organoponicos making use of containers or raised beds (Altieri *et al.*, 1999:133). It is important to ensure product quality while protecting the environment and this

includes reducing toxic chemicals, as well as pest control and diseases. Furthermore, it is of importance to include the use of organic compost and the safe recycling of wastewater for irrigation (FAO, 2015b).

The protection of people farming the gardens, as well as those surrounding the agricultural location, needs to be considered. Burleigh and Black (2001:16) note how the use of unsafe practices of pesticide through spray may drift and lead to human headache, dizziness, weakness, stomach pain and vomiting. Many of these surface related obstacles can be associated with rural agriculture and not specifically to UA alone.

2.7.3 Policy-related obstacles

From an institutional viewpoint UA requires support from political institutions. Political commitment will establish a long-term acceptance and support needed to ensure the sustainability of UA. The FAO (2015) indicates the need for policy makers to develop UA as part of the national food security strategy and to integrate UA into the urban master plan for its contribution to nutrition and the livelihoods of urban poor.

Kaufman and Bailkey (2000:57) address government-related obstacles within the United States with regards to UA and state that obstacles are typically concentrated on a local level however, the study found that all levels of government show a disinterested in this urban practice. The findings highlights challenges related to policy and practicality as UA is seen as a non-traditional land use. The challenges limits the transferring of unused urban space to agriculture land (Kaufman & Bailkey, 2000:58). Furthermore, there is a general lack of support and understanding on the potential benefits of UA. Particularly there are doubts that UA can serve as a viable economic activity, and "factors such as these lead to a widespread, less-favourable, attitude among city government officials about food production as an appropriate use of potentially valuable land" (Kaufman & Bailkey, 2000:58). From a national government perspective agriculture is viewed as a rural activity that is too small to meet the needs it aims to address (Kaufman & Bailkey, 2000:59). The negative perspective from government leads to a decrease in interest from investors leading to a lack of capital to advance UA.

On the other hand, a study conducted on UA in Accra (Ghana) showcases how officials' attitudes toward UA alter in times of economic and social-political challenges. During these times

officials view UA as a way to "alleviate hardship related to food shortages and unemployment" (Obosu-Mensah, 2002:24). The study highlights the need for government to get more involved in practice and also suggests that the status of urban farmers needs to increase in order to showcase the practice as being viable and prestigious (Obosu-Mensah, 2002:24). It was also found that the socio-political factors contributing to a positive attitude originates from the political sphere, where the involvement of the elites in the UA practice influences the perspectives of the decision makers.

2.7.4 Stakeholder engagement obstacles

The lack of stakeholder engagement in the UA system decreases the credibility of the practice. There are also challenges such as the lack of resources, e.g. water and land, where there is a dearth of stakeholder engagement and where urban farmers have little say. By way of ensuring participation of all stakeholders in UA, the collaboration between entities strengthens the argument for incorporating UA into the urban sphere.

In Boston the collaboration of non-profit organisations is successful in securing garden sites, offering management assistance and promoting UA as a community upliftment tool (Kaufman & Bailkey, 2000:50). Kaufman and Bailkey (2000:50) indicate how partnerships "as in any effective coalition, its political strength is rooted in that of its member organization", thereby highlighting the importance of establishing farmer associations and marketing cooperatives (Van Veenhuizen & Dason, 2007:54). Alternative benefits of associations include training and support on best practices with regards to UA (Van Veenhuizen & Dason, 2007:54).

2.7.5 Market-related Obstacles

The economic viability of UA poses a fundamental challenge with regards to adequate financial resources. There is a lack of external funding with many projects running on limited budgets and finance, as well as community gardens that rely on volunteers and donations (Kaufman & Bailkey, 2000:59). Once again, the size and type of the UA practice determine the level of investment needed and the capital on return in the long run. If a garden is formulated in allotments or communities, the level of investment is low as the return is focused on small production. However, if the type of garden is focused on large production and structured to include an economic aspect, the opportunity for investment increases.

The financial strength of UA determines the sustainability of the practice within an urban environment. Currently, limited credit and investment opportunities pose as major obstacles to secure UA as a sustainable urban practice. In Nairobi national planning regulations exclude UA as a formal urban land-use practice mainly due to unsecure landholding (Mireri, 2002:19). Mireri's (2002:19) study within Nairobi shows the lack of support provided by government influences the opportunity for securing finances in the form of loans from banks and other financial institutions. Although the government does not classify UA as a formal practice, funding opportunities are provided by agriculture orientated companies and agro-industries to urban farmers.

Other obstacles may include the lack of adequate qualified staff to run the project and small enterprises with specialised knowledge and experience where urban growers are typically low-paid. This challenge related to the lack of adequate time to get the project or enterprise financially stable (Kaufman & Bailkey, 2000:60).

Kaufman and Bailkey (2000:61) identified the size of the project or enterprise as an important variable that limits investment and funding. Most of the projects conducted within the United States are small-scale and thereby limit the opportunity of entrepreneurial viability. Several challenges have been identified to the viability of UA as a business, namely the lack of a sound business plan, high start-up costs and not keeping to the projects or business objectives over time (Kaufman & Bailkey, 2000:62).

Due to the variety of challenges, it is important to look at high production options to make UA more attractive. The desired outcome will be highly productive urban landscapes within the sustainable development framework. With regards to the financial/economic challenges, production needs to increase to make UA financially viable and one way to achieve this is through an increase in technology utilisation as well as increasing knowledge of the UA workforce. The social aspect of sustainable development may be addressed by incorporating low-skilled labour either directly associated with the production or indirectly regarding the transportation or processing of the products. The benefits of increasing knowledge of the low skilled labour may prove to increase the effectiveness of the projects and enterprises. Lastly, the direct environmental contribution will be through the reuse of resources such as water and waste. Reusing of water and waste can increase the competitive advantage as well as leading to a

decrease in costs. When looking at high technological production, the capital investment needed will have to extend to generating alternative energy and water to keep the cost low over the long-term. This will further increase the contribution to environment sustainability. Although highly productive, increasing the use of technology in UA requires high initial investment to ensure the surface space is sufficient and production.

2.8 UA as a tool for urban sustainability

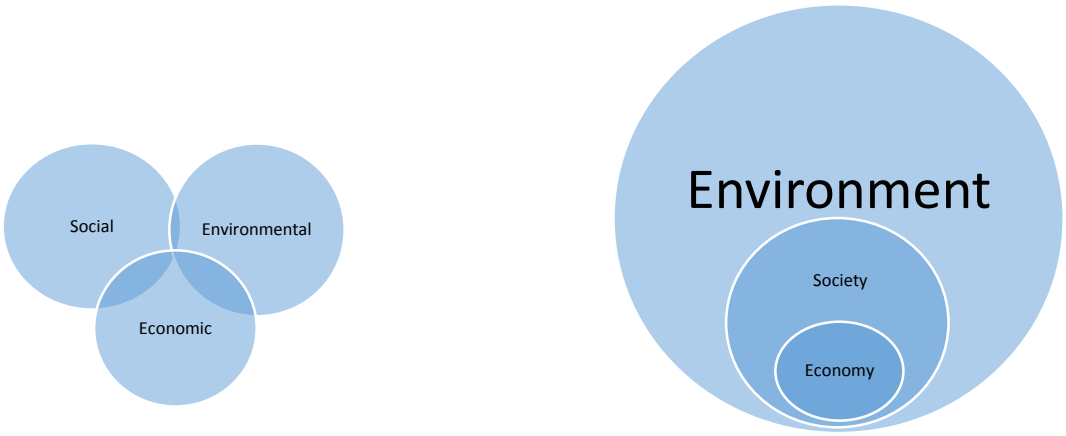
2.8.1 Contextualising Sustainable Development

Sustainability development is defined by the World Commission on Environment and Development (WCED) as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (WCED, 1987:41). The WCED report highlights two key components within the definition, namely 1) 'needs': the need of the people and particularly the needs of the poor and 2) the limitation to degradation of the environment to meet the needs of the present and the future generations (WCED, 1987:41). Although the definition of sustainable development has evolved over time, the definition discussed above still highlights the core function of living within the Earth's carrying capacity.

Development needs to incorporate the aforementioned definition in order to ensure that the human race continues to evolve within the ecosystem's capacity. Swilling and Annecke (2012:49) provide insight into the meaning of sustainable development and shed light on the importance of the triple bottom line approach rooted in ecological modernisation. The triple bottom line is an interlocking circle between the economic, social and environmental sphere. Although the approach may be subject to a trade-off between the different spheres, Swilling and Annecke (2012:49) offer the complexity system perspective as an alternative to view the three spheres as being dependent on each other and state that "a complex system perspective offers an alternative that depicts these spheres as embedded within each other. Following the logic of institutional economics, the economy is embedded within the social-cultural system, and following ecological economics, both are embedded within the wider system of eco-system services and natural resources".

The sustainability theory developed from the triple bottom line (where trade-offs are made between the three spheres) to a complex perspective (where the three spheres are embedded and

dependent on each other) allowing for a holistic perspective in developing an UA system. As shown in Figure 2.3 the interlocking circle module motivates for a trade-off between the three spheres whereas the concentric circle module ensures that the spheres are interdependent representing a complex system.



Interlocking circle module Concentric circle module

Figure 2.3: Sustainability theory: Interlocking circle module VS. Concentric circle module (Adapted from Swilling and Annecke, 2012:49)

Complexity theory is relevant to this study because of the complex nature of food security, urban populations increase and urban systems. Applying the complexity understanding, UA can be used as a tool to build resilience and contribute to true sustainability. Swilling and Annecke (2012:12) describe the development of complexity theory and elaborate on the theory, as derived from Cillers's (1998) work, in the following manner: "a complex system consists of diverse elements where the interactions between the parts are structured in a complex manner". In other words, interactions between the parts – which help transfer energy or information – take a non-linear form and the interaction between the parts cannot be predicted with certainty. Complex systems have an open structure – i.e., they receive information or energy from the external environment – and also have feedback loops which operate concurrently. Complex systems are capable of having memory and their nature is determined by the interaction between their different elements. Furthermore, complex systems are capable of adapting to any changes in the environment by reorganising itself as required.

But how do we achieve sustainable development in this complex dynamic and what is to be used as our vision, guideline or basis? Fletcher (2008:233) contributes to sustainable development by identifying 11 Rs of sustainability which can be used as practical concepts toward achieving the sustainable developments goal. The 11 Rs of sustainability contribute to achieving a sustainable urban space and it can be adopted to function as a guide to multiple programmes/policy. The original three Rs include Reduce, Reuse and Recycle, and derived from this Fletcher draws on Middelton's (1998) 10 Rs and concludes that there is an additional R (Responsibility) that needs to be added in order to ensure that the necessary steps toward sustainability are taken when moving towards a productive urban space. The 11 Rs of sustainability is listed below and is applied specifically to UA:

Reduce dependency on external food sources that increase urban vulnerability and food insecurity

Reuse space and resources available in the urban space

Recycle water, waste and any other resource found within the urban space

Recognise opportunities of UA and potential markets

Refuse infrastructure that does not incorporate sustainable development as well as policy that does not apply a holistic understanding of a complex system

Replace ineffective urban space to create productive urban space

Re-engineer the urban environment to incorporate UA, this may include infrastructure and other

Retrain policy makers, urban designers on the options of UA and how to apply a holistic solution perspective to urban challenges

Reward organizations and companies that contribute to the sustainable development reality with regards to urban food production

Re-educate population and local government on UA and effective urban design

Responsibility towards the environment, poor and future generations

The term sustainable development relates to UA on multiple levels. The advantages of UA identified multiple contributions to the urban environment on an economic, social or environmental sphere. These advantages can translate into the contribution UA has to sustainable development which includes 1) meeting food needs, 2) recycling of urban waste, 3) contributing to energy and wood demands with urban forests, 4) improving living conditions of urban areas, as well as the urban slums, and 5) better management of urban land (Smith *et al.*, 1996:7).

Although some of the Rs overlap with each other, they provide a guideline for action when considering the diverse urban reality and the food insecurity the urban environments face. The options for UA to serve as a tool for urban sustainable development are multidimensional and thus need to be identified as a pathway for achieving sustainable development in the long-term. UA takes into account the economic, social and environmental aspect of sustainable development and can contribute to realise the aims of living within the Earth's carrying capacity by creating a productive urban environment.

2.9 Conclusion

The motivation for this thesis was to look for possible alternatives to conventional food systems based on the lack of food security within urban areas. Food security and the link to malnutrition in the urban space identified the invisible urban challenge in Southern Africa. The need to address the food insecurity among poor and vulnerable households and communities required alternative solutions. This chapter advocated for UA as a possible tool to combat the increasing challenges within the urban space based on existing literature. UA allows for urban areas to be transformed into productive environmentally sustainable urban landscapes, but in order to fully comprehend the totality and multi-dimensions of this urban phenomenon, a variety of key concepts are identified.

These key concepts include different types of production, locations and types of areas, market and product destinations, types of enterprises and production sizes, different producers, types of economic activities, links to social and ecological spheres, ownership of land and the process of learnings through social-ecological memory. These concepts change and develop with the advancement of UA and is seen as being highly dynamic. For the purpose of this study, a

definition of UA did not suffice, thus it is important to identify all aspects of UA to ensure a holistic understanding.

Once the key concepts of UA were discussed, the importance of urban food production was highlighted. Similarities were found between current urban challenges and periods in history where UA provided a solution to related challenges. The reasoning for this is to advocate for UA to become a permanent practice within towns and cities drawn from learnings in the past. The section 'The Rise of UA' identifies a variety of ancient cities that co-developed with UA. The type of development was formulated in accordance to the needs and available resources within the surrounding locations. By way of identifying UA initiatives it is important to note the contribution of UA to sustainable development and resilience.

Drawing from the urban population increase during the industrialised era, UA is once more integrated within the urban space as a food relief to the urban poor due to limited resources and malnutrition. Challenges faced during the industrialised period are similar in many ways to developing countries' current challenges and provides alternative motivation to formalise UA. In the last part of this section, the study looks at the political and economic instability that cities face. This links up to the current underlining threat of relying on food supply systems within urban areas. In each one of these cases the formal food supply system collapsed, forcing urban dwellers and the urban poor to look at UA as a source of food and nutrition. The motivation for incorporating this section into the literature review is to showcase the sensitivity and underlying risk UA poses if it does not incorporate a productive UA plan that ensure long-term sustainability of the urban sphere.

In order to ensure a comprehensive understanding of UA, this chapter identified advantages and potential risks related to UA. The literature review continues by distinguishing between different types of UA practiced. The major difference that needs to be highlighted is the size and format of production ultimately structured by the need and opportunities for a food production site. Furthermore, low- and high technological use between different types of gardens have also been discussed.

This chapter concluded by questioning if this urban practice can become sustainable over the long-term, as well as how UA contributed to sustainability. The obstacles are related to

challenges that are seen as drawbacks for the development and integration of UA. These obstacles include urban resources (land and water accessibility), surface related issues (possible contamination of the environment and humans), policy obstacles (for the legalization of UA), stakeholder engagement (to ensure strong human support) and lastly, market related obstacles (for financing of UA enterprises). Finally, the framework for sustainable development was set, as well as how UA relates to achieving goals. The question on how UA can contribute to sustainable development was answered by applying the 11 Rs of sustainability. These Rs served as a guideline or a mission statement to ensure that sustainable development was realised.

This chapter aimed to set the scene for the following chapters by way of discussing the potential of UA as a viable solution to food insecurity within the urban space. This chapter presented a holistic understanding of the multi-dimensions of UA, followed by indicating the need for UA to be recognised as a formal practice in urban design. Based on the advantages of UA, challenges in developing nations can be applied and with that identify which type of UA will suit the urban space. Lastly, the obstacles allow for the possibility of sustainability to be addressed, and this last part is consequently important for the chapter that addresses the food insecurity levels of Stellenbosch.

Chapter 3: Strategic Policy Direction for UA

3.1 Introduction

Policy is a driver of change. Transformation is rooted in government and its capacity to drive change. In order to propose UA as a tool for contributing to sustainable development, Stellenbosch local government needs to structure their policy framework. This chapter investigates aspects of food security and sustainability within the policy, agenda and guidelines and connect these variables to UA. Furthermore, this chapter expresses how local planning fails to focus on the critical issues, such as food security, in a sustainable manner.

Aspects of food security are found within international and national agenda. On a local level, policy and planning need to provide a certain structure to ensure food security and sustainability of human settlements. Food security is mentioned in the IDP's health sector issues however, there are no guidelines to support the development or implementation of effective plans at local addressing challenges such as food insecurity and malnutrition (Stellenbosch Municipality, 2012a:39). Although international and national planning and policy provide guidelines for food security, planning on a local level needs to interpret the complexity of the urban food system and plan accordingly. The goal of this chapter is to motivate for UA local policy as an opportunity for growth in food security and sustainability.

The international and national policy, agenda and planning used for analysis in this study include the Millennium Development Goals (MDGs), 2030 Sustainable Development Goals (SDGs), Agenda 21, The South African Constitution, the Medium-Term Strategic Framework (MTSF), National Developmental Plan (NDP), the National Framework for Sustainable Development (NFSD) and the Integrated Food Security Strategy (IFSS) of South Africa. On a local level, the IDP provides guidance for planning by the municipality.

Ultimately, the aim of this thesis is to inform and assist government to develop a local food policy and to use UA as a tool within Stellenbosch. Making use of UA as a tool for sustainability will be motivated by linking the benefits of UA to the list of goals and agendas stipulated within this document. UA contributes to all three spheres of sustainability and thus this chapter motivates local government to create appropriate policy to incorporate UA into the town structure.

Strategic planning and resource allocation of Stellenbosch Municipality (SM) is guided by policy directives formulated from a global, national, provincial and regional scale (Stellenbosch Municipality, 2012a:34-36). On a global level, South Africa forms part of the UN which in pursuit of food security hosts multiple conferences "to address issues of world importance and reach agreement for decisive action" (Shaw, 2007:275). The global agenda formulates the basis for action and policy, and guides national policy and programmes. The agenda set on the international and national level need to translate to the local needs. Some of these specific guidelines will be discussed in the next section and will provide the basis for arguing why local government needs to provide a supportive structured environment for UA projects in Stellenbosch. Incorporating UA into Stellenbosch as a tool for sustainable development relies on government as the main driver for structural change. The structural change set by government will guide other stakeholder in taking appropriate action to increase sustainability and food security.

Combating food insecurity and providing urban resilience do not occur within one single space of development. There are various key policy directives that need to be considered when formulating a UA policy and incorporating UA into the urban sphere. The section below outlines key policy directives when formulating the Stellenbosch UA and food security policy.

3.2 International Framework: Food Security and Urban Sustainability

3.2.1 Millennium Developmental Goals and Sustainable Development Goals

The global developmental policy direction for Stellenbosch is derived from the MDGs. The MDGs were set by the UN Millennium Summit of 2000 that was attended by 189 countries (Stellenbosch Municipality, 2012a:34). The South African NFSD indicates how the MDGs provide the goals and targets set on the global platform directing and influencing the national goals (Republic of South Africa, 2008:25). The MDGs consists of eight goals (United Nations, 2015a:4-8):

1- Eradicate extreme poverty and hunger
2- Achieve universal primary education
3- Promote gender equality and empower women
4- Reduce child mortality

5- Improve maternal health
6- Combat HIV/AIDS, malaria and other diseases
7- Ensure environmental sustainability
8- Develop a global partnership for development

The MDGs' are important, because they address a broad spectrum of challenges. Greig, Hulme and Turner (2007:132) discuss the reason for the MDGs' importance, indicating that "never before had the world community accepted such accountability, measurability and responsibility for global development". The uniqueness of the MDGs lies in the UN setting specific and measurable targets.

The MDGs provides a collaboration between two worlds for the success of the MDGs relies on a partnership between poor and rich countries. "The rich countries are committed to provide aid, regenerate debt relief and abolish discriminatory trade restrictions while the poor countries need to provide the appropriate policy context for development (including good governance, sound economic decision making, transparency, accountability, rule of law, respect for human rights and civil liberties and local participation" (Greig *et al.*, 2007:132). Although a variety of challenges are associated with achieving the MDGs, the aim is to strive to realise them.

3.2.1.1 Applicability of UA within the Millennium Development Goals

Van Veenhuizen and Dason (2007:24) identify how urban and peri-urban agriculture (UPA) contributes to the MDGs from a sustainability perspective by differentiating between the three pillars of sustainable development (Figure 3.1). The different UPAs are classified by Van Veenhuizen and Dason (2007:24) as subsistence, commercial and multifunctional (this study does not differentiate between urban and peri-urban agriculture and refers only to UA). Subsistence UA contributes to sustainability on a social level to achieve MDG 1 by addressing poverty alleviation, food security and nutrition, community building and HIV-AIDS mitigation social safety net. Food security is intrinsically linked to hunger as discussed in the literature review. Although van Veenhuizen and Dason (2007:24) only link MDG 1 to UA, indirectly UA contributes to MDG 3 and MDG 5 on a social level as well. UA contributes to MDG 3 by addressing employment opportunities for women and by creating gender equality. Lastly, on a

social level, UA allows fresh produce to be available to poor households, thereby increasing nutrition that leads to better maternal health which in turn contributes to MDG 5.

Although, Van Veenhuizen and Dason description refers to the interlocked circle module of sustainability (instead of the embedded concentric circle module), UA contributions to the three spheres embedded and dependent on each other.

Commercial UA addresses MDG 1 and relates to the MDGs target 1 for it generates income, provides employment, and stimulates enterprise development and marketing. On an ecological level, UA contributes to MDG 7 as well as targets 9-11 for it provides urban greening, improves microclimate, reduces ecological footprint, provides parks and landscape management, contributes to biodiversity, provides the opportunity for environmental education and serves as space for recreation (Van Veenhuizen & Dason, 2007:24). Based on the contributions to the urban space, UA creates an inclusive, productive and environmental healthy city.

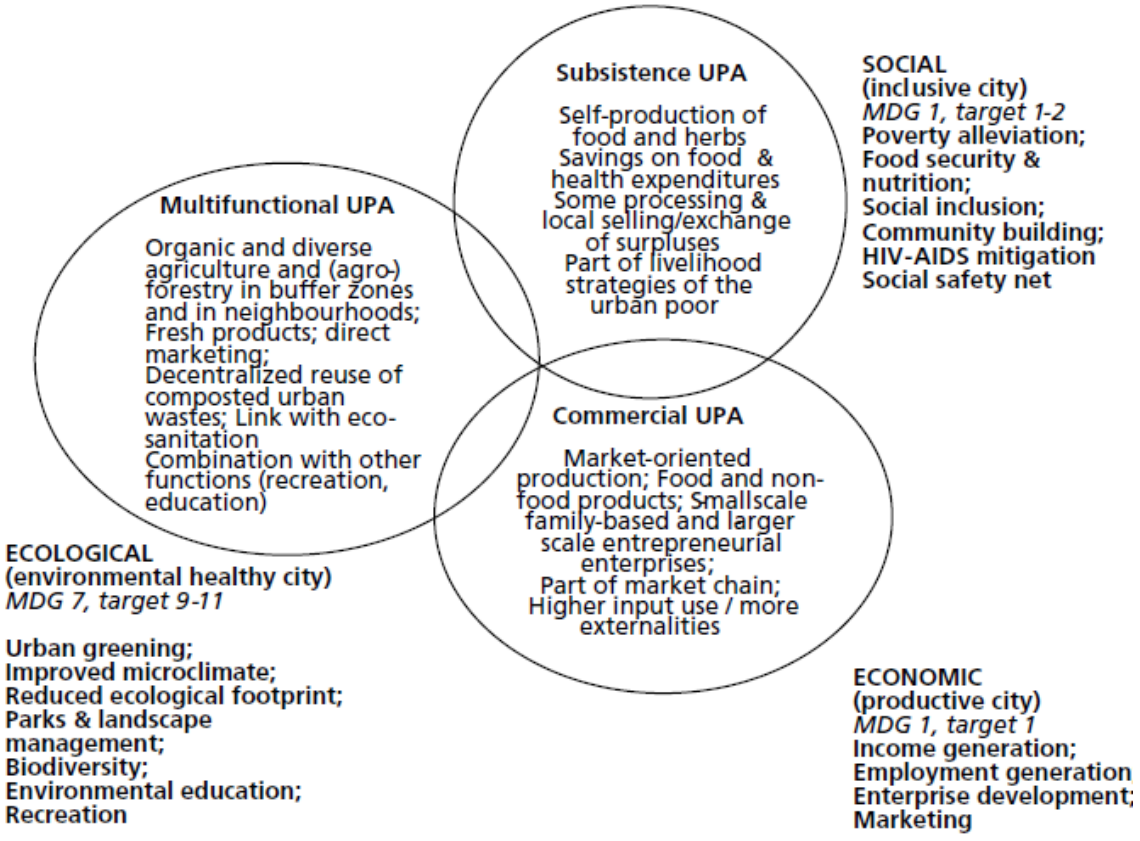


Figure 3.1: MDG and UA

(Adapted from Van Veenhuizen & Dason, 2007:24)

Evaluation of the success of the MDGs are analysed in the UNs *Millennium Development Goals Report 2015*. The report indicates how hunger has been significantly reduced however, there are multiple obstacles slowing the process to ensure true sustainability is achieved (United Nations, 2015a:20). The obstacles contributing to reducing hunger includes the economic recessions in the 1990s and 2007-8, volatility of commodity prices, natural disasters, higher food and energy prices and unemployment (United Nations, 2015a:20; FAO, 2015a:9). The obstacles identified by the UN and FAO need to be included in the follow-up on the MDGs' planning and frameworks that are structured to assists nationalities to combat food insecurity.

Based on the MDGs the 2015 UN Summit produced the *2030 Agenda for Sustainable Development* with 17 specific goals (United Nations, 2015b:16-28). The Stellenbosch policy direction will have to include the SDGs within the revision of its focus areas. The SDGs consist of the following 17 goals (United Nations, 2015b:16-28):

1- End poverty in all its forms everywhere
2- End hunger, achieve food security and improve nutrition and promote sustainable agriculture
3- Ensure healthy lives and promote well-being for all at all ages
4- Ensure inclusive and equitable quality of education and promote lifelong learning opportunities for all
5- Achieve gender equality and empower women and girls
6- Ensure availability of sustainable management of water and sanitation
7- Ensure access to affordable, reliable, sustainable and modern energy for all
8- Promote sustained, inclusive and sustainable economic growth, gull of productive employment and decent work for all
9- Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation
10- Reduce inequality within and among countries
11- Make cities and human settlements inclusive, safe, resilient and sustainable
12- Ensure sustainable consumption and production patterns
13- Target urgent action to combat climate change and its impacts

14- Conserve and sustainably use the oceans, seas and marine resources for sustainable development
15- Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reserve land degradation and halt biodiversity loss
16- Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels
17- Strengthen the means of implementation and revitalize the Global Partnership for Sustainable Development

The SDGs builds on the MDGs and continues to provide an accountable, measurable and responsible platform for the next 15 years. The SDGs reaffirms the international commitment to ensure a sustainable future is realised. The updated version is more diverse, holistic and incorporates the complexities of sustainable development.

3.2.1.1 Applicability of UA within the 2030 Sustainable Development Goals

The next section identifies how UA contributes to the SDGs and the benefits that are derived from implementing UA into the urban sphere. The applicability of the SDGs will be based on the subsistence, commercial and multifunctional type UA as categorised by Veenhuizen and Dason (2007:24).

Subsistence type UA contributes towards the SDG 1 by addressing poverty on a social level. Subsistence UA contributes to zero hunger and increases food security and nutrition by promoting sustainable agriculture linked to SDG 2 (United Nations, 2015b:17). The 3rd SDG focus on increasing good health and well-being and applies to subsistence UA through increasing health of communities and households who are actively involved in the gardens (United Nations, 2015b:18). Furthermore, subsistence UA contributes to SDG 5 due to an increase in gender equality and opportunities for women (United Nations, 2015b:20). Job opportunities and economic growth are stimulated by subsistence UA speaking to SDG 8 as well as reduces inequality and creates sustainable cities and communities linked to SDG 10 and SDG 11 (United Nations, 2015b:21-24).

On a commercial level UA contributes to SDG 1 by generating income and employment; SDG 8 creating work and economic growth; SDG 9 providing a platform to stimulate industry, innovation and infrastructure. UA supports SDG 11 for it motivates companies to contribute to sustainable cities and communities, SDG 12 stimulates responsible consumption and production, and lastly, SDG 17 by providing a platform for better partnerships to achieve the SDG goals (United Nations, 2015b:17-28).

On an ecological level, multifunctional UA contributes to SDG 6 by providing clean water and sanitation (reusing water within the urban structure and recycling urban waste); SDG 7 generating energy though clean technology; and SDG 11 participating sustainable cities. Lastly, multifunctional UA contributes to SDG 13 by promoting climate actions through greener cities and SDG 15 by protecting ecosystems on land through alternative agricultural solutions (United Nations, 2015b:20-27).

UA is a tool to increase sustainability on all three spheres of sustainability to ensure that the SDGs goals are achieved. The ideal sustainable UA framework exists where the three circles join in a concentric manner (Figure 3.1). Achieving sustainability with UA as a tool requires policy to ensure the complex nature of the system is embedded within each other instead of addressing the sustainability spheres independently allowing for a trade-off between the separate spheres. The SDGs provides the framework to structure UA in a complex holistic manner.

3.2.2 Agenda 21

The UN Conference on Environment and Development, hosted in Rio de Janeiro in 1992, produced an agreement on principals and actions to achieve environmental sustainable development (Shaw, 2007:286). The conference produced a global action plan to achieve sustainable development and yielded the Agenda 21: Programme of Action for Sustainable Development (Shaw, 2007:288). The document serves as a blue-print for policy and implementation in order to address global issues and has become the basis for action and implementation. On a local level, SM's IDP does not refer to Agenda 21. However, for the purpose of this study, Agenda 21 is included for its importance and contribution to programme focus and framework setting.

The linkage between food security and the urban sphere can be found within Agenda 21. There are two focus areas highlighted in this study for its applicability to UA, namely Chapter 3 (Combating poverty) and Chapter 7 (Promoting sustainable human settlement development). Combating poverty was identified for its links to food insecurity and UA, whereas promoting sustainable human settlements was identified for it speaks to urban programmes. Each chapter's programmes are listed followed by a description on how UA contributes to Agenda 21. Ultimately, the government needs to promote food security and food self-sufficiency within a sustainable agriculture context (United Nations Sustainable Development, 1992:16).

3.2.2.1 Combating Poverty

Poverty is an urban challenge and Agenda 21 recognises the multidimensional aspect and complexity of poverty. Chapter 3 of Agenda 21 identifies programme areas to combat poverty. Section 3.4 of Agenda 21 states that "the long-term objective of enabling all people to achieve sustainable livelihoods should provide an integrating factor that allows policies to address issues of development, sustainable resource management and poverty eradication simultaneously" (United Nations Sustainable Development, 1992:14). The programme areas are identified to connect the framework with that of UA. The programmes for combating poverty in Section 3.5 are as follow (United Nations Sustainable Development, 1992:15):

a. Focus on the empowerment of local and community groups through the principle of delegating authority, accountability and resources to the most appropriate level to ensure that the programme will be geographically and ecologically specific;

b. Contain immediate measures to enable those groups to alleviate poverty and to develop sustainability;

c. Contain a long-term strategy aimed at establishing the best possible conditions for sustainable local, regional and national development that would eliminate poverty and reduce the inequalities between various population groups. It should assist the most disadvantaged groups - in particular, women, children and youth within those groups - and refugees. The groups will include poor smallholders, pastoralists, artisans, fishing communities, landless people, indigenous communities, migrants and the urban informal sector.

3.2.2.2 Applicability of UA within Agenda 21

Combating poverty links to the fundamentals of UA on a social level. As Van Veenhuizen and Dason (2007:24) indicate, subsistence type UA is directly linked to combating poverty. The literature review identifies the influence UA has to strengthen the poor and how it is applicable to the programmes of Agenda 21. Chapter 3 of Agenda 21 lists programmes on how to address poverty, and how these programmes apply to the social pillar of sustainability and its applicability to subsistence UA. The environmental and economic benefits will be realised as an indirect benefit derived from subsistence UA.

UA contributes to all three programme areas of Combating Poverty. UA empowers communities, provide immediate measures and eliminate poverty through providing income, job opportunities, food security, community building, human capacity development, as well as gender equality. Furthermore, on a social level, UA allows for the re-education of the population creating opportunities for business and skills development. The contribution that UA provides to policy development is by retraining policy makers on holistic solutions with multiple objectives and it allows for the focus on responsibility towards the environment and the poor. Section 3.2 of Agenda 21 can be used to highlight the long-term contribution needed to combat and eradicate poverty.

Within this study, UA is proposed as a tool to address these challenges. Section 3.2 of Agenda 21 states that “a specific anti-poverty strategy is therefore one of the basic conditions for ensuring sustainable development. An effective strategy for tackling the problems of poverty, development and the environment simultaneously should begin by focusing on resources, production and people” (United Nations Sustainable Development, 1992:14). UA focuses on resources, production, and people, and the programme areas in Chapter 3 need to be used as an objective guideline for structuring local policy and programmes.

3.2.2.3 Promoting sustainable human settlement development

Regarding the urban growth and issues related to urban challenges, Section 7.4 of Agenda 21 states that “the overall human settlement objective is to improve the social, economic and environmental quality of human settlements and the living and working environments of all people, in particular the urban and rural poor. Such improvement should be based on technical

cooperation activities, partnerships among the public, private and community sectors and participation in the decision-making process by community groups and special interest groups" (United Nations Sustainable Development, 1992:45).

Furthermore, the program's eight areas are set aside to promote sustainable human settlement development in Section 7.5 of Agenda 21 (United Nations Sustainable Development, 1992:45). The programme areas for Human Settlement within Agenda 21 include (United Nations Sustainable Development, 1992:45-46):

a. Providing adequate shelter for all

b. Improving human settlement management

c. Promoting sustainable land-use planning and management

d. Promoting the integrated provision of environmental infrastructure: water, sanitation, drainage and solid-waste management

e. Promoting sustainable energy and transport systems in human settlements

f. Promoting human settlement planning and management in disaster-prone areas

g. Promoting sustainable construction industry activities

h. Promoting human resource development and capacity-building for human settlement development

The above programme areas address urban challenges and specifically motivate sustainable development. Furthermore, Agenda 21 provides guidelines on how to accomplish these goals by ensuring that plans, objectives and priorities are structured to improve urban management with the assistance of non-governments and representatives of local authority (United Nations Sustainable Development, 1992:48). Within Agenda 21, Section 7.19, the importance of transitioning from a rural to an urban population and identifying the promotion of economic activity through food production, is highlighted (United Nations Sustainable Development, 1992:49). The food production reference remains mainly within rural communities however,

effective UA will contribute to these opportunities when implemented within an urban sphere as well.

3.2.2.4 Applicability of UA within Agenda 21

Linking the urban space, food security and sustainable development, Agenda 21 provides a framework for change in policy and guides government initiatives. Emphasis needs to be placed on programmes that achieve multiple objectives based on international frameworks and guidelines. Identifying the areas of focus in Section 7.5 of Chapter 7 for programmes on Human Settlement, UA contributes to Agenda 21's aims as follow:

a) UA contributes to sustainable development on an environmental level to focus areas, b) Improving human settlement management, c) Promoting sustainable land-use planning and management, d) Promoting the integrated provision of the environmental infrastructure: water, sanitation, drainage and solid-waste management. The environmental contribution that UA provides includes the greening of urban area, the improvement of microclimate, reducing ecological footprint, parks and landscape management and an increase in biodiversity. Incorporating the environmental benefits of UA into Agenda 21 programmes will allow for reducing dependency on external food sources, reusing space and resources available within the urban space, as well as recycling water, waste and any other resource found within the urban space.

From a sustainability perspective the focus areas of the programmes within Agenda 21, the Human Settlement section in Chapter 7, and the economic and social contribution of UA applies to the programme by e) Promoting sustainable energy and transport systems in human settlements, f) Promoting human settlement planning and management in disaster-prone areas (although this ca be applied to other human settlements), g) Promoting sustainable construction industry activities, as well as h) Promoting human resource development and capacity-building for human settlement development.

The contribution UA provides in achieving Agenda 21 on an economic level is by way of promoting a sustainable industry by re-engineering infrastructure and refusing infrastructure that do not incorporate sustainable developments holistic perspectives. Furthermore, UA is able to contribute to the economy through industry development and capacity building by recognising

opportunities for potential markets, rewarding organisations and companies that add to sustainable development with regards to food production. Lastly, UA as a tool holds the potential for transforming single minded space into multifunctional space in a holistic sustainable manner. A multifunctional space may deliver on the social level, UA addresses challenges within human settlements by increasing food security, creating jobs and addressing poverty, as well as providing a green healthy environment for the citizens.

The Rio UN Summit allowed for environmental sustainable development to formulate policy. The aim is to guide government and include aspects of issues such as food security within the national framework (Shaw, 2007:291). The focus must be to find a balance between human beings and the natural environment, and the action must start with government.

At the follow-up to the Sustainability Summit, the Johannesburg 2002 Summit highlighted the importance of partnership to the private sector that was included. Kofi Annan addressed the assembly and highlighted the importance of the MDGs and indicated the importance of a responsible society that includes partnerships and allows for effective implementation (Shaw, 2007:292). Agenda 21 provides the programme and guidelines for addressing issues related to urban challenges, as well as food security. This document forms part of the framework for policy and programmes and serves as a blueprint for how government needs to address issues related to urban challenges, specifically addressing food security and urban poverty for a sustainable reality.

3.2.3 The Future We Want

The UN Rio+20 conference on sustainable development, which took place in Rio de Janeiro, Brazil in 2012, identified the steps that need to be taken to achieve a sustainable future. The conference report "The Future We Want", reaffirmed food security and nutrition as “the right of everyone to have access to safe, sufficient and nutritious food, consistent with the right to adequate food and the fundamental right of everyone to be free from hunger. We acknowledge that food security and nutrition has become a pressing global challenge and, in this regard, we further reaffirm our commitment to enhancing food security and access to adequate, safe and nutritious food for present and future generations” (United Nations, 2012:19).

The aforementioned report does not link food security to the urban sphere, and continues to focus on rural agricultural development. The Sustainable Cities and Human Settlement Section identifies aspects of integration that can be linked to the outcomes of UA. The assembly identifies the opportunity of a holistic approach to urban planning and management, to promote sustainability (United Nations, 2012:23-24):

> "We commit to promote an integrated approach to planning and building sustainable cities and urban settlements, including through supporting local authorities, increasing public awareness and enhancing participation of urban residents, including the poor, in decision making. We also commit to promote sustainable development policies that support inclusive housing and social services; a safe and healthy living environment for all, particularly children, youth, women, the elderly and disabled; affordable and sustainable transport and energy; promotion, protection and restoration of safe and green urban spaces; safe and clean drinking water and sanitation; healthy air quality; generation of decent jobs; and improved urban planning and slum upgrading. We further support sustainable management of waste through the application of the 3 Rs (reduce, reuse and recycle). We underline the importance of considering disaster risk reduction, resilience and climate risks in urban planning. We recognize the efforts of cities to balance development with rural regions."

UA encompasses the ability to play an important role in ensuring that these goals are met. The ecological footprint of cities by far incorporates the boundaries of the urban sphere and UA can contribute to the sustainability of urban space. Identifying the international focus of food security and human settlement within the three documents discussed, informs the importance of global policy and governance in providing the framework for change.

The MDGs and SDGs provides the international framework for the local SM to structure the IDP. By analysing the applicability and possibility of UA to contribute to the MDGs and the SDGs for UA incorporates multiple objectives. Agenda 21 provides a blueprint for policy and programmes to adjust the focus areas. Furthermore, the applicability of UA links to the human settlement section and poverty and allows for sustainability's complex system where one aspect is dependent on the others functionality. Lastly, from an international perspective, "The Future We Want" reaffirms the importance of food security and sustainable human settlements.

Although the linkage between UA, food security and sustainable human settlements are not made in these documents, the underlying philosophy of addressing global challenges interlinks to the opportunities derived from UA.

3.3 National Developmental Goals

3.3.1 The South Africa Constitution

The South African Constitution serves as the basis for all laws, legislation and rights of citizens within the country. The Bill of Rights within the Constitution forms the cornerstone of democracy within the country and applies to all organs of state (Republic of South Africa, 1996:1245). Two sections within the Constitution apply specifically to UA and provide the basis within governance to motivate for UA programmes. Food security and the natural environment are listed in Sections 27 and 24 of the Constitution.

Food security and health is listed within the Constitution in Section 27. The Constitution states the every person has the right to have access to healthcare, food and water that will suffice. The right to food requires the South African government to take measures to ensure food security for the people. Koch's (2011:11) analysis on the South African food security status explains that the right to food translates to the government's obligation to take pro-active action to strengthen people's access to resources thus enable them to feed themselves. Reasonable legislation and measurements need to allow for resource allocation to realise the rights (Republic of South Africa, 1996:1255). Local government need to act on the right for South African citizens to have access to food. Social security needs to be provided to those that are unable to support themselves and provision needs to be made to their dependants. Within South Africa social security is provided to poor households in the form of grants, providing poor households with a basic income (Republic of South Africa, 2002:25). Irrespective of the provision of grants, the level of food insecurity among poor households remains a challenge.

Progress of development cannot be made on a dysfunctional ecology, for this reason a sustainable environment is important. Section 24 of the Bill of Rights stipulates the importance of the environment to South Africans' well-being. The Constitution states in Section 24 that every person has the right to an environment that is not harmful to their health or well-being, thus the environment needs to be protected for current and future generations. Legislation needs

to ensure measurements are in place to prevent pollution and ecological degradation. The legislation must also promote conservation and ensure environmental sustainable development. Natural resources need to be used in a sustainable manner and its use must be justified for economic and social development (Republic of South Africa, 1996:1251-1252).

3.3.1.1 Applicability of UA within the Constitution

UA contributes to food security and increases households' consumption of healthy goods. Ultimately, better food consumption may lead to better health of the community. Production of food through UA increases household consumption and contributes to nutrition levels. The produce that is not consumed by the family may be sold and provides alternative income to the household. When a local municipality implements legislation and measurements to allocate financial, intellectual resources and urban space, it will directly contribute to Section 27 of the constitution.

The environmental contributions of UA apply to the Constitution's Bill of Rights. UA allows for the reduction, reuse and recycling of waste and water. The reduction in waste decreases harmful substances that are dumped back into the environment leading to a decrease in pollution and ecological degradation. The greening of urban space through UA increases the micro climate of the area and produces cleaner air for the surrounding communities. Lastly, UA allows for the reuse of resources currently within and urban system such as water and organic waste. The reuse of resources decreases the environmental footprint and contributes to sustainable development.

3.3.2 National Strategic Outcome

The SM identifies a variety of national policies and planning that guides and formulate local strategy. The third generation IDP of Stellenbosch outlines national policy directives that are considered in shaping the framework for the municipality's IDP. The two key policy directives on a national level include the National strategic outcome and the National Planning commission.

SM makes use of the MTSF policy priorities to be incorporated into the IDP (Stellenbosch Municipality, 2012a:34). The MTSF identifies 14 priorities as identified by the government's electoral mandate (Medium-Term Strategic Framework 2014-2019, 2014:15). By listing the

priorities it is possible to identify how applicable UA is to the national plans and its connection to the international agenda. The priorities for the period 2014-2019 include (Medium-Term Strategic Framework 2014-2019, 2014:16):

1- Quality basic education
2- A long and healthy life for all South Africans
3- All people in South Africa are and feel safe
4- Decent employment through inclusive growth
5- A skilled and capable workforce to support an inclusive growth path
6- An efficient competitive and responsive economic infrastructure network
7- Vibrant, equitable, sustainable rural communities contributing towards food security
8- Sustainable human settlements and improved quality of household life
9- Responsive, accountable, effective and efficient local government
10- Protect and enhance our environmental assets and natural resources
11- Create a better South Africa and contribute to a better Africa and a better world
12- An efficient, effective and development-orientated public service
13- A comprehensive, responsive and sustainable social protection system
14- A diverse, socially cohesive society with a common national identity

The priorities set out by the national government provide the framework and serve as a guideline to local policy and programmes. From a food security and urban environment perspective not all of the priorities apply. However, UA does contribute to the social, economic and environmental aspects of the MTSF.

3.3.2.1 Applicability of UA within the MTSF

On a social level, UA addresses priorities 2, 7, 8, 10, 11, 12 and 13. UA allows for food security and a healthy society by increasing the nutrition of households, addressing poverty and allowing for social inclusion. UA contributes to sustainable human settlement through beatification, greening of space, better microclimate, as well as landscape and park management. Furthermore, the social protection aspect providing better opportunities for the poor allows for an increase in sustainable development. Contributing to a better South Africa and a better world is to address

key challenges as stipulated by the MDGs, SDGs and Agenda 21 programmes. Priority 12 focuses on increasing efficiency and effectiveness of public services and UA can increase public service by reducing, reusing and recycling waste, water and other resources found in the urban setting.

When including the 11 Rs of sustainability, the environmental contribution of UA is applied as well. Priority 10 focuses on the environmental assets and natural resources to be protected where UA contributes to these aspects similar as in the contribution to MDGs 7. The economic contribution of UA can be applied to priorities 4, 5 and 6. From an economic standpoint the economic stimulation is aimed at a national level, whereas UA stimulates the local economy. Although UA applies to the local economy, the generation of opportunities increase in skill and stimulation occurs on a local level.

3.3.3 National Developmental Plan 2030

The National Developmental Plan (NDP) shapes South Africa's long term perspective for addressing poverty, decreasing inequality and creating an inclusive economy to realise a sustainable future. The National Planning Commission provided a comprehensive framework for the country's long term aims up until 2030. Furthermore, the NDP indicates the role different sectors need to play in order to achieve the NDPs objectives (Republic of South Africa, 2012:27). The objectives and actions for the NDP includes the following (Republic of South Africa, 2012:63):

1- Economy and employment
2- Economic infrastructure
3- Environmental sustainable and resilience
4- Inclusive rural economy
5- South Africa in the region and the world
6- Transforming human settlements
7- Improving education, training and innovation
8- Health care for all
9- Social protection
10- Building safer communities

11- Building a capable and developmental state

12- Fighting corruption

13- Nation building and social cohesion

3.3.3.1 Applicability of National Development Plan 2013

The sustainable development perspective of an embedded social, economic and environmental reality requires planning to take into account the complex nature and reality of the urban space. UA has the ability to contribute to the aims and goals listed in the NDP. On a social level UA provides job opportunities leading to an increase in income of households (NDP 1); UA provides educational opportunities through training programmes and health oriented education (NDP 7 and NDP 8). UA adds to inclusive planning for the poor and other income groups through redeveloping unused space, addressing basic needs, providing communities or households with the opportunity to strengthen themselves and build their ability to produce food contributing to resilience (NDP 6, NDP 10 and NDP 11).

On an economic level UA contributes to NDP 1 by stimulating the economy and creating job opportunities. UA also provides an opportunity for the 2nd NDP's long term objectives by increasing economic infrastructure, decreasing the water demand in urban areas and increasing available water for agriculture creating an inclusive environment.

On an environmental sustainable and resilient (NDP 3) level UA contributes to the aim for zero emissions buildings. For rooftop gardens provides isolation, reduce waste disposal through recycling of organic waste, increase renewable energy usage, and improves preparation for extreme weather and climate events such as drought and floods that influence the production capacity of rural agriculture. Lastly, UA provides the opportunity for increase new agricultural technologies.

3.3.4 National Framework for Sustainable Development

The South African government produced a NFSD in 2008 derived from the World Summit on Sustainable Development held in Johannesburg in 2002 (Republic of South Africa, 2008:3). The framework aims to address global issues of sustainability and in doing so align South Africa's development to realise and achieve sustainability. The framework's strategic focus "is based on

an analysis of the social, economic, natural resource and governance trends, and aligned with the existing policy and institutional context to identify the key actions required" (Republic of South Africa, 2008:32).

The NFSD's (Republic of South Africa, 2008:33) focus areas are as follow:

1- Enhancing systems for integrated planning and implementation
2- Sustaining our ecosystems and using natural resources sustainably
3- Investing in sustainable economic development and infrastructure
4- Creating sustainable human settlements
5- Responding appropriately to emerging human development, economic and environmental challenges

The five strategic focus areas allow for the national guideline to incorporate sustainable development into the local framework. The influence from global guidelines is clearly found within the national framework. MDG 7 provides the basis for economic growth and sustainability of the environment and forms the basis for the NFSD. UA's contribution can be found within all five goals of the NFSD.

3.3.4.1 Applicability of UA within the NFSD

The social benefits of UA are linked to Focus Area 4 where human settlement sustainability is increased by producing food, addressing human settlement poverty amongst others as highlighted in Section 2.3.2. On a social level, the increase in integrated planning and management of Focus Area 1 is incorporated within UA benefits that allow the municipality to incorporate policy with a holistic objective.

Focus Areas 3 and 5 allow for economic development to be addressed through effective UA systems. Economic development and infrastructure, as well as human development, can be enhanced through UA. The local economic stimulation, job opportunities, income generation and creating a productive urban space, are stimulated through UA. Lastly, the environmental contribution of UA to increase sustainability, addresses Focus Area 2. Resources are reused and the pressure on the environment is decreased by providing a productive urban environment.

3.3.5 Integrated Food Security Strategy of South Africa

The IFSS is a multidimensional strategy focused mainly on rural food insecurity on a household level. Koch describes the IFSS as "an innovative blend of mechanisms with clear programmes, coordinating units and multi-sectoral fora to stimulate and support programmes that would engage creatively with food insecurity" (Koch, 2011: 4). The IFSS relates to international food security challenges and sets the national framework for food related issues. The IFSS defines food security as having "physical, social and economic access to sufficient, safe and nutritious food by all South African at all times to meet their dietary and food preferences for an active and healthy life" (Republic of South Africa, 2002:15).

The IFSS also relates to the Bill of rights highlighting the right to food. "Although the IFSS does not refer specifically to the right to food, South Africa adopted a rights based approach to food security in 1996, which is entrenched in its constitution. The food security framework expresses a paradigm shift that recognises that agricultural production and food security at the national level are not the only considerations, but that a more complex range of circumstances may contribute to food insecurity, such as the failure of livelihoods to guarantee access to sufficient food. The country recognises the importance of enabling people to feed themselves, but where this is not possible it aims to ensure that strategies, plans and programmes are in place to address food insecurity. South Africa's rights based approach is linked to poverty alleviation programmes and the empowerment of disadvantaged groups, and provides recourses in the event that a claimant's right to food, as ensured by the Bill of Rights, is violated" (Koch, 2011: 15).

South Africa faces a variety of challenges contributing to food insecurity relating to vulnerable households. Firstly, inadequate safety nets remain a challenge on a household level. Income of poor households in South Africa is low and these households "depended on migrant remittances and social security grants" (Republic of South Africa, 2002:25). Although discussing the urban challenges food production is mainly focused in rural areas. The IFSS focus on rural food insecurity and indicate that rural households do not have the production capacity to fulfil their household's needs and rely on non-farm income. The IFSS identifies rural population as the most vulnerable relying on income sent to them from urban areas. At a national level there is a lack of economic inclusion of the poor leading to food insecure households. Stimulating the economy

will minimise household's dependency on governmental assistance and social safety nets which should only apply as a 'last resort' (Republic of South Africa, 2002:25).

Secondly, South Africa has a weak institutional support network and disaster management systems. Policy makers require information with regards to food risk and vulnerability per area in order to implement relevant policies and programmes (Republic of South Africa, 2002:25). More specifically South Africa lacks an efficient information system to deal with disasters triggering food insecurity such as droughts and floods (Republic of South Africa, 2002:26).

Thirdly, South Africa has inadequate and unstable levels of household food production. "Hunger and malnutrition in South Africa stem from insufficient, unstable food supplies, at the household or intra-household level" (Republic of South Africa, 2002:26). Lastly, the IFSS noted that poor households do not have enough purchasing power to ensure a nutritional diet leading to chronic malnutrition especially with children under the age of 6 (Republic of South Africa, 2002:26).

The priority areas identified within the IFSS includes (Republic of South Africa, 2002:28-32):

1. Increase household food production, trade and distribution
2. Increase income and job opportunities
3. Improve nutritional status
4. Enhance institutional support networks

The IFSS identified food vulnerable communities within rural areas and focus to increase food availability, accessibility, reliability and distribution to these communities. Irrespective of the rural poor population food security status the urban environment presents similar food insecurity challenges. The IFSS priority areas can be adapted to the urban environment when implementing UA into the urban sphere.

The IFSS provides the institutional arrangement and process structure for addressing food security issues. The National Food Security Forum is assigned to provide the strategic leadership and advisory service for food security and these standards will provide recommendations for policy options (Republic of South Africa, 2002:26). However, on a district and local level the District Food Security Committees are responsible for identifying food insecure areas as well as

recommended projects for funding. These Committees will monitor and evaluate projects and their effect on food security (Republic of South Africa, 2002:36).

Information is needed to implement new strategy on food security. The action plan provides guidelines on the collection of information to ensure that data is available to influence the food security strategy. Action Plans for implementation (Republic of South Africa, 2002:38-39):

- Design priority programmes
- Set key performance indicators
- Set service delivery standards
- Pass food security legislation
- Design management and administrative structures
- Design information and communication systems
- Design monitoring and evaluation systems
- Formulate the disaster management plan
- Formulate public private partnership framework
- Secure human and financial resource requirements
- Obtain approval for priority programmes
- Obtain approval for the plan of action
- Appoint the national steering committee

3.3.5.1 Applicability of UA within the IFSS

The primary objective of the IFSS is to overcome food insecurity of rural households by increasing the household's participation in the agricultural sector (Republic of South Africa, 2002:28). The aim of the IFSS is to decrease poverty and nutrition related challenges. UA provides the opportunity to address similar social challenges in the urban sphere. UA provides diversified job opportunities, commercialise agriculture opportunities to increase income and employment, improve infrastructure as well as provide social development and empowerment for the poor (Republic of South Africa, 2002:30). UA relates to a variety of social aims identified in the IFSS by enhancing education, improving household food security and nutrition training and equip individuals with skills to integrate (Republic of South Africa, 2002:31). UA provide the

opportunity of improving access to credit for the poor who are involved in the production, trade or distribution of UA.

On an economic level UA contributes to the priorities set out by IFSS by increasing production, trade and distribution of food. Once institutional support networks are provided UA can improve trade through liberalised trade groups, reduce producer's tax, improve infrastructure and invest in food distributions (Republic of South Africa, 2002:30). The IFSS indicate the need for improving monitoring methods to support multisector partnerships well as the need to increase resources, technology, training and credit (Republic of South Africa, 2002:28). These aspects can be applied to UA and enhance the economic opportunities within the urban sphere for there is an increase in productivity and environmentally sustainable technologies, better access to food technologies for production and processing, and improved knowledge and access to information.

The IFSS aims to create an environment where the poor and vulnerable can become part of the economic mainstream. Strengthen public goods (infrastructure, information, research and technologies), cost effective recovery for services provided by the private sector, data management, mapping techniques and information safety nets (Republic of South Africa, 2002:32). Furthermore, the IFSS aims to create a labour intensive and diversified agricultural sector. UA contributes to the possible policy interventions that is proposed in the IFSS through diversified job opportunities on a local level and for small to medium scale enterprises, support labour intensive agriculture, strengthen access to credit, strengthen market systems (information and infrastructure), and support skills training (Republic of South Africa, 2002:30).

The environmental applicability to IFSS and UA includes better technology decreasing water usage and promotes alternative use of water through irrigation of technologies and rainwater harnessing (Republic of South Africa, 2002:29). The IFSS is socially focused and the contribution to the environment is as an outcome of good management and environmentally sustainable and productive agricultural practices.

The IFSS focus on the rural food insecurity while the vulnerable urban possibilities are left invisible to planning. The section on food insecurity within the literature review motivates to plan and implement policies and programmes that benefits the urban vulnerable. UA provides the opportunity for implementing the priority areas listed in the IFSS.

The identification within the IFSS that new projects and funding focus should originate on a local level, provides the ideal location for effectively piloting of a project that aims at address food insecurity. Data collected in a UA project can inform and motivate for a variety of project to be implemented and tested.

3.4 Golden thread for International and National Policy Directions

The SM's IDP was used to guide the search for applicable international and national policy guidelines. Although the IDP makes use of more than the abovementioned policies and frameworks; for the purpose of this study, these where identified as applicable and sufficient to motivate for UA as a tool for achieving sustainable development, enhancing food security and addressing poverty and human settlement challenges, as well as enhancing urban resilience.

Some of the goals, objectives and programmes can be linked to multiple spheres of sustainability. UA allows for multiple benefits that incorporates a complex system and concentric module of sustainability. Goals such as achieving sustainable human settlement are linked to social contribution of UA. However, achieving sustainable human settlement applies to the environment for it decreases dependency on external resources and it decreases waste, leading to a lower carbon footprint. Another multidimensional goal for instance is eradicating poverty and hunger applied to the economic as well as the social aspect of UA. The economic benefits of eradicating poverty and hunger spills over to the social challenges for UA allows for a decrease in poverty, an increase in nutrition and an increase in human capacity development.

Table 3.1 illustrates how this research study applied the three spheres of UA applicability to sustainable development. The international and national guidelines were aligned to one of the three tiers of UA. The numbers in brackets indicate the order in which the goals are presented within the ambit of this thesis.

Table 3.1: UA Applicability to International and National Development documents

UA Sustainable Development	MDGs	SDGs	Agenda 21	South African Constitution	National Strategic Outcome	National Developmental Plan	National Framework for Sustainable Development	Integrated Food Security Strategy
Ecological: Urban greening, improved microclimate, reduce ecological footprint, parks & landscape management, biodiversity, environmental education, recreation, reduce waste, reuse water	Ensure environmnetal sustainability (7)	Ensure availability of sustainable management of water and sanitation (6)	Improving human settlement management (7.5.b)	Environment (Section 24)	Protecting and enhance our environmental assets and natural resources (10)	Environmental sustainable and resilience (3)	Sustaining our ecosystem and using natural resources sustainabilty (2)	
		Ensure access to affordable, reliable, sustainable and modern energy for all (7)	Promoting sustainable land-use planning and management (7.5.c)					
		Make cities and human settlements inclusive, safe, resilient and sustainable (11)						
		Target urgent action to combat climate change and its impacts (13)	Promoting the integrated provision of the environmental infrastructure: water, sanitation, drainage and solid-waste management (7.5.d)					
		Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reserve land degradation and halt biodiversity loss (15)						
Social: Poverty alleviation, food security and nutrition, social inclusion, community building, human capacity development, gender equality, resilience	Eradicate extreme poverty and hunger (1)	End poverty in all its forms everywhere (1)	Focus on the empowerment of local and community groups through the principle of delegating authority, accountability and resources to the most appropriate levels to ensure that the programme will be geographically and ecologically specific (3.5.a)	Health care, food, water and social security (Section 27)	A long and healthy life for all South Africans (2)	Economy and employment (1)	Enhancing systems for integrated planning and implementation (1)	Increase household food production, trade and distribution. (1)
		End hunger, achieve food security and improve nutrition and promote sustainable agriculture (2)			Vibrant, equitable, sustainable rural communities contributing towards food security (7)	Transforming human settlements (6)		
	Promote gender equality and empower women (3)	Ensure healthy lives and promote well-being for all at all ages (3)				Improving education, training and innovation (7)		
		Achieve gender equality and empower women and girls (5)			Sustainable human settlement and improved quality of household life (8)	Health care for all (8)	Creating sustainable human settlements (4)	Increase income and job opportunities (2)
		Promote sustained, inclusive and sustainable economic growth, gull of productive employment and decent work for all (8)	Contain immediate measures to enable those groups to alleviate poverty and to develop sustainability (3.5.b)			Building safer communities (10)		
	Improve maternal health (5)	Reduce inequality within and among countries (10)	Contain a long-term strategy aimed at establishing the best possible conditions for sustainable local, regional and national development that would eliminate poverty and reduce the inequalities between various population groups (3.5.c)		Create a better South Africa and contribute to a better Africa and better world (11)	Building a capable and developmental state (11)		Improve nutritional status (3)
		Make cities and human settlements inclusive, safe, resilient and sustainable (11)						
Economic: Income generation, employment generation, enterprise development, marketing, productive use of space, production, distribution and trade	Eradicate extreme poverty and hunger (1)	End poverty in all its forms everywhere (1)	Promoting sustainable construction industry activities (7.5.g)		Decent employment through inclusive growth (4)	Economy and employment (1)	Investing in sustainable economic development and infrastructure (3)	Enhance institutional support networks (4)
		Promote sustained, inclusive and sustainable economic growth, gull of productive employment and decent work for all (8)						
		Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation (9)	Promoting human resource development and capacity-building for human settlement development (7.5.h)		A skilled and capable workforce to support and inclusive growth path (5)		Responding appropriately to emerging human development, economic and environmental challenges (5)	
		Make cities and human settlements inclusive, safe, resilient and sustainable (11)				Economic infrastructure (2)		
		Ensure sustainable consumption and production patterns (12)			An effective competitive and responsible economic infrastructure network (6)			
		Strengthen the means of implementation and revitalize the Global Partnership for Sustainable Development (17)						

3.5 Local Strategic Planning: Stellenbosch Integrated Development Plan

The international and national goals to achieving sustainability need to be aligned with local policies and planning. Identified in the IFSS the District Food Security Committees are responsible for identifying food insecure areas as well as recommended projects for funding. These Committees will monitor and evaluate projects and their effect on food security (Republic of South Africa, 2002:36). Although the District Food Security Communities are responsible for recommending, monitoring and evaluating projects the aim is to identify challenges on a local level to stimulate change. One key document that was identified that will allow for planning on a local level is the IDP of Stellenbosch.

The IDP is a five-year management tool used to guide planning at local government level (Stellenbosch Municipality, 2012a:4). The IDP allows municipalities to allocate resources and guides "municipal budgets, land management, promotion of local economic development and institutional transformation" (Stellenbosch Municipality, 2012a:5). The IDP is chosen for this study for it guides development and addresses structural issues of local importance. Furthermore, the IDP provides the opportunity to guide multiple stakeholders such as the private sector, NGOs and other agencies in the development of the municipality (Stellenbosch Municipality, 2012a:5).

The broad strategic goals and focus areas of the SM are divided into nine categories (Stellenbosch Municipality, 2012a:9):

1- A leader in governance, partnership and civic participation
2- A skilled and customer-focused administration
3- Sound and sustainable municipal financials
4- A treasured, protected environment
5- Responsible development management
6- Opportunity for enterprise, creativity and business development
7- Dignified living
8- Efficient infrastructure and services
9- A safe town

The first three categories focus on the administrational goals, whereas the rest is focused on the services provided to the community. Poverty and food security are not explicitly stated within the goals however, the alignment of the strategic goals to the MDGs' National Strategic Outcome is identified within the IDP. Goals 4, 6 and 7 are aligned with MDG 1, focused on eradicating poverty and extreme hunger (Stellenbosch Municipality, 2012a:123-124). Although there is a focus on these social issues, there is still a lack of clear guidance on how to address poverty and food security within the IDP.

3.5.1 Applicability of UA within the IDP:

UA relates to multiple goals set by the municipality. One key challenge for the municipality is to ensure protection of the natural environment. The SM identifies its shortfall with regards to protecting the environment and states that they do not have the environmental management capacity to uphold environmental protection, for instance lack in capacity for air and water pollution management. However, advancements have been made in river cleaning and urban greening (Stellenbosch Municipality, 2012a:88). UA advantages discussed in the literature review chapter will increase Stellenbosch's green space, opportunity for water recycling, microclimate and better quality air, as well as an increase in biodiversity.

The responsible spatial and development management goal allows UA to contribute to the social and economic spheres of sustainable development. Spatial direction for development allows for guidance of investment in specific areas. When looking to implement a subsistence type UA, challenges such as poverty and malnutrition will be identified, contributing to the social sphere of sustainability. Furthermore, health and nutrition increases access to fresh produce contributing to dignified living of lower income communities.

Implementing commercial type UA into the framework of Stellenbosch has multiple benefits. Commercial UA increases job opportunities and stimulates the local economy. The opportunity for new enterprise development is furthermore found within a commercial type UA system. Both the subsistence and commercial UA contribute to SM's focus on efficient land use management. The focus of efficient and green buildings can be linked to UA for it allows for a multifunctional society and an increase in human settlement sustainability. UA addresses infrastructure

challenges by providing opportunities for waste and water recycling. The alternative methods of delivering services increase the capacity of green infrastructure.

3.6 Structural Change: Local policy environment

Policy is a driver for change. Now that the applicable policy and agendas have been identified and their linkage to UA have been established, the environment for UA needs to be set within local policy. It is important to create a policy environment that favours UA to ensure the development of sustainable UA (Van Veenhuizen & Dason, 2007:54).

The reasons why government needs to provide this framework for structural change will be explored in the next section.

3.6.1 Good Governance

Effective governance is the key for growth that refers to the government's ability to do things in an effective manner (Weaver *et al.*, 1997:85). Weaver *et al.* (1997:85) identify the role of government as:

> "It chooses, implements, and enforces policies that are embodied in a system of laws and regulations. It produces routine regulatory actions. It issues licenses and permits; allocates access to government resources and subsidies; monitors compliance of companies, non-governmental organisations (NGOs), and individuals; and intervenes to stop activities that do not meet regulatory standards. It either produces public goods and services itself - such as roads, schools and clinics - or contracts for these goods and services. Then it distributes access to governmental goods and services among citizenry according to its own criteria of need and program eligibility."

The obstacles of sustainable UA were discussed in Section 2.7, and based on these obstacles policy and local municipality are identified as the driver for structural change. The role of government applies to all obstacles associated with ensuring a sustainable UA system.

Firstly, resource-related obstacles limit the capacity of UA to become sustainable. Government's role relates to resources with regards to space, water and administration (in the form of permits). Based international and nation policy aims addressing poverty, hunger, nutrition and food

security holistic solutions needs to be incorporated on a local-governmental level. Thus this study motivates local government-owned land to be allocated to individuals or entities focused on implementing projects that are holistically focused and address the three spheres of sustainability such as UA projects. The type of lease or renting structure needs to be formulised and must be a long-term structure to ensure incentives for UA. UA practiced within the urban space needs to be formally recognised as a viable urban food production industry in order to attract the relevant support. Furthermore, local government needs to provide permits to UA entities within the city and establish a regulatory system. Lastly, UA must be granted access to resources such as water. Irrespective of the water limitations in urban areas, local government needs to motivate or supply recycling of water for UA use or the catchment of water on site.

The second obstacle to ensure sustainable UA is surface-related, specifically to contamination of crops. Government's role with regards to this obstacle applies to implementing regulatory measurements to ensure that crops are not contaminated. This will result in compliance of companies, NGOs and individuals to regulations to ensure that crops that are supplied to the market fulfil health related standards. Incentives and subsidies need to be put in place to motivate UA to use organic pesticide and compost for production quality and protection of the environment, as well as people involved in the production. Brownfield sites must also have monitoring and evaluation protocols to ensure that contamination is eliminated, managed or minimised

Policy needs to provide a framework for programmes and guidance to stimulate the UA industry on a micro and meso scale. Policy-related obstacles can be addressed through local government by producing a food security strategy and by incorporating UA into the urban master plan or the Spatial Development Framework (SDF). The long-term sustainability of UA projects depends on the incorporation of UA within the urban master plan, which will guide development and enterprise development. Local government needs to allocate resources within its capacity to assist and stimulate UA.

Stakeholder engagement is identified as the fourth obstacle for sustainable UA. Local government needs to foster a favourable environment for stakeholder engagement and support, or it needs to provide management assistance. This is currently a prerequisite of local government, however, this environment need to provide stimulus and guidance to increase

connections as identified with the private sector (to provide funding) and the public intellectual sector (to provide research and knowledge). The IDP of Stellenbosch indicates how the municipality consulted with various stakeholders and hosted a variety of public participation meetings to formulate the IDP (Stellenbosch Municipality, 2012a:13). This indicates that the municipality has the capacity to be the driver for change and provide an efficient platform for stakeholder engagement. Government needs to provide a platform for collaboration between public stakeholders with investment aimed at fostering a public private partnership.

The last obstacle focuses on the limitation to realise UA due to funding and credit opportunities. These market-related obstacles need to be addressed by government for they are able to provide funding or subsidies. Furthermore, local government can subsidise cost by providing goods and services to the UA sector to support and ensure success of the industry.

3.6.2 Policy Environment for UA

A question that needs answering is: What does the policy environment look like? MacRae's (1999:182) research on food policy in Canada provides a guideline on what a food policy needs to incorporate and states that "a comprehensive food policy has optimal nourishment of the population as its highest purpose, makes agricultural production and distribution a servant of that purpose, and ensures that the food system is financially and environmentally sustainable". This perspective is one that needs to be adopted within any policy framework that focuses on addressing poverty and food security. MacRae (1999:187) continues to identify aspects of a sustainable and comprehensive food policy. Although this study is applied to the Canadian framework, it is still relevant and provides a structure for any food policy. According to MacRae (1999:187-188), an effective food policy will ensure that:

1- Everyone has enough food (quality and quantity) to be healthy
2- Food production, processing, and consumption are suited to the environmental, economic, technological, and cultural needs, potentials, and limits of the various regions (in Canada)
3- The food system is seen as providing an essential service, food supply and quality are dependable, and it is not threatened by social, political, economic, or environmental changes

4- Food is safe for those who produce, work with, and eat it, and it's safe for the environment
5- Resources (energy, water, soil, genetic resources, forests, fish, wildlife) are used efficiently (in an ecological sense) and without waste
6- The resources of the food system are distributed in a way that ensures that those who perform the most essential tasks have a decent income (in particular, people in rural communities should have enough work and income to maintain or improve their lives and to care for the rural environment)
7- The system is flexible enough to allow people to improve and adapt it to changing conditions
8- Everyone who wants to be involved in determining how the food system works has a chance to participate
9- Opportunities are available in the food system for creative and fulfilling work and social interaction
10- The food system allows other countries to develop food systems that express similar values

MacRae (1999:187) provides the guidelines for food policy in general, as well as the needs that should be applied to UA. Ellis and Sumberg (1998:219) identify two types of categories for UA policy, firstly those that apply to the municipal planning framework, and secondly the sectoral agricultural policy. The municipal planning framework type policy focuses on land access with regards to zoning and access to tenure. This type of policy will consider by-laws regarding land use, prohibit land eviction, provide guidance for areas where the municipality prefer certain crops or animal husbandry, identify public land that can be converted, allocating land as the city or town expands, providing a legal framework for protection of farmers on private land, and lastly, encourage NGO activities in certain urban areas (Ellis & Sumberg, 1998:220). The sectoral agricultural policy refers to the inputs and outputs of the farming system. More specifically, UA sectoral policies are focused on providing credit, advancing research, extensions, new seed development, increasing yield and stimulating marketing (Ellis & Sumberg, 1998:220).

SM aims to focus on relevant issues and provides the structure for decision making (Stellenbosch Municipality, 2012a:78). The municipality indicates in the strategy that it wants to ensure that the different functional areas have the capacity to deliver services in the short, medium and long-term (Stellenbosch Municipality, 2012a:82). Based on the contribution UA makes to address aspects of the international and national policy agenda, the local government needs to incorporate a food policy, programme or framework to foster UA and to ensure that the advantages to the urban sphere are realised.

3.6.3 Policy Failures

There is no food and poverty policy, programme or agenda for the town of Stellenbosch or the greater municipality. Chapter 5 will identify just how sensitive the food structure of Stellenbosch is and the current levels of poverty and food insecurity.

The current IDP as a planning document for Stellenbosch does not provide clear guidance on how the issues of food security will be addressed and refers to land transfers and vegetable gardens as a solution (Stellenbosch Municipality, 2014:70). This is vague with no measurable or specific targets. The MDGs and the SDGs provides a framework for how accountability and action-driven change need to look. The SM needs to adopt this perspective in order to address challenges faced within the area.

The MDGs and the SDGs agreements requires developing countries' governments to provide appropriate policy environments that include good governance, sound economic decision making and accountability. The SM applies aspect of these requirements however, it does not address the critical issues of food security, healthcare, nutrition and poverty in such a manner that provide guidelines to lead to the implementation of programmes.

Agenda 21 provides the blue-print for policy and programmes to be implemented. Poverty reduction can be realised through assigning resources, implementing measures and providing long-term strategies. The IDP needs to focus on providing guidance for structural changes and should aim to implement programmes with multiple objectives. The global agenda emphasises food security, nutrition and sustainable human settlement and thus needs to be integrated into the local SM goals.

3.7 Conclusion

A variety of important international and national policies, agendas and planning were used to identify the challenges that need to be addressed on a global scale. The applicable documents were analysed to identify food insecurity, poverty, sustainable human settlement and nutrition as key points within the international and national arena that need to be translated to local policy planning and agenda.

Food security continues to form part of the international agenda as a key focus area. The linkage within these documents addresses agriculture and urban challenges separately. The idea of food production located in rural locations away from cities, needs to transform in order to incorporate the possibilities that UA has to offer in contributing to urban sustainability. Although UA will never provide total food supply, its contribution to sustainability needs to be included into local frameworks for development. Irrespective of whether the linkages are not made in the international agendas, the national and local policy framework can produce multifunctional programmes that address both urban sustainability and food production.

This chapter strived to motivate for a UA policy and programmes that needs to be implemented on a local level. Furthermore, the contribution UA has to offer to realise sustainability and address challenges, have also been identified. The complexity perspective needs to be incorporated into a planning document that aims to achieve a true sustainability on all three spheres. This requires local government to think holistically and multi-objectively.

Chapter 4: Research Methodology and Design

4.1 Introduction

This chapter presents the methodological perspective and research process that has been applied to answer the research questions. Firstly, the underlying philosophy of the research is identified as an interpretive research approach. The explanatory and exploratory nature of the research allows for the identification of the research purpose and the importance of identifying solutions related to urban food insecurity.

4.2 Underlying Philosophy

The philosophical perspective of a study guides the research and structures how assumptions are made about the knowledge and how it can be obtained. There are three categories of epistemologies: positivism, critical and interpretivism.

Positivism is a research philosophy where the researched aims to gain knowledge through an objective method of enquiry. Applying positivism assumes that the properties can be measured usually to test a theory and include research experiments and surveys to collect data (Welman *et al.*, 2005:6).

Critical theory guides the research by assuming that the social reality is formed by people and reproduced. Critical theory assumes that although people can change they are influenced by their social, cultural and political domain. Thus the focus of critical research philosophy is based on opposition, conflict and contradiction within society (Orlikowski & Baroudi 1991:19).

Interpretivist research attempts to understand phenomena through the meaning people give them. Interpretive research focus on the full complexity and the interaction between variables making a situation emerge. For the purpose of this research and interpretive research method was chosen.

Interpretative research was chosen as the appropriate method for this research since human complexities were studies so as to try and understand how they think, deal and approach urban food insecurity (Orlikowski & Baroudi 1991:4-5).

4.3 Research Purpose

The purpose of this research is both explanatory and exploratory. An exploratory study is useful when little information is available about the phenomenon being studies (Welman *et al.*, 2005:14). This study is exploratory since the area of UA and food security are well research but the context in which this research took place is unique and limited research has been done on the contribution and possibility of UA within Stellenbosch. A limited amount of research has been done to explore alternative schools of thought and their application to the current solutions provided within the Stellenbosch UA context. Secondly this research was explanatory as the findings where further explored and a comparison was made with more literature sources as the research progressed

4.4 Research Approach

Two main research approaches in the social sciences includes qualitative and quantitative research. Quantitative research generated numerical data or information whereas qualitative research generated non-numerical data. Qualitative is a research method that makes use of unstructured observations, interviews and open-ended questionnaires.

Qualitative research has been identified to be the most appropriate research method for this study. The descriptive form of research allowed for the identification of sustainability elements and the links to UA. The nature of this study allowed for an exploration of meaningful interactions between urban food security and human and ecological reality. Welman, Kruger and Micthell (2005:188) define qualitative research as a descriptive form of research relevant to case studies.

A qualitative research design allows for historical research data to be used where existing sources were located to allow for a description, analysis, and interpretation of events which has already taken place (Welman *et al.*, 2005:188).

4.5 Research Method

One method of qualitative research is the use of a case study. Qualitative case study research is the most suitable method to allow for an in-depth analysis into the UA phenomenon and its applicability to the town of Stellenbosch. Qualitative case study research allows the researcher to

include elements and values which have not previously been applied in existing theories, for it explores alternative theory possibilities. A case study allows for innovation that will advance an existing theory or generate a new theory regarding the subject under consideration (Eisenhardt, 1989:548). The researcher used a qualitative case study design in order to gain an in-depth understanding of the food insecurity and vulnerability in the town of Stellenbosch.

Eisenhardt (1989:534) elucidates that case studies are useful in terms of combining various types of data collected from sources such as "archives, interviews, questionnaires, and observations". Thus, the case study research approach allowed for the use of existing literature and articles regarding Stellenbosch's food status, the municipality's developmental documents structuring the framework for current and future development, national statistical data and institutional documentation, as well as interviews with the local environmental department. Furthermore, a case study assists with "understanding the uniqueness and the idiosyncrasy in a particular case in all its complexity" (Welman *et al.*, 2005:139). A combination of data collection methods has been applied during this reasearch paper. This contributes to triangulation and adds rigour to this research.

Seawright and Gerring (2008:300) provide the basis for a diverse case method where a set of cases is selected which allows for representing a range of values. The investigation into the diverse case study method "is understood as exploratory (hypothesis setting)" when focusing on the relationship between the values presented. The diverse selection of case studies was applied to active UA projects in Chapter 6. The variables which allowed the qualitative comparative analysis were based on the UA concepts identified in Chapter 2.

Seawright and Gerring (2008:294) explain how a case study allows for a better understanding of a bigger system by focusing on a specific part, and how it allows for a representation of cases "that is often much larger than the case itself". According to George and Bennett (2004:5), a case study approach is somewhat intuitive and allows for a detailed examination of one event that may be generalised to other events. George and Bennet (2004:19-22) provide several advantages of using case study methods for testing hypotheses and developing theories, namely their potential for achieving high conceptual validity (considering contextual factors allowing for conceptual refinement over a small number of cases), their strong procedures to foster new hypotheses (identifying new variables by studying deviants and outliers or through the process of

field work), their value as a useful means in allowing close examination of "the hypothesized role of casual mechanisms in the context of individual cases" (examining the contextual and intervening variables), and lastly, their capacity for addressing complexity (the complex interaction between relations).

The explanation of how the case relates to other cases needs to be provided to link to the broader applicability of the study. The research method is based on a case study regarding Stellenbosch food insecurity and vulnerability. The applicability to the 'broader universe', as indicated by Seawright and Gerring (2008: 294), is based on the urban sustainability challenges the town face. The urban food insecurity challenges in Stellenbosch directly correlate to other urban areas and thus allow a broader applicability of the study. Furthermore, the study continues to make use of the case study method for identifying sub-cases of UA production to provide a new perspective linking ideas and theories to practice. The selection of the sub-cases took into consideration how urban challenges were addressed and how it is applicable to Stellenbosch. The aim is to provide policymakers on a local level with the opportunity to motivate and implement a UA project or programme that leads to an improved food security status.

4.6 Research Questions

Welman *et al.* (2005:12) describe that the first steps of a research process "is to formulate the specific problem that is to be examined clearly". Defining the research problem allows for the research focus to be small enough to allow for investigation and this is achieved by defining the research questions (Welman *et al.*, 2005: 13). Eisenhardt (1989:536) argues that the first step to conducting a case study research is defining the research question. The research question enables the conceptualisation of the research process itself.

It is possible to identify the research question before the study begins, however, the question may change or be modified as more information on the topic is gathered (Eisenhardt, 1989:536). Despite this, Eisenhardt (1989:536) argues that it is important to identify some key variables to guide the study. Key variables that were identified and guided this research study include, but is not limited to: food security, urban food challenges, urban sustainability, UA, the type of UA and policy development. Following Eisenhardt's approach, the researcher commenced the study by

identifying the following two research questions. However, the research questions evolved considerably as more information surfaced on the topics and key elements under consideration.

Research objectives have been addressed through the following research questions:

1- How can industrial UA or community-based UA contribute to food security and ensure long-term urban sustainability?
2- Why does Stellenbosch provide suitable opportunities to achieve sustainability through the establishment of UA?

4.5 Research Framework

The research framework for this study is based on a concept of a system where the different elements of the system is dependent on each other and they are linked together in a complex web like system. Swilling and Annecke (2012:12) describe the development of complexity theory and elaborate on the theory itself, as derived from the work of Cillers (1998), in the following manner: "a complex system consists of diverse elements where the interactions between the parts are structured in a complex manner". In other words, interactions between the parts – which help transfer energy or information – take a non-linear form and the reaction to the interactions cannot be predicted with certainty. Complex systems have an open structure, i.e. they receive information or energy from the external environment and also have feedback loops which operate concurrently. Complex systems are capable of having memory and their nature is determined by the interaction between their different elements. Furthermore, complex systems are capable of adapting to changes in the environment by reorganising themselves as required (Swilling & Annecke, 2012:12-13).

Developing a deep understanding of the dynamic and changeable nature of a complex system such as our current food system requires a rigorous research approach. The complex causal relations are explored through the use of case study methods (George & Bennet, 2004:10). This approach is also known as a holistic research approach collecting a wide range of data "for example documents, records, photos, observations, interviews, and case studies" (Welman *et al.*, 2005:9). This required the interpretation and reporting of research findings to reflect the true sequence of events and challenges experienced within the complex system. Throughout the

research process, the researcher chose to reflect findings from multiple sources and documented the process to ensure transparency and to strengthen the credibility of the research process.

4.7 Data Collection

4.7.1 Sampling Method

The context of this study was focused on food insecurity within Stellenbosch. Purposeful sampling method was applied to identify the policies analysed, these policies are applicable for they were either identified in the IDP of Stellenbosch or applicable to the case of food insecurity in urban areas.

Based on the findings within Stellenbosch and the challenges faced in the urban area ten UA food gardens were chosen with a specific purpose in mind. The purpose were to select UA initiatives with specific characteristics based on how they address urban food insecurity. The purpose was to select projects that address urban food insecurity in an innovative unique methods and which has feasible successful solutions which can be applied to the Stellenbosch context.

The UA cases were selected based on a discriminant analysis to identify diverse cases. During the research process, it became evident that the type of UA projects found within urban areas differ in their goals, either addressing food insecurity of the poor or focus on high levels of production. In order to provide a holistic understanding of UA the first section focus on livelihoods and communities based UA whereas the second part focus on private enterprises and production. The selection criteria for the first category included focus on food insecure vulnerable population, innovative community up-liftmen projects, and livelihoods based UA focused on access, distribution and nutrition. The second section of cases was selected based on the private orientated enterprise structure of the company, high production quantities, innovative solutions to agricultural practices, located within high densely populated areas and make use of alternative agriculture methods for high food production. The idea is to provide a holistic understanding of the different types of UA implemented and each's contribution to sustainability and urban resilience

Both primary and secondary sources have been used in this study. Although preference is given to primary literature sources, secondary sources are referenced to increase the credibility of the study. Furthermore, interviews were conducted with individuals currently active in implementing and maintaining food gardens in Stellenbosch. The findings highlighted in the next chapter analyse these solutions and motivates how these could be applied within the Stellenbosch context.

Table 4.1: Sampling Method

Sampling Technique	Purposive
Unit of Analysis	Food Gardens, Policies and Programs
Target Population	Policies Related to Stellenbosch Food Security, innovative projects with practical solutions to food insecurity.
Sample Size	10 UA gardens, 10 Policies and Programs

4.7.2 Data collection

Multiple data collection methods were used during this case study; this ensured triangulation that allowed for the cross-checking for internal consistency. Triangulation was applied and a variety of sources were selected, including target specific journal articles, policies, programmes and governmental documents, interview with local project managers and internet resources. Historical data was used to link urban development and urban food production and thereby strengthened the argument for the need to development UA.

The use of multiple data sources increase the credibility of a study as it allows for the corroboration of evidence or the triangulation of data (Welman *et al.*, 2005:194). Eisenhardt (1989:538) explains that triangulation allows for stronger validation of constructs and hypotheses. This study investigates multiple data sources which provide information on the same phenomenon. Triangulation is applied to industrial and community-based UA to identify new variables in Chapter 6, setting the policy framework by addressing complex interactions to UA in

Chapter 3; and defining the research case study in Chapter 5. Triangulating the information collected from these sources has allowed the researcher to identify connections, as well as develop and present an in-depth understanding of the complex challenges the urban system faces in order to achieve sustainability.

This study employed a systematic literature review method to produce a qualitative description of the knowledge-base relating to UA. In addition, the policies and agendas analysed identify the Stellenbosch food insecurity status, the reaction towards this food insecurity and the innovative solutions which could contribute towards local food production.

The research process followed to address research question 1 analysed and discussed food security within the urban sphere. This was framed by the available literature on the significance and status of food security, specifically within sub-Saharan African countries and South Africa. The clarification of food security and the related urban challenges assisted to identify UA as a tool to increase food security within the urban sphere. Firstly, relevant literature on UA was used as a guideline to structure the framework for understanding UA. Providing a holistic definition of UA posed challenging for the available definitions lacked the holistic perspective of UA. Motivated by this challenge data collection and analysing these sources highlighted main concepts of UA based on available resources to clarify the various element of UA.

Through data analysis the viability and sustainability of UA within the urban sphere was provided. Based on the urban challenges historical resources was used as part of the data collection process which evaluated cities which experienced similar challenges in the past. Additional literature are included to identify why, how and when UA was active in urban areas. Urban challenges that provided the basis for this research includes the rise and expansion of cities in 2.4.1, the population increase in 2.4.2 and economic and social crisis in 2.4.3.

The contribution of UA to increase urban sustainability were identified through analysis of information gathered during the literature review. Lastly, sustainability motivated for UA as a tool to increase urban food security within a complex system. The aim is to provide a clear understanding of what urban food security consists of, the opportunity for addressing these issues through UA and what makes UA sustainable to increase urban resilience.

Findings from the literature answers research question 1 and provided a framework for answering and addressing research question 2. This framework was used to further analyse literature and local government documentation searches to determine the food status of the town of Stellenbosch. Furthermore, the fieldwork conducted in Stellenbosch allowed the researcher to explore UA implemented by the local municipality. The information on Stellenbosch provided the context for this research study and the research problem, with specific reference to food insecurity, food vulnerability and the resources available in the town as a solution to the findings.

The process used to address research question 2 includes the examination of specific policies and local planning documents in order to identify the current state of food security within Stellenbosch. The IDP was used as the main framework to identify the current issues within Stellenbosch and specifically the food security status of the area. The IDP further provided the key international and national policies relevant to structuring the focus areas for the local government (thus these policies sets the foundation and basis of UA). The policies and programmes allowed for the identification of key elements where UA address the aims and goals relevant to these documents. As a solution to the urban challenges, policy was selected as the driver for urban change. In Chapter 3, primary resources has been highlighted to identify international, national and local policy and developmental programmes that guide and inform change.

4.8 Data Analysis

Qualitative data analysis has been applied during this research paper. Considering that Stellenbosch lacks a food security policy, the relevant documents' analysed in Chapter 3 have been used as basis for analysis to identify the opportunities that UA will provide for an area such as Stellenbosch. The international and national policies and programmes each provide a section which includes either goals, aims, rights or programme areas. The researcher further highlighted the possibilities of how UA will contribute to these goals, aims, right and programmes. Based on UA contributions the documents was analysed to motivate for a local food programme or policy that tests the possibilities.

During the literature review qualitative data analysis has been applied and open coding used to identify nine key building blocks for UA. These nine themes where chosen because they are

considered to be key elements of UA and incorporates holistic, complex and resilient characteristics of UA. Constant comparison took place during this phase, and these nine themes formed the building blocks of the theory. Once these themes were identified the researcher further analysed the ten case studies in Chapter 6 with the nine key building blocks in mind.

4.9 Summary of Research

This chapter outlined the research method used within the ambit of this research study. Since there was extensive literature available on the topics under consideration in research question 1, the researcher conducted a non-empirical literature review in search of an answer. The researcher has also attempted to answer research question 2 by means of a literature review however, due to a dearth of documentation on urban agriculture in Stellenbosch, the researcher adjusted the research method to include empirical research through the application of a case studies. These case studies assisted in identifying the potential of UA projects to contribute to food security and to build urban resilience.

Table 4.2: Research Summary

Research Context	UA and food insecurity
Research Purpose	Exploratory and explanatory
Research Epistemology	Interpretivism
Research Approach	Qualitative
Research Method	Case Study
Research Framework	Complexity
Data Collection	In depth interviews, Primary and Secondary literature sources
Data Analysis	Qualitative

Chapter 5: Stellenbosch Food Insecurity

5.1 Introduction

The literature review provided a background on UA and the potential of integrating UA into the urban environment. The concept of producing food within an urban space was identified as a tool for achieving sustainable development. The complex and holistic challenges the urban environment face relate to food insecurity, poverty, joblessness, waste accumulation and population increase in the urban sphere.

This chapter outlines the current food structure of Stellenbosch and describes the growing concern of food insecurity in the area. Specifically, it identifies the vulnerability of the town's food system with its dependency on outside food sources, as well as the transportation system. This chapter forms part of the broader case study of the potential for innovative UA initiatives and serves as a precursor for the following chapter in which those initiatives are discussed in more detail. This chapter assists in providing an answer to this study's second research question: Why does Stellenbosch provide the opportunity for achieving sustainability through the establishment of UA?

This chapter begins by describing the food insecurity status of Stellenbosch, as well as the limitations of the current structure and the vulnerability to further food insecurity. Furthermore, this chapter discusses the short and long-term food relief programmes in Stellenbosch as a reaction to the food insecurity. Within the ambit of this chapter, Stellenbosch is presented as a pilot study for increasing sustainability through implementing UA.

5.2 Stellenbosch Reality

The town of Stellenbosch is located in the Cape Winelands, 50 km from Cape Town (Seen in Figure 5.1). Stellenbosch is the second oldest town in South Africa dating back to 1679. The town is surrounded by agricultural land focused mainly on wine production and it has a strong tourism industry (Stellenbosch Municipality, 2014:10).

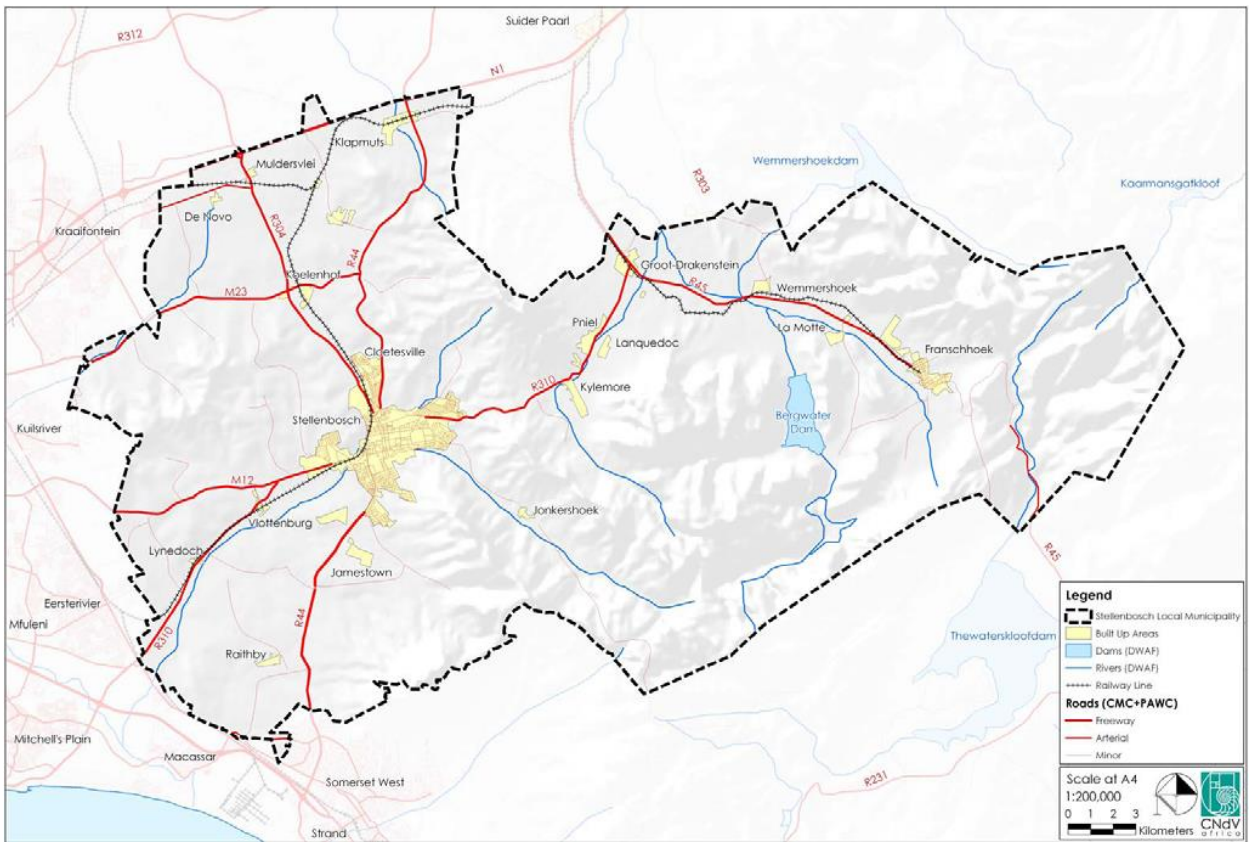


Figure 5.1: Stellenbosch Municipality Area
(Adapted from Stellenbosch Municipality, 2012a:12)

The population in Stellenbosch has seen a drastic increase from 2001 to 2011. The population almost doubled during this period in comparison to the population calculation between 1996 and 2001 (Stellenbosch Municipality, 2014:22). Figure 5.2 graphically depicts the population growth of Stellenbosch with the drastic incline post 2001. This development has put increasing pressure on resources, as well as the municipality to ensure that services are delivered to all households located in the town. As is the case in many cities and towns where there have been a drastic population increase, the food insecurity, poverty and the carbon footprint have also shown a drastic increase.

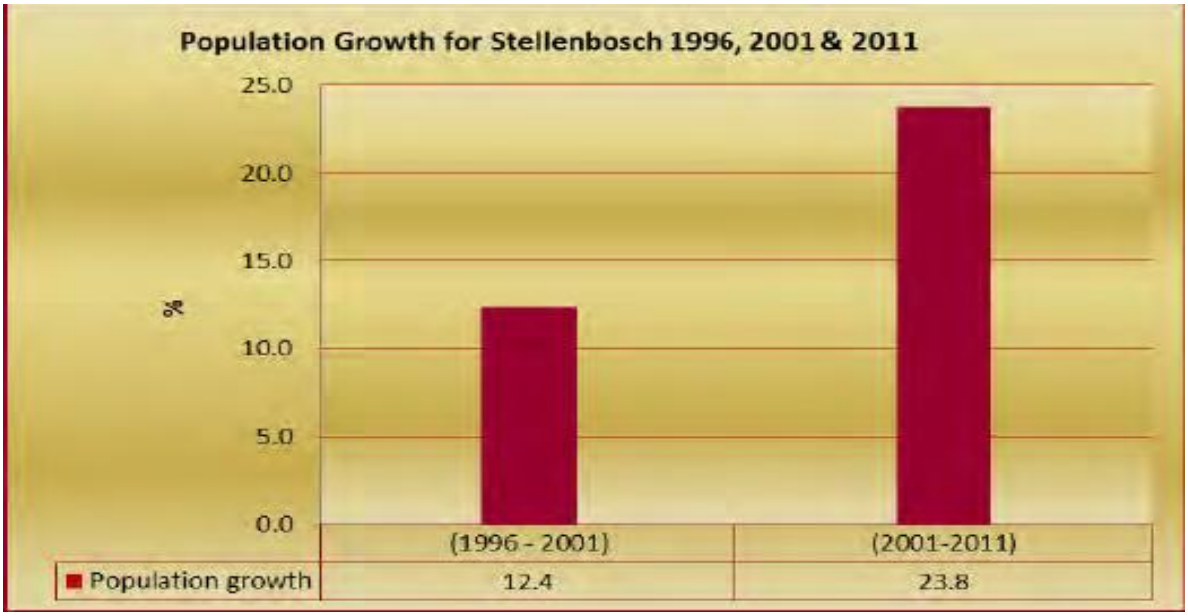


Figure 5.2: Population growth for Stellenbosch 1996, 2001 and 2011
(Adapted from Stellenbosch Municipality, 2014:22)

With an increase in population a number of other challenges, such as urban poverty, is identified. Urban poverty places a continuous burden on policy makers to find solutions to the urban challenges. In the FAO (2012:13) report, Lutaladio and Thomas state that 43 percent of Sub-Saharan Africa's urban resident are classified as poor and that this translates directly to poor living conditions and malnutrition. Urban poverty leads to a growth in unsuitable living conditions for the poor cannot afford better alternatives due to the diversity of challenges they face and limited income of the households in these communities. Lutaladio and Thomas (FAO, 2012:13) estimate that out of the urban population 52 percent live in slums (better referred to as informal settlements in a South African context). This urban challenge transpires in Stellenbosch as well. As identified in the 2012 Stellenbosch IDP, the informal settlements' growth is unplanned and continues to place pressure on the municipality, ecosystems and other resources (Stellenbosch Municipality, 2012a:99).

The growth in informal settlements coexists with low employment rates and low income. The Stellenbosch IDP of 2012 shows how unemployment within the Coloured racial group was at 50.2% in 2007, 47.3% under the African population, and the Whites, Indian and Asian

population were at 0.4% during 2007 (Stellenbosch Municipality, 2012a:24). Furthermore, the 2014/2015 SM IDP reflection indicates the employment rate at 21, 4% in the area (Figure 5.3). This is more than a five percent increase from 2001 to 2011 (Stellenbosch Municipality, 2014:24).

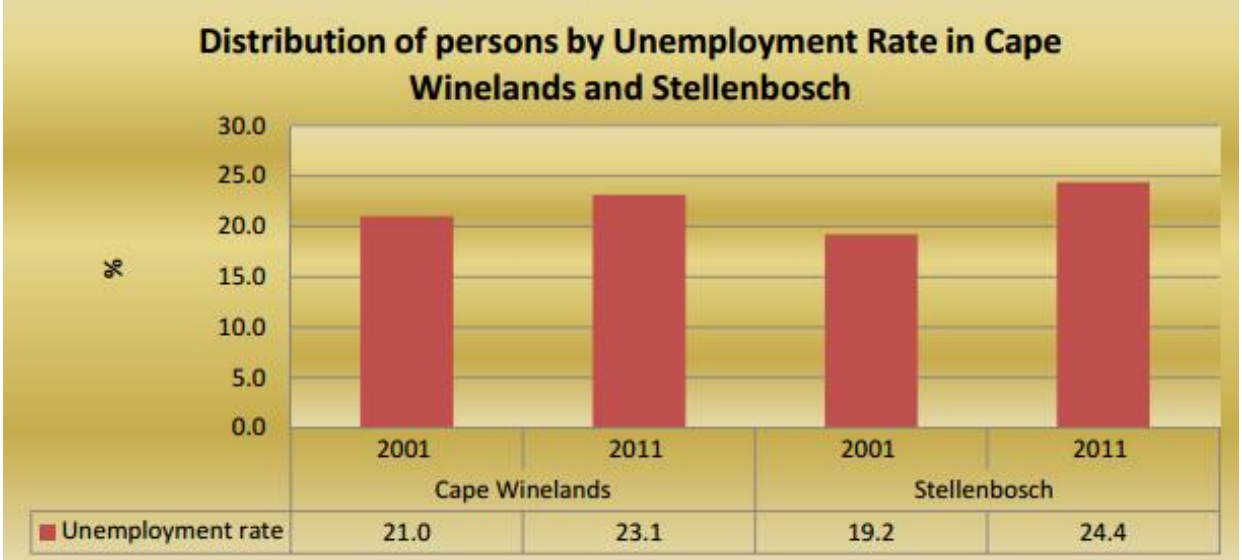


Figure 5.3: Distribution of unemployment rate in the Cape Winelands and Stellenbosch (Adapted from Stellenbosch Municipality, 2014:24)

Results from Statistics South Africa's Census of 2011, shown in Table 5.1, reflect the increasing challenge of employment in Stellenbosch. The number of unemployed amounts to 10178 compared to of 56957 employed in the town, indicating high risk of social challenges and urban food insecurity (Statistics South Africa, n.d.).

Table 5.1: Employment Status for the town of Stellenbosch based on 2011 Statistics South Africa Census
(Adapted from Statistics South Africa, n.d.)

Employment Status	Number
Employed	56957
Unemployed	10178
Discouraged Work Seeker	2731
Not Economically Active	42666

An increase in the population size, poverty and unemployment lead to an increase in food insecurity within the urban sphere (FAO, 2012:14). Lutaladio and Thomas (FAO, 2012:14) specify how urban malnutrition among children in Sub-Saharan African counties increases faster than the population and that the main cause of this urban challenge is poverty. Malnutrition increases during times of economic, social or political crises as in the case with the economic crisis of 2008-2009. The economic crisis directly affects the buying power of the poor and limits the diversity of the poor households' diets. Lutaladio and Thomas (FAO, 2012:14) express that in South Africa's "urban settlements the level of dietary diversity is very low (in a seven-day period, more than half the women interviewed ate no fruit or vegetables at all)".

Food insecurity is a current reality within Stellenbosch, especially in lower income areas. The 2014 SM IDP identifies that the most vulnerable to food insecurity and poverty is located within the informal settlement of Stellenbosch (Stellenbosch Municipality, 2014:77).

5.3 Food Insecurity in Stellenbosch

The FAO report on State of the World describe how every one in four people are undernourished in sub-Saharan Africa (FAO, 2015a:12). In order to combat malnutrition, a balanced diet is

required. “Hunger and undernutrition mean less-productive individuals, who are more prone to diseases and thus unable to earn more and improve their livelihoods” (FAO, 2015a:27).

Stats SA (2000) cited by the Republic of South Africa (2002:22) in the Department of Agriculture’s IFSS explains that 35 percent of the total population of South Africa is vulnerable to food insecurity and of those most is found under women, children and the elderly poor. The strategy furthermore states that 1.5 million children under the age of 6 are malnourished (2002:23). According to Swilling and Annecke (2012:238), 51 percent of households in South Africa experience hunger and in urban areas 70 percent of poor households experience food insecurity.

A healthy diet is dependent on a number of variables and this includes access to fresh healthy food, having the buying power to purchase these foods and preference. Kelly, Schulschenk, Landman and Haysom (2012:109) postulate that the Stellenbosch region’s poor nutrition is the outcome of poverty and poor food choices. Food choices can be linked to the buying power of a household or the lack thereof, as well as preference.

The lack of buying power directly influences households' ability to access healthy food. The Stellenbosch IDP section on poverty and joblessness identifies variables influencing the buying power of poor households. The IDP refers to how the demand for biofuels leads to an increase in the price of maize and other traditional staple foods (Stellenbosch Municipality, 2014:90). However, food security depends on the availability of food, access to food and knowledge of nutrition and health (WHO, 2016). The price of and income of households are economic barriers and affects the buying power of the poor to ensure food security (FAO, 2008: 18).

Furthermore, Lutaladio and Thomas (FAO, 2012:14) highlight the challenges urban poor face with keeping to a healthy diet due to a lack of appliances such as refrigerators. Those households living in slums or informal settlements have little or no access to uninterrupted power, water and proper sanitation. Within these areas households do not have the buying power to purchase appliances such as refrigerators. These households thus need to store smaller quantities of food to ensure that the food does not perish. As a result, the households need to buy smaller quantities at a higher price than buying in bulk.

The lack of buying power and the higher cost of healthy food affect households' preference. One recognisable outcome of higher prices of healthy food is that households would choose cheaper fast food alternatives such as starchy staples typically consisting of low-cost fats and sugars (FAO, 2012:14). Cheaper food is associated with cheap energy where the transportation of food from distant monocropped land is a consequence of where the land, labour and other resources are cheaper to purchase, use or exploit (Lang, 1999:222). In areas like Italy, with a thriving urban/peri-urban agriculture, the 'slow food' movement is seen as a reaction against the fast food industry, whereas the "movement promotes a grow it, cook it, eat it slow approach" (Smith *et al.*, 2001:20).

However, the fast food industry continues to supply cheaper alternatives to healthier food options as the poor spend most of their income on purchasing cheaper food options (FAO, 2012:14). This phenomenon is also evident in Stellenbosch. An increase in the price of healthy food and a simultaneous growth of fast food chains in the town have resulted in more and more people consuming fast food on a daily basis. However, fast food consumption is notoriously bad for health as it is known for its use of refined grains and highly processed food (Haysom, 2011:22).

Preference to types of food consumed plays a role in the health and nutrition levels of all households and especially those of the poor. The Department of Agriculture's IFSS (Republic of South Africa, 2002:26) also highlights the lack of purchasing power for specific types of food products influences consumption habits which in turn impacts the nutrition level of individuals. According to Haysom (2011:34), poor households consume food with high carbohydrate content and which is energy dense and low in nutritional values. Such a preference however, results in the poor consuming an unbalanced diet and contributes to malnutrition and an unhealthy community overall. The price of healthy fresh food can therefore have a direct effect or influence on the preference of a household to purchase certain products.

To summarise, the complex reality of food insecurity and malnutrition is an outcome of poverty, unemployment, lack of buying power, cheaper fast food options, an increase in the price of healthy food options, dependency on cheap oil and preference. As indicated in the aforementioned section, these challenges are a reality within Stellenbosch. Figure 5.4 contributes to the perspective of food insecurity as a complex and holistic challenge. The food insecurity within lower income households in Stellenbosch can be identified based on these challenges,

however, there is an alternative food insecurity level not discussed in the main stream urban literature when referring to food insecurity. This level of food insecurity applies to all households irrespective of income or status. The next section identifies these hidden vulnerabilities.

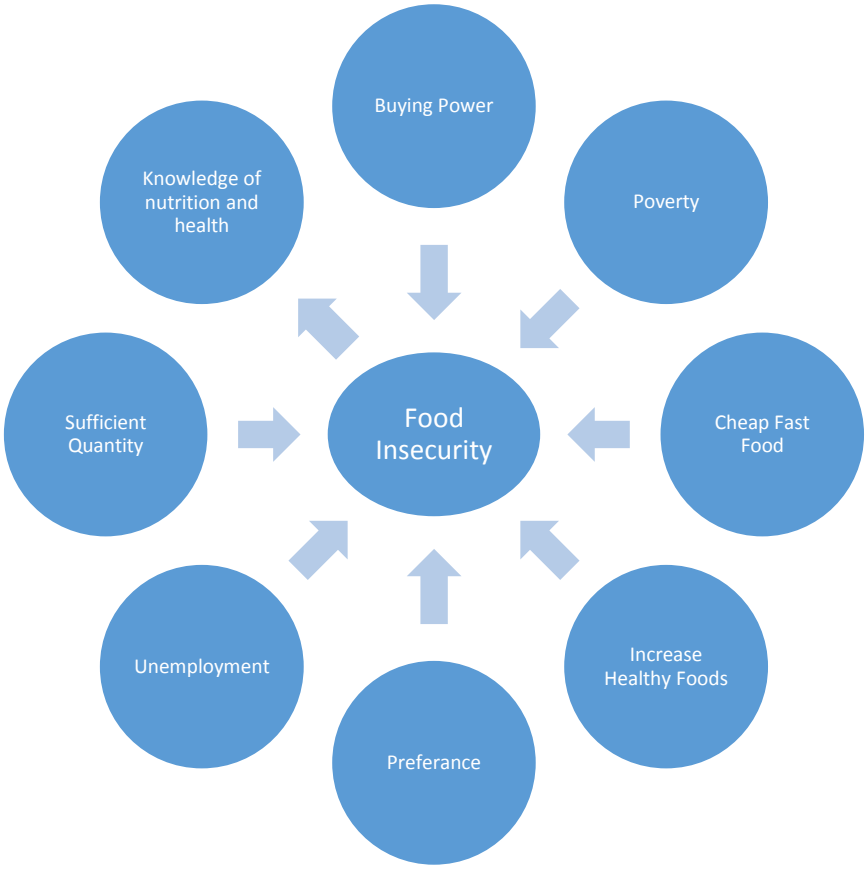


Figure 5.4: Food Insecurity - A Holistic Challenge

5.4 Hidden Vulnerability: Stellenbosch Food Insecurity

Food insecurity among poor households in the town of Stellenbosch is a consistent challenge however, Stellenbosch faces a bigger vulnerability with regards to food security. The entire population will be affected by food insecurity if the current logistical food system is compromised. Due to this vulnerability, the following section will focus on the current food consumption and supply system of Stellenbosch.

5.4.1 Consumption patterns

The food structure of Stellenbosch poses possible further food insecurity within the region when looking at the current food distribution. Stellenbosch's food system is further compromised by the complicated logistics involved in importing food into the area. Kelly *et al.* (2012:109) describe the distribution process of food in Stellenbosch where food produced in the Stellenbosch region for consumption purposes is transported first to central distribution points before being sent to distributors in the area. The distributors either consist of large retailer outlets or informal traders. The complicated logistics involved in exporting food widens the gap between the producer and the consumer and make food prices vulnerable to changes due to the number of variables that are involved in the transport process.

The vulnerability of Stellenbosch's food system is directly connected to the globalised agricultural system. One of the threats to food security, other than the current population increase, is the dependency on the transport system for food supply. Kelly *et al.* (2012:103) refer to the peak oil era as a micro trend influencing the food system. The high oil prices will have a direct effect on the price of food due to the transportation cost of food (Swilling & Annecke, 2012:42). Transportation of goods, especially agricultural, food production is dependent on cheap oil to reach the market. Seeing that the system of transportation depends on cheap oil, an increase in the price of oil is directly correlated to an increase in food prices (Swilling & Annecke, 2012:37). Irrespective of the increase in oil the price of transport and distance to the market are classified as physical challenged (FAO, 2008:18).

At the same time, Stellenbosch appears to lack a culture of buying produce directly from the source. Research indicates that up to 70 percent of the food which is consumed in Stellenbosch is bought from supermarkets or retailers (Haysom, 2011:22). Not only does this discourage producers from trying to sell their food directly to locals, but it also helps in perpetuating the system of importing food for consumption. Food consumed on a daily basis by locals is imported into Stellenbosch. This exposes the locals to all the weaknesses of conventional agricultural systems such as the fragile logistical system of transporting food. What is also problematic about this situation is the fact that private owners of land – concerned about maintaining their profits – do not indulge in growing crops that could be used on a daily basis by locals, since grape production is extremely lucrative.

5.4.2 Production potential

An examination of literature on food security in Stellenbosch revealed that while the town is surrounded by agricultural land, it is being used primarily for the production of only one type of crop: grapes. The fruit sector makes use of the largest production and contributes 87.5 percent of the total gross farm income, whereas other vegetables account for 9.9 percent of the income and 2.6 percent is for other horticultural products (Schulschenk, 2009:88).

Haysom (2011:48) suggests that Stellenbosch has the capacity to grow a sustainable system, but indicates that the local resources such as the local-food distribution networks need to partake in the effort. Irrespective of this, the current level of demand for food is not being met. In order to satisfy this demand, a transformation of the existing agricultural system is required. Specifically, the system should reduce its dependence on global imports for food and shift towards a local-based consumer-orientated market.

The singular crop production and use of agricultural land in Stellenbosch is one reason why a significant amount of the food which is consumed on a day-to-day basis by locals, is being imported into Stellenbosch. Only a small percent of agriculture in Stellenbosch produces crops that can be used by locals for daily consumption. As illustrated in Figure 5.5, much of the rest of the land is used for grape production and other products which do not necessarily contribute to food crops production.

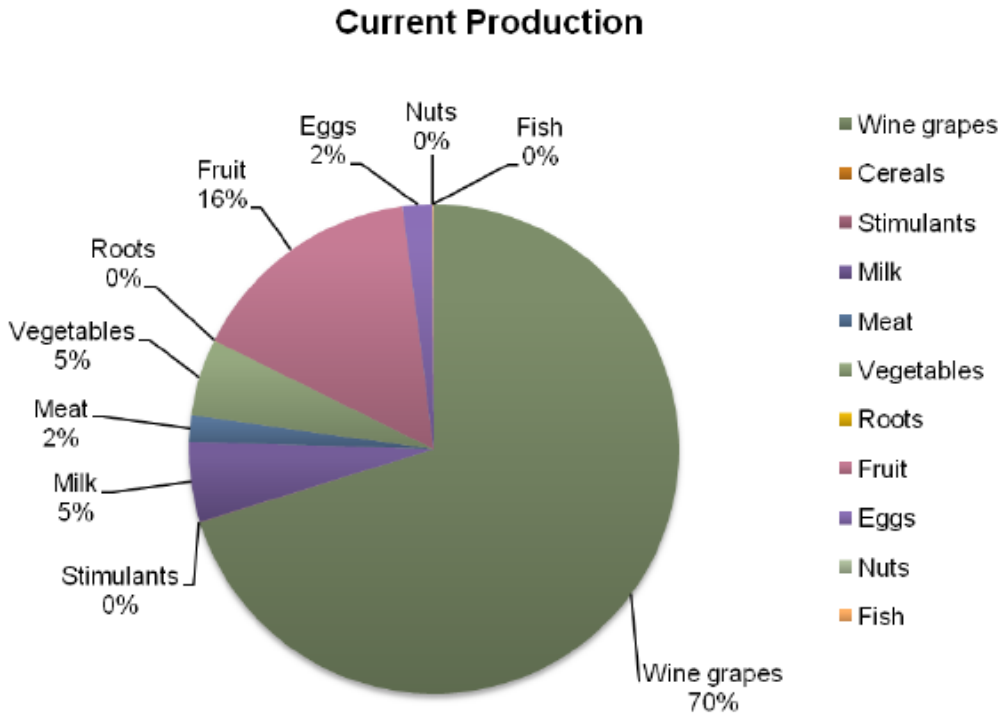


Figure 5.5: Current production by food group for Stellenbosch
(Adapted from Schulschenk, 2009:91)

The lack of production of varied crops in Stellenbosch and a reliance on the conventional agricultural system to feed its population results in low levels of food security.

The current food system in Stellenbosch therefore has multiple weaknesses, particularly when viewed through the lens of building urban food resilience. The system encourages the import of food for local consumption despite the availability of land in Stellenbosch to produce such food to contribute to local demand. The system also appears to encourage a very inefficient allocation of land for the production of the types of food that are consumed on a day-to-day basis by locals. Furthermore, the system appears to be doing nothing to encourage individuals to buy local produce directly from the source, hence the dependency on supermarkets.

There are two main levels of food insecurity currently in Stellenbosch, namely food insecurity of poor households that are unable to maintain a healthy diet, and food insecurity/vulnerability of

the entire urban population of Stellenbosch that is dependent on a globalised agriculture system. Thus, there is a need to address the immediate food challenges, as well as the vulnerability to ensure functionality when the transportation (oil) system fails. Given the current structure of the Stellenbosch agricultural industry, alternative solutions need to be explored. Productive UA is proposed as a viable option for increasing food security to produce for direct market consumption.

5.5 Reaction to the food insecurity

The awareness of the food insecurity status of Stellenbosch is reflected in the planning documents of the municipality. The strategic focus area of the municipality's IDP identifies the national strategic outcome under the focus area of the greenest municipality as "Ensuring vibrant equitable and sustainable rural communities with food security for all", and this is translated in the municipality's focus area to “create an environment and forge partnerships that ensures the health, safety, social and economic development of all communities including the empowerment of the poor in the Cape Winelands District” (Stellenbosch Municipality, 2014:50). Although the translation to the local aims does not explicitly state food security, it is embedded in the aim of health and safety.

The “3rd Generation” IDP 2012-2017 of Stellenbosch discusses issues related to food insecurity, and mentions the lack of food sources in low income communities to be problematic (Stellenbosch Municipality, 2012a:29). The IDP proposes solutions to address certain aspects of the food insecurity crisis. Broadly, it suggests that the responsibility of dealing with food insecurity rests with the municipality, because of its position as the governing body within the district and it determines which resources must be mobilised to combat the challenge.

The IDP’s reaction to food and agriculture is mainly focused on transforming 10 000 ha of land within the Stellenbosch area for local food production and consumption. The IDP proposed that this is possible through land reform programmes (Stellenbosch Municipality, 2014:70). This proposed solution depends on national funding and is therefore not ensured. There is no clear indication of when the land transfers have been completed whether it will increase or ensure food security, and in addition, the measurements and planning are also not mentioned. Food security and poverty alleviation go hand in hand when looking at informal settlements in the area

(Stellenbosch Municipality, 2014:77). How will land transfers address food security of the poor located in these areas, as well as the vulnerability to achieving sustainable food sources?

Furthermore, the IDP does not clearly identify to what level the proposed solution is to address the food crisis. The document is also silent on matters related to achieving urban food security through the programs it implements, particularly among low income households. This has resulted in a situation where the SM, following the IDP, is aware of the food crisis among low income households, but has not set any explicit performance indicators to measure growth and success of programmes that aim to deal with the situation. The municipality has neither planned for the improvement of food resilience for the entire urban sphere nor has it addressed the challenges posed by the conventional agricultural system.

Although the municipality does not provide efficient guidance on food insecurity, there are indications under the separate wards to address this problem. As part of the IDP, community participation identified a project that needs to be implemented within wards that are applicable to UA. The Idas Valley community identified the need for development of communal vegetable gardens however, this was the lowest on the priority list (Stellenbosch Municipality, 2014:64). Furthermore, the Raithby and Vlottenburg wards identified backyard food gardens as a need in the community (Stellenbosch Municipality, 2014:165).

5.5.1 Institutional Relief Programmes

As a reaction to the food insecurity in the area, food relief programmes are actively trying to address nutrition through short-term relief food banks. The 2010 study conducted on the civil society interventions providing food relief to the Stellenbosch area consisted of three types of projects 1) large NGOs, 2) diverse community projects and 3) small projects (Van den Berg, 2010:1). The study was conducted in the Stellenbosch and surrounding area and included 94 projects, of which 31 were situated in Stellenbosch (Van den Berg, 2010:5). Due to the dynamic environment of the food aid, many projects closed down and new ones opened up.

The food relief projects are divided into a diverse range of institutions. The 31 Stellenbosch projects consisted of school feeding schemes (10), individual food garden development projects (9), faith-based feeding schemes (5), soup kitchens and other feeding schemes (NGO-oriented, non-faith based) (3), faith based soup kitchens (2), community food gardens development

projects (1), NGO food security work by organisations who express brief is Food Security in Stellenbosch (1), NGO-run feeding schemes where corporations are key donors, but play no role in the process and simply donate (0) (Van den Berg, 2010:5).

Feeding programmes in the areas surrounding Stellenbosch supply around 25 000 food parcels on a daily basis on weekdays (Kelly *et al.*, 2012:104). However, food banks or food relief programmes do not address the structural features of food insecurity and functions as a relief in such a manner that they provide households with a short-term solution. Husbands's (1999:107) study on food banks in Toronto, Canada, identifies certain limitations which can be applied to the case of Stellenbosch. Food banks are a reaction to emergency assistance, but it is not a structural solution to food insecurity. Food banks assist with the immediate need, depend on public and corporate funding which is not a secure source of income, rely on volunteers, and have a low fundraising ability due to a lack of financial resources (Husbands, 1999:107).

On the other hand, Husbands (1999:108) identifies anti-hunger organisations as institutions that address the structural issues driving hunger and food insecurity. The aim of an anti-hunger organisation is to eliminate the need for food banks and other welfare agencies that provide food relief to poor households. These organisations need to work in close partnership with local municipalities and private partners to establish a long-term solution to food insecurity instead of relying on food relief programmes as the only option.

Local government’s reaction to food insecurity in Stellenbosch contributed to the establishment of UA gardens during the 2013-2014 financial years. The local government of Stellenbosch established 20 food gardens within the town, mostly located in lower income areas. The Stellenbosch environmental department initiated their food gardens project at the end of 2013. By July 2014, the department had founded and was supporting 20 food gardens in the Stellenbosch area, mostly within lower income communities (Craig, 2014). Three of these gardens are maintained by the municipality and have been established on public municipal land. The other gardens are maintained by private or non-for-profit institutions on their own land. These institutions vary from schools, to churches, to old age homes that face and tackle issues related to food insecurity. No preference is shown by the municipality in terms of the institutions they support. The gardens are predominantly located within low income communities.

UA gardens located on private land are provided with seedlings and compost by the municipality. In some cases, the municipality established the gardens for these organisations on their sites. The three public gardens that are fully maintained by the municipality are located in Idas Valley, Jamestown and the Beltana site. The aim of the Idas Valley and Jamestown gardens is to supply the local community with food produce from the garden for household consumption (Esau, 2014). Crops produced in the Idas Valley garden are also supplied to feeding schemes within the region which in turn supply the local community with daily food parcels. The Idas Valley food garden has limited capacity to expand and provide feeding schemes with a consistent supply of food. The municipal food garden in Beltana serves as a nursery which produces seedlings and compost for the other 19 gardens. The nursery capacity of Beltana is also limited due to budget constraints and space. Furthermore, the amount of seedlings and compost produced by the Beltana garden however, are not enough to match the current demand that exists for produce from the remaining 19 gardens (Esau, 2014).

The UA initiative originated in response to the current food insecurity among low income communities in the Stellenbosch area. As such, one of the primary aims of these food gardens is to provide food relief for communities and households that do not have the financial means to ensure the consumption of healthy nutrition. Esau (2014) explains that the idea of the municipal gardens is to enable a household to have easy access to nutritious food. Focusing only on providing households with food however, limits the ability of the municipality to develop plans to address overall food security of the entire urban sphere. This is because these food gardens are structured in order to provide aid and relief to the vulnerable and not to address the issue of developing urban resilience in the larger urban system.

Currently, the municipal-run gardens are experiencing serious difficulties in terms of expanding employment opportunities while the 17 private gardens run by non-governmental institutions are mostly supported primarily by volunteers and do not have the capacity to support paid employees.

5.6 Stellenbosch Sustainability Crisis

Sustainability in Stellenbosch is a challenge on multiple levels for Stellenbosch face a number of developmental issues and one of these is the need for addressing food security issues. In order to

motivate UA as a tool for achieving sustainability, it is important to identify the variety of issues Stellenbosch face that can relate to UA as a possible solution. The holistic nature of the challenges Stellenbosch face requires a holistic solution and UA provides the ideal opportunity to implement a strategy that addresses complex challenges. The types of challenges range from economic, social and environmental and they include, but are not limited to, housing and water shortages, lack of capacity for waste management and the ability to generate job opportunities in order to increase income for the poor.

The Stellenbosch Spatial Development Framework (SDF) of 2012 indicated a shortage of 20 000 housing units (Stellenbosch Municipality, 2012b:8). Combined with the existing inequality within the area, the required growth in service delivery is a complex challenge for energy, water, waste and sanitation services. The estimated infrastructure upgrade for these challenges was valued at R1 billion (Stellenbosch Municipality, 2012b:8).

The lack of appropriate infrastructure to support sustainable development is evident in the municipality's lack of managing and disposing of waste. Stellenbosch's waste disposal challenges and the municipality's inability to provide efficient disposal can be addressed through the recycling of waste within the UA system. The municipality's landfill site was at full capacity in 2012 with the proposal of a potential new site to be constructed (Stellenbosch Municipality, 2012b:9). The municipality however estimated that the new site will only provide capacity until 2017. The 2012 SDF highlights the necessity for "recycling-oriented waste management systems" (Stellenbosch Municipality, 2012b:9). The waste disposal site has reached critical levels and thus alternative solutions need to be explored. In order to render solutions, the IDP identified public-private partnerships, community involvement, as well as alternative technologies as a solution to the Stellenbosch waste crisis (Stellenbosch Municipality, 2014:80).

Stellenbosch's waste is not currently recycled and ends up in landfills or sewage works (Kelly *et al.*, 2012:109). As a result, waste water treatment cannot meet the need of the current Stellenbosch population. This backlog does not even consider the increase in capacity with new developments or the municipal plans to develop 20 000 houses as indicated in the IDP. As a possible solution, the SDF motivates for new developments to implement localised waste and water treatments with the use of sustainability-orientated technologies. Furthermore, within the

SDF of 2012, the municipality recognises the potential for waste water as a source of water, nutrients and methane gas (Stellenbosch Municipality, 2012b:8).

With the population increase in Stellenbosch the ability of the municipality to provide all the households with sufficient water provides a different set of challenges. Although the municipality of Stellenbosch does not have a basic water or sanitation backlog, the projected increase in demand may exacerbate the situation (Stellenbosch Municipality, 2014:84). The fresh water supply of Stellenbosch is directly affected by the poor infrastructure and water pollution is caused by the poor management of solid and liquid waste. Statistics SA indicate, based on the 2011 census, that only 72,4 percent of households in Stellenbosch have access to piped water inside their dwelling (Statistics South Africa, n.d.). These constraints limit the ability to ensure uninterrupted water supply and the SDF indicated the need for water storage and recycling to accommodate peak water demand (Stellenbosch Municipality, 2012b:8).

These challenges limit the capacity of Stellenbosch to realise sustainability. However, appropriate technology motivated through UA projects may provide alternative solutions to address these urban challenges. Many urban areas face the same dilemma and this is why Stellenbosch provides the ideal opportunity to test UA and its contribution to sustainability to develop a holistic module of success that can be used as a test project. As identified in the IFSS local projects can be recommended and provide the opportunity to monitor and evaluate the projects and their effect on food security (Republic of South Africa, 2002:36).

5.7 The Case of Stellenbosch: Prime Pilot for UA to achieve sustainability

Stellenbosch was selected for this case study as the dynamics found in the town are applicable to other urban areas, not only in South Africa, but in other developing nations as well. Stellenbosch's sustainability levels are low and complex challenges include population, poverty and informal settings, as well as food insecurity/food vulnerability and resource constrains (limited water supply, mismanagement and lack of capacity for waste treatment).

The SDGs identified the need for Global Partnerships to ensure implementation of the new goals. "It will facilitate an intensive global engagement in support of implementation of all the Goals and targets, bringing together Governments, the private sector, civil society, the United Nations system and other actors and mobilizing all the available resources" (United Nations, 2015:30).

However, Stellenbosch encompasses the capacity to serve as a pilot for UA sustainable solutions that work. Stellenbosch is the perfect location to test and produce a module that can be adopted in other areas, and it has the appropriate resources and stakeholders that can be allocated to initiate a pilot for a successful UA module. The resources and stakeholders includes financial, intellectual and urban space. On top of the available resources, SM has the willingness to transform into an innovative green municipality. Haysom (n.d.:124) highlights the responsibility of not only government to address food insecurity, but also civil society and the private sector. The resources will be evaluated and discussed in the next section in order to motivate the use of Stellenbosch as the prime location for a holistic UA pilot, taking into account the complexity of the urban issues and addressing them through a process that considers a concentric module of sustainability.

5.7.1 Financial Resources

The economic challenges of Stellenbosch discussed in Section 5.6, highlight poverty and joblessness. Irrespective of these challenges, Stellenbosch obtains diverse stakeholders in the public and private sector that can contribute to the implementation of UA for realising sustainability.

Stellenbosch has been classified as the Silicon Valley of South Africa due to innovation within the town (Phakathi, 2013). The town is home to some of South Africa's biggest companies, including British American Tobacco (BAT), Remgro Limited and Distell. Some of these companies were involved in the infrastructure setup of fibre-optic cables to increase internet capacity in the town (Phakathi, 2013). This related to their ability and willingness to contribute to the innovation of the town.

These companies are dedicated to increase social and environmental responsibility and are invaluable resources to include within the planning and success of UA innovative initiatives. Remgro Limited (2015a) indicates that they focus on minimising their impact on the environment on issues related to the environment (carbon emissions, energy, water and waste management). The corporate social investment of Remgro Limited donates to South African programmes in community development, cultural development, entrepreneurship, the environment, healthcare and sport development. Table 5.2 indicates that Remgro Limited has

spent R14 million in 2013 and R23 million during 2014 on a variety of projects (Remgro Limited, 2015b). The complexity of UA allows for the budget items of more than just the environment and can include community development, entrepreneurship, training and education, as well as investment into the environment.

Table 5.2: Remgro CSI spending
(Adapted from Remgro Limited, 2015b)

REMGRO CSI Spending		
	Year 30 June 2014 R million	**Year 30 June 2013 R million**
Community Development	8	4
Cultural Development	3	2
Entrepreneurship, training and education	9	4
Environment	1	2
Healthcare	1	1
Sport Development	1	1
	23	**14**

The second potential financial partner in Stellenbosch is identified as BAT. BAT headquarters are situated within the town of Stellenbosch. As one of the biggest companies in South Africa, they contribute to socio-economic development on three focus areas: 1) Empowerment, 2) Sustainable Agriculture and 3) Civic Life. The primary focus of BAT is to "create various opportunities for individuals and groups to access the formal economy" (British American Tobacco, 2015).

Lastly, Distell established a foundation that focuses on creating societal value, addressing social problems for self-sustainability and contributing to a democratic South Africa (Distell, 2015b). Distell invests into communities through the Corporate Social Responsibility programmes based on the UN MDGs. The Distell Company includes sustainability into their focus areas and especially focuses on the environment for the health of the environment determines their

production capacity. Some of the resources that they highlight as important are soil, climate, water and energy (Distell, 2015a).

The SM needs to foster an environment that includes these private stakeholders into the planning and funding of effective UA projects. These companies are potential partners to achieving sustainability and provide the ideal module for UA.

5.7.2 Spatial Resources

The availability of space is one of the main concerns for establishing productive UA. Stellenbosch has a variety of open spaces that are not currently utilised in a productive manner.

Urban open space needs to be analysed on its contribution to social, economic and environmental sustainability. For instance, in Stellenbosch the public parks are covered by grass, most of the time neglected by municipality, with singular tree lines on the outer edge. This space is mostly viewed as unsafe and is not used for the purpose set out by the municipality. The SDF indicates that land owned by the municipality is to be allocated for the "most appropriate use, and that the land be used or applied by the municipality - preferably under a lease agreement - to allow for the desired development to become feasible, rather than being sold to the highest bidder" (Stellenbosch Municipality, 2012b:7). The two largest employers and land-holders within the town of Stellenbosch are the Stellenbosch University (SU) and the SM (Haysom, 2011:79).

Assessing the resources within an urban environment allows for public spaces to be converted into one that promotes ecological sustainability and urban resilience. A city like Montreal, Canada, for example, has transformed their municipal parks into large community garden programmes (Mougeot, 2006:xiv). This resulted in stimulating the awareness of sustainable development, promoting local food supply and transforming space in the urban environment to become productive. Montreal is, however, not the only city to make use of unused urban spaces to develop UA systems and to develop urban resistance. Cities such as Quito and Resaroti in Ecuador and Benin in West Africa have been retrofitting unused urban space to develop UA systems (Redwood, 2009:6-7).

Prime opportunity exists for Stellenbosch to a model of transforming unused public or private space. This transformation contributes to the development frameworks and aim of Stellenbosch

to become the Innovation Capital of South Africa. One way of contributing to sustainable development is transforming the urban space to become more efficient, productive and ecologically sustainable and UA allows for the transformation of open urban space.

Open space in Stellenbosch needs to transfer into and open-minded space. Open space forms part of a significant resource to ensure the success of UA. Lastly, the UA industry has been known for its ability to innovate with regards to available space where gardens are located on the most unusual surfaces. Ultimately, the option exists to retrofit the current infrastructure available within the urban framework where innovative architects are designing gardens in densely populated areas.

5.7.3 Intellectual Resources

Research institutes are a main driver of innovation. Stellenbosch is home to the SU as well as the Council for Scientific and Industrial Research (CSIR). These two intellectual institutions have a high capacity of research and project implementation. Combined, they offer the capacity for innovation in UA to become a viable alternative to rural agriculture. When implementing innovative solutions for UA, research needs to include implementation and testing in order to develop a module for success. The idea is to find a sustainable solution that stimulates the economy, include environmental responsibilities, as well as generate low skilled job opportunities and food security.

5.7.3.1 The Stellenbosch University (SU)

One of the central focus points of the SU is to be a key driver of innovation. The vision of SU is to be "inclusive, innovative, and future focused: a place of discovery and excellence where both staff and students are thought leaders in advancing knowledge in the service of all stakeholders" (Stellenbosch University, 2013:7).

Haysom (2011:70) argues that the municipality, as well as the SU are the biggest drivers of the economy in Stellenbosch, specifically with regards to job creation. SU currently encompass a large section of central Stellenbosch with regards to space, population and economic importance. The SU thus needs to "actively engage in strategies to support the local food economy" (Haysom, 2011:70). The municipality realises the capacity of the SU to contribute to the

innovation of the town. Within the SDF the university is identified as a leading entity to implement appropriate innovations, specifically with regards to energy and waste alternatives (Stellenbosch Municipality, 2012b:9).

Currently, the SU has projects in place that motivate and stimulate sustainable development. The overall aim of the SU is to contribute to sustainability on all levels within its capacity. The policy on Integrated Management of Sustainability of the SU describes their level of commitment to achieving sustainability as follows (Stellenbosch University, 2010b:2-3):

1- Aims to deliver leaders for the 21st century who have the insight, attitude, practice and skills to integrate sustainability into their own lives, their work and their communities;
2- Commits itself to continuous action to integrate sustainability in a meaningful way into all its activities, whether teaching, research, community interaction or operations;
3- Strives to manage its resources in a balanced way realising and recognising the intertwinement of ecological, social and economic systems;
4- Recognises the uniqueness of the university as a town university situated in a unique landscape which includes a river and a fynbos biome;
5- Strives for sustainable success in the areas of: teaching and learning, research, community interaction, operations, finance and ecology and lastly, student life;
6- Supports integrated sustainability;
7- Develops and implements appropriate measuring instruments to monitor the pursuit of sustainability and continuously further "best practice". These include an applicable Strategic Management Indicator encompassing all the university's core functions, as well as operations, finance and ecology.
8- Reports in an appropriate and integrated manner on sustainability in terms of the standards determined by, among others, the Higher Education Act, King III and the Global Reporting Initiative.
9- Supports the appropriate management behaviour regarding sustainability, including principles such as transparency and accountability.

Currently, within SU the Hope Project can be used as one of the tools where innovation of UA applies. The Hope project focuses on research, community and learnings specifically to address

challenges locally, nationally and within the greater African continent. The Hope Project has five initiatives that can contribute to the aim of food security (Stellenbosch University, 2010a):

1- Stellenbosch University Food Security Initiative
2- Combating Poverty, Homelessness and Socio-Economic Vulnerability under the Constitution
3- Energy and the Environment
4- Stellenbosch University Water Institute
5- Standard Bank Centre for Agribusiness leadership and Mentorship Development

Lastly, the Centre for Studies in Complexity will bring all the aspects together for it "aims to harness the insights of complexity theory in the search for comprehensive solutions to the challenges of human development in South Africa and the rest of the continent" (Stellenbosch University, 2010a).

5.7.3.2 The Council for Scientific and Industrial Research (CSIR)

Another leader in innovation within South Africa is the CSIR, with one of its branches in Stellenbosch, it is an ideal institute to include in the innovation of sustainable and complex UA. The CSIR undertakes directed and multidisciplinary research, technological innovation, as well as industrial and scientific development to improve the quality of life of the country's people (Council for Scienfic and Industrial Research, 2015). The main focus of the CSIR is to advance innovation for a competitive global economy. One of the key attributes that makes the CSIR attractive to include as a main stakeholder in the UA innovation in Stellenbosch, is its capacity to compete on a global scale, as well as its ability to function within a multi-stakeholder environment. The CSIR is all about developing science and technology for commercial and social benefits.

Combined these two intellectual institutions allow for a golden combination to be included in the development of an UA project that truly addresses sustainable development. The intellectual capacity of these two institutions contributes to UA for it can combine the different elements of UA in a holistic manner and ensure the complexity of the food insecurity system functions

effectively, productively and in a sustainable manner. The contribution these institutes offer is of utmost importance to initiate and implement an effective sustainable UA model.

5.7.4 Innovative Capital: Stellenbosch as a case for UA

Irrespective of the challenges currently faced in Stellenbosch, the municipality provides the basis for motivating a case for sustainable UA. The SM identified five values in the IDP that guide decision making. The last value focuses on innovation where the acknowledgement and reward will be given to initiatives that show creativity and ingenuity (Stellenbosch Municipality, 2012a:68). The 2012 IDP of Stellenbosch does not expand on this value however, the 2014 IDP review does, and it makes innovation the flagship for change and addresses challenges.

The SM identifies innovation as a key for possibilities and new technology with the aim of becoming "the Innovation Capital of South Africa" (Stellenbosch Municipality, 2014:12). The review of the IDP quotes the mayor of Stellenbosch stating that “Stellenbosch has tremendous resources. It has a world-class university, a lot of technology businesses, and many of the richest people in the country lives here” (Stellenbosch Municipality, 2014:94). The challenges faced by the town, as well as in South Africa, can be addressed by applying innovative solutions. The overarching focus of the municipality has shifted from a town that delivers excellent services to the "Innovation Capital of South Africa” (Stellenbosch Municipality, 2014:96). With innovation as guidance the aim is to do everything in an innovative manner, finding a new and better way of doing things (Stellenbosch Municipality, 2014:97).

This shift in thinking from service delivery focus to innovation focus prepares the way for integrating UA into the town of Stellenbosch. The municipality’s willingness to change and address issues innovatively motivates the case of Stellenbosch to implement, test and deliver a UA module for true sustainability. Becoming the innovative capital will rely on Stellenbosch doing things effectively, differently and sustainably.

5.8 Conclusion

The overall aim of this study was to identify the opportunity of Stellenbosch to function as a pilot for sustainable development and food security solutions in an urban space. This chapter introduced the town of Stellenbosch and highlighted the complex challenges currently faced.

Similar to other urban areas, Stellenbosch is faced with the reality of poverty, population increase and malnutrition. Food insecurity in Stellenbosch is found within poor communities. This chapter also highlighted the vulnerability of the food system within the area.

In a reaction to the food insecurity within the poor communities, food aid is supplied in the form of food banks and community gardens (managed and supported by the municipality with a lack of community participation). This however, is a short-term solution and does not address the structural challenges leading to food security within Stellenbosch. Furthermore, the consumption and production patterns of the Stellenbosch community and agricultural industry contribute to food insecurity, food vulnerability and malnutrition.

In addition, Stellenbosch is faced with diverse challenges leading to a sustainability crisis. The shortage of water and energy is a demanding challenge within the town, and the municipality is faced with the challenge to address these issues. The cost of implementing an effective infrastructure system will require financial resources. Limitations to the waste treatment is further indicated as a variable contributing to the sustainability crisis, where the capacity to manage the waste has reached its peak. These variables were focused on as it is considered to be a resource within the UA industry. UA allows for waste water to be recycled, energy to be generated and waste to be transformed into compost. Transforming the resources already available will allow for UA to become a tool for sustainable development.

How is Stellenbosch going to address these challenges? What is the possible solution to these challenges? Irrespective of these challenges, Stellenbosch has been identified as a prime location for addressing these complex challenges. The unutilised resources found in Stellenbosch allow for the opportunity to initiate and implement a UA project that addresses three spheres of sustainability. The resources available within Stellenbosch include financial, space and intellectual resources. By combining these resources, it is possible to create a UA model for success that can be adopted and implemented within other urban areas facing the same crisis.

Chapter 6: Community-based UA vs. Industrial UA

6.1 Introduction

This chapter explores the difference between two divisions of UA in order to identify the ideal UA project. The key concepts of UA, as defined in literature, are used to analyse ten cases of UA projects of which half focus on industrial UA and the other half on community-based UA. Both divisions' advantages and risks will be used to provide a platform for developing a model that will provide maximum urban sustainability.

The reason for comparing these two different practices of UA is motivated by the findings gleaned from the Stellenbosch case study. On the one hand, the IDP indicates how current food insecurity will be addressed through land transfers and the establishments of community gardens (Stellenbosch Municipality, 2014:70). The SM has further established community gardens in lower income areas to address food insecurity and malnutrition. In contrast, the SM has motivated for the development of innovation within the town to address issues currently faced. Policy is a driver of change and innovation is the tool for implementation. Thus, the two types of gardens allows for this chapter to identify UA contribution and compare them in order to motivate for UA that encompasses the advantages of both.

Typically, rural areas are largely associated with food production, whereas the urban areas are commonly associated with industry type production (Weaver e*t al.*, 1997:133). However, this perspective is changing for the advancement in technology allows certain agriculture produce to be manufactured in an industry type urban setting. Technology is identified in the policy section as a method of achieving sustainability by building resilient infrastructure, promoting inclusive and sustainable industrialization and fostering innovation (SDG 9), increase competitive and responsive economic infrastructure network (MTSF 6), increase economic infrastructure (NDP 2), improve education, training and innovation (NDP 7) and allow for investing in sustainable economic development and infrastructure (NFSD 3). So what is the most appropriate form of UA that will address the concentric model of sustainability as well as contribute to urban sustainability? Will it be industrial design based on technological advancements or community-based UA focused on livelihoods, or a combination of both?

The importance of developing effective UA has been highlighted in Chapter 2. In order for UA to contribute to the sustainability of urban areas, existing projects need to be explored. On the one hand you have livelihoods based producers and on the other commercial farmers. The aim is to identify advantages of each and combine these aspects to realise the full advantage of UA, focusing on urban sustainability, specifically food security. Sustainability of "UA basically implies its ability to continue in the future and operate at the current or increased levels. In order to be sustainable, UA should be profitable and economically viable, environmentally sound, socially just and culturally acceptable" (Van Veenhuizen & Dason, 2007:27).

What does the ultimate sustainable development orientated UA project look like, how does it include the environment, the economy as well as the total urban society? Current UA project development and focus can be seen between innovative projects addressing mass food production and community-based UA focused on food security for the poor. These two need to be combined in order to fully address sustainable development. In order to build a module that is viable, this chapter will look at a few UA projects from both spectrums. This chapter will identify the attributes of each of the projects in terms of achieving sustainable development and the challenges that need to be addressed in each as a shortfall for sustainable development.

6.2 Community-based UA

Community-based UA focuses on the urban poor to increase food nutrition of households. The aim is to increase sustainability of these communities that are trapped in urban poverty. This meso and micro type UA is livelihood-based production with the focus on aid. Based on the key concepts of UA, five community-based projects were identified and analysed.

By analysing these projects it is possible to identify how they contribute to sustainability of those involved, as well as the greater urban area. The advantages identified are to be duplicated in the UA projects that the town of Stellenbosch develops.

Literature on community-type UA allows for project details rather than one specific garden. Based on the available information, the data has been used to categorise the five projects according to the key concepts of UA. A limited amount of direct access to specific community gardens lead to the search of literature on projects that encompass more than one garden yielded a diverse range of resources to identify community-based UA.

6.2.1 Abalimi Bezekhaya ("Farmers of Hope")

Abalimi Bezekhaya is a community supported agriculture project located in Cape Town (Figure 6.1). The project is run as a NGO aimed at encouraging UA among residents of Nyanga, Phillipi, Kayelitsha, Browns flats, Crossroads and Gugulethu townships. The project allows for low income individuals to grow vegetables for social sustainability and water wise plants for environmental sustainability. The motivation of the community garden section is to grow food for household consumption to combat poverty, supplement diets, and to increase income and nutrition. Due to the amount of produce, the surplus is sold to the public through a supporting marketing project named "Harvest of Hope" (Abalimi Bezakhaya, 2013).

Figure 6.1: Abalimi UA project
(Adapted from Abalimi Bezekhaya, 2013)

The Abalimi Bezekhaya UA project contributes to a social sustainability within urban poor communities by means of organic plant-based production growing vegetables. The gardens are located on open spaces in a peri-urban site on the corridor of Cape Town. The location is characterised by low-rise buildings that are highly densified due to its informal settlement nature.

Gardens are found on open space and plots where the official land use of the areas is for residential use.

Although the aim is to increase low income households' nutrition, a market has been created with the assistance of Harvest of Hope. The marketing project allows the surplus produce to be sold to the public through a bag scheme (Harvest of Hope, n.d.). The Harvest for Hope project estimates that they have sold around 250 boxes to local schools in 2010 (Green Renaissance, 2010).

This type of garden is classified as a self-consumption enterprise with a small aspect of trade. The nature of the enterprise is a micro and meso scale garden in backyards or communal land. The type of farmers consists of low income individuals and community groups with a strong presence of women working the land (Small, 2009:2). By 2010, the project has established 3000 growers in the area who receive subsidised inputs, as well as training, from Abalimi (Green Renaissance, 2010).

The economic activity is focused on production, and with the surplus sold, to integrate trade activity. Income generated through the Harvest for Hope outlet of Abalimi allows mothers to pay for alternative expenses of the household (Green Renaissance, 2010).

Linking UA to social and ecological systems is important. The project and gardens are mostly socially focused with a small aspect of environmental responsibilities. The social benefit forms the basis of the project, increasing “nutrition and health, food security, income generation, job creation, community building and community-based nature conservation through organic micro farming and gardening among the poor” (Small, 2009:2). Many of the farmers are elderly women allowing a sense of purpose for those who run the gardens (Green Renaissance, 2010). The gardens contribute to the greening of the urban space, whereas the areas are typically located on sandy surface surrounding Cape Town (Green Renaissance, 2010). Although the gardens focus on organic farming methods there is no indication of reusing water or organic waste a definite possibility to increase the effectivity and limit input costs.

The ownership of the land is not specified in the available literature, but can differ from public to private land. From a social ecological memory standpoint, Abalimi offers training courses focused on organic gardening, horticulture and integrated land use design. The project focused

on protecting the natural habitat and indicates the importance of the ecosystem with regards to the overall aim of the project (Abalimi Bezekhaya, 2013).

6.2.2 Food Ladder

Food Ladder is an innovative vertical community-based UA project. This project was chosen for its innovative methods to address food insecurity, as well as the fact that it can provide crop production in small spaces. Food Ladder is a social entrepreneurship model that works in partnership with other organisations to ensure the effective implementation of the food production units in low income areas. Its collaboration with Conserve India addresses food insecurity among low income families of the informal settlement in Delhi (Food Ladder, 2014). Although the India gardens project has only two greenhouses, this social entrepreneurship module was important for this study to ensure a diverse selection of community type UA modules to address urban challenges (Food Ladder, 2015). This high-tech innovation is an important factor to consider in developing a module for success to address food insecurity, nutrition, sustainability and an increase in urban resilience.

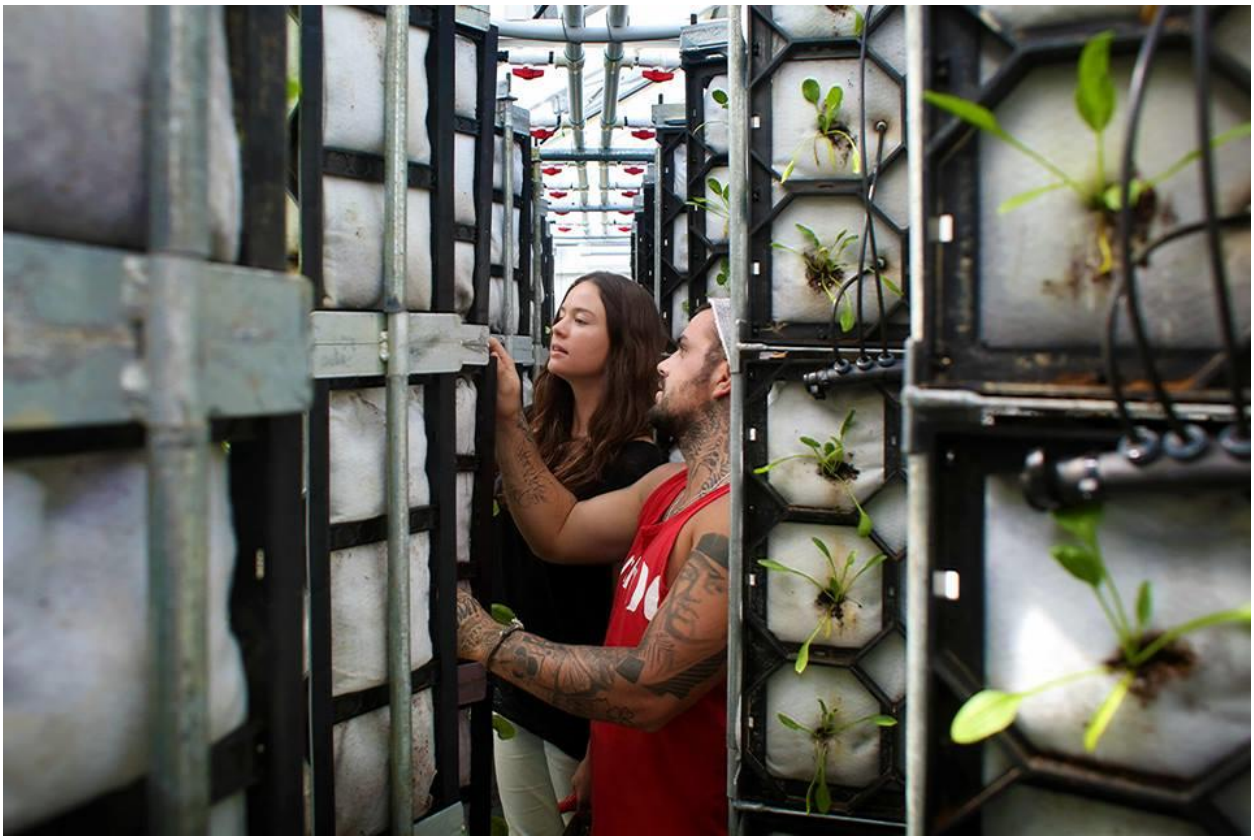


Figure 6.2: Food Ladder Hydroponics
(Adapted from Facebook, 2015)

The Food Ladder project is a hydroponic greenhouse garden system producing mostly leafy greens (Figure 6.2) (Food Ladder, 2014; Facebook, 2015). In India, other produce such as tomatoes and chillies are also produced (Facebook, 2015). The small portable greenhouse is suitable for open or built space. Gardens are furthermore placed on the roofs of existing buildings close to the informal settlement of Delhi (Food Ladder, 2014). The projects market is for self-consumption of poor households and the surplus produce is sold to the surrounding community. From the start the project's aim was to supplement household food consumption, as well as to provide opportunity for social entrepreneurship (Food Ladder, 2014).

Food Ladder is a non-profit enterprise however, the small gardens are established based on a social entrepreneurship business module (Food Ladder, 2014). The greenhouse is a meso scale garden with a high level of production within a small space. The low income individuals are trained on how to manage the hydroponics system to ensure high productivity. The farmer

demographics include poor individuals living within the informal settlement of Delhi (Food Ladder, 2014). Estimations of production indicate that the hydroponics greenhouse garden will generate 30 jobs and allow for the supplement of 250 individual diets (Amust, 2015).

The main aim of this community type UA is to produce food for the low income households to supplement their diet, as well as to increase household income. Thus, the economic activity of production is focused on consumption and trade to increase household income. Food Ladder contributes to social learning by teaching the technology of hydroponics to the farmers (Food Ladder, 2014). Indirectly, the hydroponics makes use of low water inputs and non-soil based production contributing to a small environment footprint. This meso scale greenhouse is built and designed to be able to be transported and moved as needed. In Deli the gardens are located on-top of roofs of existing buildings, thus ownership of land can be public or private. The design of the garden ensures flexibility of the site and if a land owner does not allow the production to continue, the garden can relocate and continue production elsewhere.

The technology used requires the participants to learn how to operate and function the hydroponics system. These learnings forms part of a social memory of the gardeners. However, there are no learnings of incorporating species into the gardens and allowing the ecological aspect of social ecological memory through the system.

6.2.3 Revision Urban Farm

The third farm is similar to the Abalimi farm with regards to the soil dependent open space production. Revision Urban Farm is a community-based UA project growing fresh produce at an affordable rate (Figure 6.3). The garden produce is either sold directly to the community or used for the Revision Family Home. The collaboration between the Revision Urban Farm and the Revision Family Home provides an opportunity for the homeless in Boston. The garden was established in 1990 to provide nutritional healthy food to the homeless mothers in the area (Victory Programmes Incorporated, 2015). In 2013, the gardens produced up to 25 different vegetable crops (Revision Urban Farm, 2013).

Figure 6.3: Revision Urban Farm
(Adapted from Revision Urban Farm, 2013)

The community-based garden produce is used by the community to increase their livelihoods. The variety of crops produced are grown on open urban spaces. The gardens are located on a brownfield site where the typical land use is residential. Originally the open plots were surrounded by shelter for homeless in the area (Victory Programmes Incorporated, 2015). Although primary production takes place on open spaces a greenhouse was built in 2011 allowing there to be a larger seasonal production (Rimol Greenhouse Systems, 2015).

The market for the produce is grown for consumption for the Revision home and other homeless families in the areas. Supplement produce is sold to the public through a farm stall market run by ReVision (Victory Programmes Incorporated, 2015). Furthermore, produce is also supplied to the Boston Living Centre with estimates that the farm produces 7000 pounds (3.1 ton) of food a year (Rimol Greenhouse Systems, 2015). The enterprise is a community supported agricultural project with meso scale food production.

The type of farmer or producer is a low income farmer. The income generated by selling the crops does not provide enough to ensure that the farm stays active. The operational cost of the

farm are too high to be covered by the sales of crops or the farms stay active through sponsorships and other funding support. Thus, the economic activity is the production of crops for consumption, whereas the sales only cover half of the operational costs (Community-Wealth.org, n.d.).

The Revision home provides shelter for pregnant and parenting homeless mothers. The gardens provided a means to deliver fresh produce to the homeless families in the area. The social benefit is to supply fresh produce to households and individuals, as well as to create job opportunities. Currently, the farm employs three permanent staff and five full-time interns in the summer months. They also have the capacity of training 600 volunteers and provide youth job-training (Community-Wealth.org, n.d.).

Land ownership of the gardens differs from public to private ownership. Overall, the land is owned by the organisation with public land added in 2012 as part of The City of Boston's Pilot Urban Agriculture Initiative. From a social ecological standpoint the gardens offer volunteer opportunities, learning youth and residences of homes on sustainable agriculture and food access issues (Revision Urban Farm, 2013). There is no indication of teaching referring to the importance of the ecosystem and the contribution made to the natural environment. However, the greening of urban space and the learnings associated with the increase in diverse plant species allows for an ecological contribution.

6.2.4 City Slicker Farms

The City Slicker Farms focus on community empowerment and producing healthy, affordable, fresh and organic produce to the community of West Oakland (Figure 6.4). This area is known for limited or no access to healthy and fresh food. Furthermore, the area is known for high levels of unhealthy food consumption habits leading to nutrition challenges such as obesity (White, 2008). The project runs its own farms, but also provides education and training programmes to implement backyard gardens with the aim of stimulating food self-sufficiency (City Slicker Farms, n.d.). Focus is placed on low income residential locations where an estimated 60% of the residences live below the poverty line (White, 2008).

Figure 6.4: City Slicker Farms Harvest
(Adpated from City Slicker Farms, n.d.)

A variety of vegetables are produced and in 2012 the organisation sold a total of 9000 pounds (4 tons) of food (Flaherty, 2013). Some of the farmers also participate in animal husbandry of goats and chickens (White, 2008). Farms are located on vacant open lots in the urban area. Some of the land is bought by the organisation and others are donated (Flaherty, 2013). The newest garden of City Slicker Farms, which totals 1.4 acres, previously housed a painting factory, thus, a Brownfield site (Thomas, 2013). The gardens are open type farms located in industrial urban locations. The organisation currently has three community market farms open to the public.

The market is used for self-consumption and surplus is sold to the surrounding community. The produce is sold on a sliding scale and in some cases the produce is given away to the poor (Flaherty, 2013). In 2008, there were around 300 residences that bought produce from the market each week (White, 2008). During 2011, about 28 percent of the visitors to the farm stand received their produce for free (Thomas, 2013).

City Slicker Farms is a community-based gardens programme with a heavy dependency on funding (Flaherty, 2013). The non-profit module allows funders to contribute to the success of the farm for the project is dependent on funding to ensure that the project runs in perpetuity (Thomas, 2013).

The type of farmer or producer is a low income farmer that is part of a community farming group. It is estimated that the farms allow for 5 fulltime employees and 200 volunteers (White, 2008). The economic activity is consumption and selling of surplus production for trade. The produce is sold on a sliding scale and in some cases the produce is just given away (Flaherty, 2013). The three-tier scale is setup in such a way that low-income residences pay what they can afford, whereas the higher income residences pay almost full price (White, 2008).

The social benefit is to provide fresh locally grown crops to low income households in the area, as well as allowing space to reconnect with the Earth. The backyard garden programme further assists households to have their own garden (Flaherty, 2013). Overall, the social contribution allows households access to healthy produce and saves money for the low income resident (White, 2008). The information available does not indicate any focus on the environmental contribution of the gardens however, the outcome of greening space allows for multiple environmental advantages.

The ownership of the land is either private or public and through financial support the organisations are able to purchase land within the area (Flaherty, 2013). However, some of the farms that are rented and this limits the ability to generate long-term funding (Thomas, 2013). Lastly, on a level of social ecological memory, learnings of how to grow crops are transferred to the surrounding community through the backyard garden programme (Flaherty, 2013). By 2005, the organisation has helped to create 83 residential gardens (White, 2008). There is however no indication on the importance of species and incorporating species into the gardens.

6.2.5 Cities without Hunger: Case Sao Paulo

"Cities without Hunger" is a non-profit urban project that focuses on increasing urban poor nutrition. The project allows poor individuals and group access to unused urban space to produce organic crops for self-consumption or sales to the local community. The information available allows for analysis of the project "Cities without Hunger" rather than one specific garden or

farmer. Currently, there are 21 active community gardens located on unused public and private plots to increase nutrition in the low income areas in the city of Sao Paulo (Figure 6.5). The aim of the project is to “encourage the social integration of marginal groups through gardening and to improve the nutrition of adults and children” (Cidades sem Fome, 2015).

Figure 6.5: Urban Farm Sao Paulo
(Adapted from Beach, 2015)

The type of production is organic crops production for consumption (Temp, 2015). Gardens are located on vacant and underutilised open space in urban areas (Beach, 2015). Open space in residential areas is selected and cleaned by the organisation to ensure healthy and safe cultivation of crops (Metropolis, n.d.). The gardens can be classified as intraurban within corridors or wedges within highly populated areas.

The market for the produce is self-consumption focused on providing increased nutrition for the urban poor, generating job opportunities and selling produce not used by households (Metropolis, n.d.). "Cities without Hunger" is a NGO where the individual farmer can be seen as an informal enterprise (Beach, 2015). Income generated by the gardens is seen as income to the

farmer, however out of the 21 gardens established, only three is financially self-sufficient (Metropolis, n.d.).

The type of farmer is a low income community farmer and out of the 21 gardens there are a total of 115 people working on the farms. Cities without Hunger also established greenhouses in the areas and these allow for seven greenhouse farmers (Cidades sem Fome, 2015). The economic activities include self-consumption of crops to increase the household nutrition and trade by selling surplus produce. Due to the low level of production and income from crops, the farms are still dependent on funding to ensure the sustainability of the gardens (Metropolis, n.d.).

Linking UA to social and ecological systems is important and the projects address both social and environmental aspects. The gardens allow for an increase in empowerment among low income areas in Sao Paulo, generate job opportunities, address skills development, generate income and improve nutrition (Metropolis, n.d.). The ownership of land is either public or privately owned, usually abandoned urban open space. These urban spaces are identified in the area where Cities without Hunger contacts the owner to make use of the space, as well as clean the sites for growing crops. Thus, the land can be Brownfields or Greenfield sites. The lease of land has shown to present challenges for the owner as they may shut down the garden at any stage and push out the farmers (Metropolis, n.d.).

With regards to the social ecological contribution, skills development and entrepreneurial development allow for an increase in organic crop production (Metropolis, n.d.). However, literature did not indicate any contribution to the ecosystem's functionality. The organic method for production may allow for the assumption of integrating sustainable ecological crop production methods.

6.2.5.1 Community-based UA Advantages and Risks

Based on the concepts of UA, five community-based UAs were analysed. There are multiple similarities within these projects. However, all of these gardens have one aim and this is to address urban poverty by increasing low income household nutrition and livelihoods. For the households who are directly involved in the production of the crops or those the garden aims to mainly supply, an increase in dietary diversity occurs. However, there are restrictions to the

amount of surplus produce that the gardens generate to allow for an increase in household nutrition to the surrounding community.

The economic contribution of the community gardens allows for poor household access to fresh produce. These households then need not spend their small income on ensuring food diversity. Income is also supplemented through selling surplus food produced by the gardens. The income generated is low and allows only for a small economic stimulation and does not produce a high volume to supply to the lager urban population. Furthermore, the gardens do not allow for numerous job opportunities. Food Ladder gardens have the highest employment rate and when the gardens function at full capacity, they provide 23 employment opportunities.

The initial input of the gardens is low for some of the projects, such as Cities without Hunger, ensuring that contamination of Brownfield sites are eliminated at their own cost, with the exception of Food Ladder, which requires a high input cost due to its hydroponic nature. Although the input of the gardens is low, the economic viability is also low. The income generated does not allow the gardens to continue functionality and the operations are dependent on external funding to ensure that the gardens stay active. Revision Urban Farm, City Slicker Farms, as well as Cities without Hunger indicated that the gardens depend on funding to ensure functionality.

The type of market is also challenging where the City Slicker Farms and Revision have small farmers market stands. Abalimi creates the opportunity for selling to a market through a basket system. A further economic challenge is that without a quality control approval, selling to a higher income market will be challenging. The individual targeted for this type of garden has a low level of skills and each of the projects indicated that they need to provide skills training to these individuals. Although the cost of skills development increases, the initial input into social contribution is high.

On a social level, the gardens allow for fresh produce to be made available to the households involved in the production. Surplus produce is also sold through the farm stalls or the basket system. The gardeners are low income individuals and in the case of Food Ladder and Cities without Hunger, the farmers are from informal settlements. The contribution to social suitability is through increasing social interaction and rebuilding the sense of community, and there is also a

high involvement of women in the gardens allowing for the most vulnerable to be empowered. Other social advantages UA provides includes increase in health and nutrition, knowledge of healthy produce, social interaction as well as physical activity.

The environmental contribution of community-type production is diverse. Some of the produce is organic, contributing to the environment, as well as the greening of urban space. Except for Food Ladder, there is little focus placed on reusing water or waste in the system. Incorporating species into gardens is not emphasized, but the organic production methods indicate awareness of the larger ecological system. With the main focus on supplying the urban poor and the perspective of aid, there is little mention of incorporating global ecological concerns typically found in agriculture.

The examples provided for community based agriculture applies to Stellenbosch for the need to increase nutrition and address lack of income for poor households. Households can supplement their food with what is grown in the community garden and in the process increase knowledge of diverse food available to increase nutrition. Lastly, if the production exceeds the need for the household the surplus produce can be sold and increase the household income.

6.3 Industrial advanced UA

Urban crops production in an industrial type setting has seen a drastic increase in urban areas. This has occurred in cities looking for innovative solutions to urban challenges, addressing global environmental concerns and increasing sustainability. This type of production is industrial-based with a high dependency on technology. The enterprise module is a private entity with high input costs. The reason this research study has utilised this production type, is because it allows for mass crop production, making use of urban resources in an innovative manner. Furthermore, technology is identified as method of achieving sustainability by building resilient infrastructure, promoting inclusive and sustainable industrialization and fostering innovation (SDG 9), increase competitive and responsive economic infrastructure network (MTSF 6), increase economic infrastructure (NDP 2), improve education, training and innovation (NDP 7) and allow for investing in sustainable economic development and infrastructure (NFSD 3).

There are a variety of challenges associated with this production type however, it contributes to the sustainable development of the urban area in various ways. The contribution to sustainability

includes: producing crop close to the market increases accessibility, ensuring that the supply to the market is not hindered by logistical challenges, reusing of resources available in the urban sphere, supply to the larger urban market and not only the poor household, to mention only a few. This type of mass industrial crop production challenges the dogma of food that needs to be produced in a rural setting.

Although these projects are seen as trendy, they are innovative and address key challenges associated with increasing sustainability of urban areas. They are forward thinking and fits into the SM's aims of becoming the Innovation Capital of South Africa. Planners need to look beyond incorporating community gardens and farmers markets and should look at the broader design of the city, thus addressing large-scale structural issues of the urban areas by way of incorporating urban crops production.

Although this type of macro crops production will not be able to replace all conventional crops, it allows for alternative urban designs and increases urban resilience. In order to provide a holistic overview of the solution, this research study focused on innovative projects that produce high volume crops in an urban environment. Aspects such as limited space, water and resources were used to identify projects of this calibre.

6.3.1 Gotham Greens

Gotham Greens is a New York based company that designs, builds and operates macro scale greenhouses for vegetable production. The company makes use of greenhouses to grow crops in highly densified urban areas (Figure 6.6). Gotham Greens (2015) states that they are “about being 'local' 'sustainable' and 'natural'” and “they care about what these things stand for: flavour and nutrition, preserving water and soil resources, biodiversity, reducing harmful chemical use in food production, fair treatment of workers, and spending their dollars closer to home”. This company was investigated as it produces large amounts of produce in a highly densified area. Gotham Greens uses technology that allows limited inputs for water and soil and it generates a percentage of the energy used for production.

Figure 6.6: Gotham Greens Farm
(Adapted from Gotham Greens, 2015)

A Gotham Greens greenhouse is located on top of buildings and grows leafy green and vegetables in a high density populated urban area. The analysis of the garden is based on the key concepts of UA identified in Chapter 2. Gotham Greens produces a variety of herbs and vegetables. One of the rooftop greenhouse facilities located in Brooklyn, New York has an annual harvest of around 100 tons (Gotham Greens, 2015a). The type of produce Gotham Greens grows includes soft vegetables and herbs. The year-round produce includes butter lettuce, basil, red oak leaf lettuce, a variety of gourmet lettuce, Bok choy, Arugula, Tropicana green leaf lettuce, Swiss Card, Baby Kale Medley, a variety of Asian lettuce, Iceberg Lettice, and a variety of interesting tomatoes (Gotham Greens, 2015b).

Gotham Greens is an intraurban type UA where the sites are located within the core of the city. The greenhouse gardens are located within densely populated areas situated on the roofs of existing buildings. The current active greenhouses are built on-top of buildings in Greenpoint and Gowanus in Brooklyn, New York (Resh, 2013:376). Gotham Greens established a market

for their produce by selling directly to the retail industry, restaurants and other institutions (Gotham Greens, 2015c).

The business dimension of Gotham Greens is a formal type enterprise with a high dependency on technology. This type of enterprise forms part of macro commercial farms in a greenhouse production setup. The company is a private limited company where the private entity is run as an agribusiness. The employees are experts in the field of hydroponics to ensure high level of crop production. The economic activity of Gotham Greens is the production and trade for consumer use.

When analysing UA production, the social and ecological aspects play an important role to determine its contribution to the sustainability of the urban area. The type of production within a greenhouse setup allows for Gotham Greens to produce crops that is pesticide-free (Gotham Greens, 2015c). Furthermore, Gotham Greens focuses on implementing energy efficient sites. The greenhouse in Brooklyn is built with solar panels allowing energy to be transferred for the production of the corps (Resh, 2013:376). The company states that the year-round production allows for 20-30 times more production per acre than field productions. Water is a scares resource and Gotham Greens hydroponics production allows for smaller quantities of water usage than traditional land use production. Water is recirculated through the hydroponics system indicating that they make use of 20 times less water than land-based conventional agriculture. The system allows for no agricultural runoff, one of the main causes of water pollution (Gotham Greens, 2015a).

On a social level, this type of production does not allow for a high level of employment. Thus, it does not address urban poverty, malnutrition or food security among the poor. The company produces crops for the larger urban population thus increase accessibility and access. The company employs over 30 full-time employees in its New York operations (Gotham Greens, 2015c).

Although Gotham Greens provides the service of implementing gardens for other companies, the two Brooklyn-based gardens are owned and operated by Gotham Greens, thus it is a private land ownership. The last concept of UA applies to the contribution of UA to social ecological memory. The Gotham Greens team consists of experts in “technologically sophisticated

controlled environment agriculture (CEA), hydroponics" to name just a few (Gotham Greens, 2015). The learnings happen in a closed environment with little or no access to the public. However, the learning of producing food in a closed environment and adjusting to challenges such as water and soil shortages indicates a contribution to food production in the long-term. There is however no indication of integrating other species into the gardens and contributing to the diversity of species.

6.3.2 Sky Greens

Sky Greens UA innovation is a macro production type vertical farm located in Singapore (Đurić, Bogdanović, Petrović, Mihajilović, Bogdanović, Šušteršić, Pertrović & Bodganović, 2015:128). As graphically depicted in Figure 6.7, Sky Greens is a low carbon, hydraulic vertical farm. The farm makes use of minimal land, water and energy resources to produce a variety of vegetables (Đurić *et al*., 2015:128). The research collaboration between Sky Greens and the Agri-Food and Veterinary Authority of Singapore led to the development of a vertical structure using green technologies named "A Go-Grow". The aim of this vertical tropical vegetable farm is to address urban food sustainability and to provide food leading to a resilient Singapore (Sky Greens, 2014a). Most of the vegetables of Singapore are imported and Sky Greens provide an alternative to produce food locally on a small piece of land. Singapore is a highly densified area located on an island with little opportunity for land-based agriculture. Due to these constraints, the Sky Greens food gardens are innovative in addressing the urban challenges specific to Singapore (Đurić *et al*., 2015:128).

Figure 6.7: Sky Greens Vertical Garden
(Adapted from Sky Greens, 2014a)

This revolving vertical structure produces plants for consumption purposes (Đurić *et al*., 2015:129). The Sky Greens farm produces a variety of vegetable crops, including Xiao Bai Caim Naibai, Cai Xin, Chinese Cabbage, Mao Bai, Lettuce, Bayam, Kai Lan, Kang Kong and Spinach (Sky Greens, 2014c). The vertical greenhouse consists of 120 aluminium towers producing up to half a ton of vegetables per day. Sky Greens vertical gardens are located within the metropolis of Singapore making it an intraurban type production. The greenhouse is built on an open site (Zimmer, 2012).

Sky Greens vertical gardens established a market by selling directly to the supermarket and its produce is sold directly to supermarkets in Singapore, specifically to FairPrice Finest supermarket. The produce is 10 to 20 cents more for Sky Greens's vegetables, but the locally growing fresh factor attracts consumers (Dvorsky, 2012). This formal enterprise consists of a commercial type farm with an innovative vertical greenhouse setup. The farmer is an

agribusiness registered as a private company producing on a commercial scale. The type of economic activity includes production and trade of high quality fresh vegetables (Sky Greens, 2014b).

Linking UA to social and ecological systems is important and Sky Greens vertical gardens allow for high yield production and estimates of producing ten times more per unit of land area compared to traditional farming methods. Water usage of the farm is minimal and by making use of a flooding method, the water is recycled and reused (Đurić *et al*., 2015:129). The design allows for low energy usage for the structure rotates pallets that allow the vegetables to reach natural sunlight, thus there is no use of artificial lights. Furthermore, the structure is powered by a water-driven system that allows the water and gravity to rotate where "only 40W electricity (equivalent to one light bulb) is needed to power one 9m tall tower" (Sky Greens, 2014b). Due to the greenhouse setup of Sky Greens vertical gardens, the farms are protected from environmental factors, thus allowing for low maintenance and labour inputs.

Similar to Gotham Greens, the ownership of the Sky Greens vertical gardens is run in a private capacity and there is no specific indication of who the owner is but can be assumed that it is a private entity similar to Gotham Greens thus privately owned land. Lastly, on a social ecological level, the literature does not indicate any connection to the learnings of social ecological memory. However, the type of technology used requires an expert team. There is no indication of transferring the knowledge to the public, however the learnings allows for an increased knowledge on UA efficiency. Due to the closed off nature of the greenhouse no species is incorporated into the system thus the contribution to local ecology is limited.

6.3.3 Lufa Farms

The third type of high production technological-based industrial UA is located in Montreal, Canada (Resh, 2013:372). This is another green rooftop innovation with productive greenhouses. The first farm was built on-top of existing buildings and the second farm is a newly developed site in the Montreal area. Lufa has two UA programmes, namely Laval, totalling 43 000 square feet, and Ahuntsic that covers 32 000 square feet (Figure 6.8). The UA is run on a hydroponics system and is located within the urban space. This company supplies directly to the consumer by making use of an online shopping and basket-based system (Haberman, Gillies, Canter, Rinner,

Pancrazi & Martellozzo, 2014:1105). The vision of Lufa Farms is to feed a growing urban population (Lufa Farms, 2014).

Figure 6.8: Lufa Ahuntsic Farm
(Adapted from Lufa, 2014)

Lufa Farms falls into the category of producing crops directly for a consumer market. The Laval site produces up to 120 metric tons of produce in one year, whereas the smaller Ahuntsic farm produces 70 metric tons of crops per year (Lufa Farms, 2014). Both facilities make use of a hydroponics cultivation method to grow crops (Lufa Farms, 2015a). In total the facilities produce around 40 varieties of vegetables (Mok, 2013).

Both sites are located within the urban areas of Montreal and are set up on top of a building. The gardens are located within an interurban location. In contrast to the first two gardens that supply to retailers, restaurants and other institutions, Lufa Farms supplies directly to the consumer. Innovative methods used by Lufa Farms are marketing and e-commerce. The business module is based on a basket-type market where you order the basket online and the produce is dropped off at 150 pick-up points throughout the city (Halais, 2014). The basket system increases the food security levels by increasing distribution and trade. The baskets cost about $30 Canadian dollar each per week (Lufa Farms, 2015b). In 2013 it was estimated that more than 2500 baskets were

dropped off each week (Mok, 2013). Lufa Farms is a formal enterprise producing vegetables at a macro scale.

The greenhouses are located on-top of other buildings within the urban setting and depends on technology for production. The type of farmer is an agribusiness consisting of a high income private enterprise. This formal business is driven to supply produce for a consumer market. Although the main economic activity is crop production, Lufa Farms also serves as a trader where the company has partnerships with other local food growers and suppliers allowing for basket diversity (Mok, 2013).

With regards to linking UA to ecological sustainability, Lufa Farms recirculates all of its water as well as captures rainwater for irrigation. The hydroponic system allows for less water usage with estimates of between 50-90 percent less water being used than with conventional agriculture. The production of crops occurs in a controlled environment incorporating biological pest control methods. Biological pest control makes use of living organisms. One of the pest controls they make use of is ladybugs as a biocontrol and algae for biological products. The production of crops do not make use of synthetic pesticide, herbicides and fungicides. The produce is not purely organic for it depends on a variety of nutrients that are mined for the hydroponics system and these nutrients are classified as non-renewable (Lufa Farms, 2015a).

The production facility allows for low levels of energy usage and heating of greenhouses occur during the evening. Typically night time temperatures tend to be significantly higher than in the country due to a decrease in heating required. In order to decrease energy use Lufa Farms implemented energy curtains that insulate the greenhouses and reduce heat lost at night. Furthermore, Lufa Farms produces organic compost from the organic waste of the gardens that are sold to the community (Lufa Farms, 2015a).

The company is a private company and the land is privately owned. The contribution to the social ecological memory is through the use of biocontrol indicating that the knowledge of the ecosystem plays an important role in production. Although the controlled environment does not have access to a wider spectrum of ecosystems, the use of biocontrol is an interesting factor. Lufa Farms provides the public with the opportunity to visit the production site allowing knowledge of practice to be transferred to the public (Lufa Farms, 2015a). Lufa Farms focuses

on the consumer by supplying directly to the market and integrating knowledge learning to the consumer. This has not been a factor in the first two high-tech gardens.

6.3.4 Brooklyn Grange

Brooklyn Grange is a soil dependent rooftop farm in New York that produces 50 000 pounds of organic vegetables and herbs each year (Brooklyn Grange, 2015a). Established in 2010, Brooklyn Grange is the largest rooftop farm in the world (Hunt, 2012). This private UA enterprise is located within a high density urban environment and is identified for its use of urban space and ecological contribution to bee populations in the urban environment (Figure 6.9).

Figure 6.9: Brooklyn Grange
(Adapted from Brooklyn Grange, 2015b)

The production diversity of Brooklyn Grange is higher than that of the hydroponics system allowing plant and animal husbandry (Ackerman, Conard, Culligan, Plunz, Sutto & Whittinghill, 2014:199). The gardens produce a variety of vegetables and herbs, as well as egg-laying hens (Brooklyn Grange, 2015a). The private company also establishes and maintains bee hives around the city and produces honey for the consumer market (Woo, 2012:28). The company hosts 30

naturally managed honey hives located throughout NYC (Brooklyn Grange, 2015b). The farm grows an estimated 50 000 pounds of organic produce annually (Miller, 2015).

Brooklyn Grange consists of two sites both situated on rooftops in Brooklyn and Queens (Brooklyn Grange, 2015a). Brooklyn Grange supplies to a variety of retailers, restaurants, caterers and the public on a weekly basis through a farm stall. The enterprise structure is private and the farmer is a high income agribusiness. The economic activity of the farms is to deliver produce for trade purpose.

On a social and ecological level, the gardens convert organic waste into compost (Brooklyn Grange, 2015a). Brooklyn Grange produces their own compost by collecting food waste from restaurants in the area, as well as wood chips from local tree services, and uses this as fertilisers on their farms (Brooklyn Grange, 2015b). The land ownership is private with agreements and leases set up to make use of roof space. There is however no indication on the number of employees that contribute to the social level of sustainability.

Brooklyn Grange values the ecological aspects of the gardens by stimulating the bee population within the city. In addition, they offer training programmes to the public, and a variety of workshops are provided to educate on growing crops and bee keeping (Woo, 2012:28). In collaboration with the Refugee and Immigrant Fund, Brooklyn Grange has provided horticulture training to refugees. Youth programmes are also provided through the City Growers partnership increasing the social contribution to sustainability (Brooklyn Grange, 2015). The apprenticeship programme is provided to urban dwellers focusing on how to manage their own bee hive allowing for ecological aspects within the garden and the greater New York area (Hunt, 2012).

6.3.5 Mirai plant factory

The last innovative UA project is the Mirai plant factory located in Japan. The facility was previously used as a Sony factory and has been transformed into an urban farm. The hydroponics facility makes use of a LED lighting system to optimise production of plants in the facility (Figure 6.10). The collaboration between Mirai and General Electric (GE) lead to the development of a LED light which wavelength allows optimal plant growth (Mitchell, 2014).

Figure 6.10: Mirai Plant Factory
(Adapted from Markham, 2014)

The produce is plant-based for a consumption market. The 25 000 square feet facility can produce up to 10 000 heads of lettuce each day (Mellino, 2015). The increase in vegetable growth makes this plant more financially viable than others. The farm uses hydroponic cultivation with the use of LED lights to increase plant growth (Bamsey, Zabel, Zeidler, Gyimesi, Schubert, Kohlberg, Mengedoht, Rae & Graham, 2015:16). The plant variety is leafy vegetables where ninety-five percent of the vegetables grown can be used for cooking in comparison to soil grown vegetables allowing only 50-60 percent to be generally used (Mirai, n.d.). The factory produces four types of vegetables (Lettuce, green leaf, Sabchu leaf and Romaine), however the factory provides the option of producing a wider variety of crops on order (Mirai, n.d.).

The factory is located within an urban area. The factory was previously used as an industrial facility that was transferred into an indoor UA production system. The company focuses on

developing sites in areas where locally grown vegetables are difficult to come by or grow. Other than the Tohoku Japan factory, there are currently two small factories located in Mongolia of which one is located in the south Gobi desert and the other in Ulaanbaatar. Mirai is building a new development in Hong Kong and is looking to expand into Russia (Dickie, 2014).

The Mirai market consists of wholesales and restaurants. The enterprise structure is a private company allowing the type of farmer to be an agribusiness. The main economic activity is the production of crops in a hydroponics setup, as well as trade to sell to the market. Mirai also contributes to research and development of plant factories in collaboration with General Electric (Mirai, n.d.).

On an ecological level, indoor production with the use of the LED lights, increases yield. With regards to waste generated from crop production, the hydroponics system allows for 80 percent less food waste in comparison to land-based agriculture, and 99 percent less water is needed for the production of the plants (Mellino, 2015). Furthermore, the cultivation of crops takes place without using any pesticide (Mirai, n.d.). On a social level, the production of the plant is half automated and does not allow for a high employment rate.

The ownership of land is private with the company acquiring sites for setting up industrial plants. On a social ecological memory level the production does not incorporate any species or knowledge transfer of ecosystem functionality within the gardens. However, the knowledge generated contributes to the larger advancements of technologically-based UA.

Industrial UA Advantages and Risks

Innovative UA projects are analysed based on the concepts of UA. There are a variety of similarities between the gardens contributing towards sustainable development and increasing food security. From a food security perspective the gardens increase access, trade, production, distribution and reliable sources of vegetables. Although many of the produce are leafy greens the technology opportunity proves that food production is possible in the urban space and can produce at high levels of output. The production sites make use of resources within the urban areas and provide alternative mass production to land-based agriculture. The production is driven by selling to retailers, restaurants and in the case of Lufa Farms, directly to the public. The gardens produce large amounts of crops supplying to the larger population. Each one of the

projects address urban structural challenges and focus on providing solutions to ensure that agriculture is reintroduced within the urban space. The crop diversity is limited indicating production of leafy greens, herbs and a few other crops for consumption. Although there is limited crop diversity the ability of urban space to produce combined with technological capacity makes it possible to innovate and include a higher diversity of crop and produce food with higher nutritional values. The greenhouse structures allow for year-round crop production with a high level of accountability for the produce consumed.

The economic contribution of the gardens allows for the local economy to be stimulated for the selling of crop takes place on a local level and the money stimulates the local economy. The food security levels are increased by increase in trade, distribution and providing reliable food sources. The gardens produce for the larger community with a dependency on investment. The production type is highly specialised and in the case of Mirai, the plant is mostly automated and thus limits job opportunities. In the case of Lufa Farms, the market that they established includes various types of produce, included in the basket, increasing indirect job opportunities.

The initial cost inputs of the gardens are high, but the large amounts of crop production ensure that income is generated once a market is established. Mirai produces enough on a daily basis to ensure financial viability.

Each one of the gardens established their own market by selling directly to specific outlets based on agreements and contracts. The gardens address urban vulnerability by producing in close proximity to the consumer market. Similar as in the case of the community-based gardens, the establishment of a market proves to be challenging, but if the produce is of high quality and the supply can be consistent, this challenge can be overcome. The target group of private industrial crop production is the larger urban market and not only one group, as in the case of community-based UA.

The social contribution of the gardens are limited and provide little employment. The farmer is a highly specialised individual and in most cases knowledgeable about hydroponic crop production. The social contribution is to supply fresh produce to the urban market irrespective of income and with a focus on urban resilience. Typically, the production is for a niche market and the site allows for high quality regulated crop. The gardens require technologically advanced

innovations and large financial resources allowing for a diverse stakeholder engagement. The stakeholder engagement allows for urban restructuring through reintroducing UA into the urban space.

Each one of the gardens focus on emphasising the ecological contribution by addressing global ecological concerns associated with land-based agriculture. If the basis for integrating ecological concerns due to international agendas or to decrease the production cost the long term effect on the ecology is positive. With the hydroponic systems the water usage is lower than conventional land-based agriculture. Food waste is decreased for the production method limits crop challenges, as well as the elimination of transport dependency. The usage of pesticides is also less for greenhouses, allowing a controlled environment. Lufa Farms makes use of species to allow crop management and Brooklyn Grange incorporates bee populations into the city. Furthermore, the overflow of nutrients into the water system is excluded due to the recycling of the water. However, this type of production demands energy that is not necessary for conventional crop production. In order to address these challenges, the plant generates its own power through solar panels, has its own built in heat curtains to contain heat, and makes use of LED lights to lower energy consumption. In the case of Sky Greens, the hydro system circulates the plants to allow for natural sunlight to grow crop.

6.4 Conclusion

Sustainable development consists of a complex nature and interaction between the three spheres and UA addresses these spheres on different levels. This chapter identified two developments of UA of which one focused on the poor and the other on higher compact production of specific crops within an urban environment. Each one of these divisions contributes to sustainable developments spheres on a different level.

Currently, projects allow for two divisions (economically and socially) of UA of which each have different levels of environmental contributions. The aim is to identify and inform policy on the most applicable UA to increase urban sustainability and food security. What type of garden should policy consider to invest in and implement within the urban structure?

Community-based UA addresses poor nutrition, health, and food insecurity of the poor. Industrial UA is designed according to the larger urban challenges and looks at supplying food to

a larger growing urban population. Both of these projects have little opportunity for direct employment but the stimulation of trade and industry creates indirect job opportunities. The income generated with industrial production is high and it stimulates a formal local market. On the other hand, community UA allows alternative income for the poor and stimulates an informal local economy. Although the cost for industrialised UA is high and the nutritional value of current crop in the projects analysed are low these projects are used as examples to showcase the possibility of high food production in urban pace.

Both developments allow for social change by supplying fresh produce to consumers, closer to the market, increase accessibility, trade and production on a local level. The production happens close to the market, increase reliability and distribution and lowers dependency on conventional agriculture. Food security is increased by both spectrums of UA. The community gardens address vulnerable populations and the industrial address larger structural concerns of conventional agriculture. The first is short term aid based focused and the second focus on larger agricultural challenges and increase urban resilience by producing within the urban space at a high level to a larger market.

On an environmental level some of the community-based gardens show the ability to respond on a garden level by implementing organic production and greening of urban space. In contrast, the industrial UA gardens address global environmental concerns associated with agricultural production. The cases used for analysis indicate that industrial production addresses water, soil and chemical challenges.

It is possible to combine aspects of both to allow for urban sustainability, resilience and food security. When structuring the urban food security of Stellenbosch, the municipality needs to either implement a UA system that combines these two options or implement both gardens separately to contribute to urban sustainability. This chapter identified how community UA addresses food crises among the most vulnerable and how industrial UA increase food sustainability in the long run. Both of these are equally important and applicable to Stellenbosch's food insecurity and vulnerability and provide structural change for food insecurity if managed appropriately.

Chapter 7: Conclusion and Recommendations

7.1 Introduction

This final chapter summarises the findings of research question 1 (How can industrial UA or community-based UA contribute to food security and ensure long-term urban sustainability?) and research question 2 (Why does Stellenbosch provide the opportunity for achieving sustainability through the establishment of UA?). In response to question 1, the importance of UA contribution to sustainability of the urban area is described by identifying the urban dependency on food production through comparing current projects as a way to increase food security. Stellenbosch is presented as the ideal town for a pilot project due to its food insecurity, vulnerability, lack of food policy, and the financial and technological resources available.

7.2 Research results

Results are summarised by presenting the conclusion for research questions 1 and 2 and lastly recommendations are provided based on the research findings.

7.2.1 How can industrial UA or community-based UA contribute to food security and ensure long-term urban sustainability?

Food security consists of availability, access or effective demand, reliability and distribution. The urban vulnerable population in Southern Africa requires effective solutions to the challenges limiting food security. Based on this need an investigation was conducted into the coexistence of food production and the urban sphere (Section 2.3) to motivate for reintroducing UA into urban areas as a permanent urban feature. A literature review established the key concepts of UA, its advantages and risks to the urban area, the type of enterprises and the production of UA. The advantages and risks motivates for UA to be included in planning on a local level. The literature revealed the challenges that UA face in order to structure a policy to overcome these challenges. UA is a tool to contribute to a productive, environmentally sustainable urban space and increases resilience. A productive urban space which includes UA contributes to the complex embedded system of sustainability as expanded upon in the literature review and the sub-case studies in Chapter 6. As a guideline to achieve sustainable urbanism, the 11 Rs of sustainability were presented as basis for thinking about sustainability:

- **Reduce** dependency on external food sources that increase urban vulnerability and food insecurity
- **Reuse** space and resources available in the urban space
- **Recycle** water, waste and any other resource found within the urban space
- **Recognise** opportunities of UA and potential markets
- **Refuse** infrastructure that does not incorporate sustainable development as well as policy that does not apply a holistic understanding of a complex system
- **Replace** ineffective urban space to create productive urban space
- **Re-engineer** the urban environment to incorporate UA, this may include infrastructure and other
- **Retrain** policy makers, urban designers on the options of UA and how to apply a holistic solution perspective to urban challenges
- **Reward** organizations and companies that contribute to the sustainable development reality with regards to urban food production
- **Re-educate** population and local government on UA and effective urban design
- **Responsibility** towards the environment, poor and future generations

The 11 Rs act as a guideline to increasing urban food security through the use of UA. A review of relevant literature returned that the contribution UA brings to urban space is multidimensional. Resources available within the urban space need to be reused to increase sustainability. This research study wishes to add a 12th R to the sustainability guidelines, namely Redevelop - Redevelop urban infrastructure of physical space that incorporates the embedded and dependent structure of sustainability. Redevelopment as guideline relates to UA in the following manner:

- **Redevelop** urban resources flow to be included in UA production on any or all levels

The literature identifies aspect of UA and its contribution to urban sustainability and food security. Chapter 6 investigates existing projects and identifies their contribution to sustainability based on the key concepts of UA. The findings lead to the identification of two different perspectives in solving urban challenges and increasing food security. The one is community-based UA focused on the poor, vulnerable and food insecure producing in traditional conventional agriculture method. The other is industrial UA focused on ecological responsible production, close to the market through the use of technology and innovation. The first addresses

food crises and malnutrition among poor urban communities, and the second increases food security for a broader urban population who can afford to pay for food/ dietary variety and addresses global challenges typically associated with conventional land-based agriculture.

Research results show that both developments contribute to food security. Community UA addresses crises and functions as an aid-based solution, whereas industrial UA is concerned with structural changes of food production and supply of a larger urban space. With regards to UA's contribution to sustainability, the complex nature of sustainability needs to be addressed in order to ensure resilience. The contribution to the three spheres varies based on the type of UA.

On a social level, community-based UA increase food security and nutrition among poor urban populations by increasing access and availability of food. Furthermore, community UA increases the livelihood capacity and health of those involved in the gardens. Conversely, industrial UA allows for the fresh production of crop close to the market for a larger population than community-based UA. The lack of funding and financial productivity creates an environment where community-based gardens have low capacity to employ and the industrial UA requires high levels of specialisation thus do not employ low skilled labour. However, the production of urban crops stimulates trade, distribution in other related industries which in turn creates job opportunities.

From an economic standpoint community-based UA falls into the informal business category allowing for a slight increase in households' or gardeners' income. The production capacity allows for a local economic stimulation on a low level however, the surplus production contributes to other individuals' food security in the community although it is a limited scope. On the other hand, industrial-based UA forms part of the formal business enterprise with a higher increase in local economic stimulation in trade, distribution and related production as is the case of Lufa farms.

From a sustainable perspective the environmental contribution of the gardens to increase ecological capacity on a multidimensional level is depended on the choices the farmers make. Community UA allows for the greening of urban space and the organic production method allows for a possible increase in ecological diversity. Industrial-based UA looks at larger conventional agricultural challenges. Overall, the production type makes use of less water and

soil, captures and recycles water, and decreases agricultural waste with some of the gardens making use of species for pest management.

Based on these findings, this thesis provides a deeper insight into the evolvement of UA as a legitimate practice within urban areas. The overarching objective is to report on how UA is to be re-imagined and contribute to sustainability. Both community and industrial UA allow for the increase in the interconnected spheres of sustainability. Thus, the practical mobilisation of UA needs to apply the benefits of each to increase overall sustainability. The options are to either implement both types of UA or to produce a module that combines these designs. It all comes down to the availability of funding and the choices being made by the company or gardener and the level of sustainability they will incorporate. The practical articulation of redesigning the urban space is thus applied to the second research question within the case study of Stellenbosch.

7.2.2 Why does Stellenbosch provide the opportunity for achieving sustainability through the establishment of UA?

The town of Stellenbosch was identified as a suitable case study where a multipurpose pilot of UA could be implemented and tested. The sustainability crisis of Stellenbosch with regards to poverty, food insecurity, malnutrition, population increase, infrastructural limitations, as well as urban waste and water's limited capacity, motivates for alternative solutions. Other developing countries' urban areas face similar challenges and by testing a project with multipurpose and holistic solutions, the model can be implemented in other countries as well. In order to implement and test a pilot study, a combination of resources were needed and Stellenbosch provides the ideal location. The town contains a variety of financial, spatial and intellectual resources which can be utilised to develop a UA system with the best possible sustainable outcomes. In addition to these resources, SM furthermore wishes to become the innovation capital of South Africa, indicating the political will and motivation for structural change. This tactical venture fashions the creative and political potential to implement UA in such a way that food insecurity and vulnerability is addressed.

Policy is identified as a driver of change. Food security and sustainability take place at different levels of the political terrain. Global and national policy frameworks were used to structure the framework for the applicability of UA to realise the aims and goals. The SM relies upon these

political frameworks for guidance, but the local articulation of food security and urban sustainability is lacking with regards to local planning and implementation. The IDP provides a vague solution to urban poverty and food insecurity by stating food gardens and land transfers will address these issues (Stellenbosch Municipality, 2014:70). By addressing the urban challenges, the perspective focuses purely on aid-based solutions and does not provide administrative, financial or structural guidelines to increase sustainability of the town.

Chapter 3 provides the strategic policy direction for UA motivated by international and national policy agendas and goals. The identification of food security and urban sustainability in these documents provides the framework for local SM to structure a food policy that motivates change. The idea is to inform policy and local decision makers about the opportunity of UA based on applicable strategic policies to ensure that transformation is realised. The literature findings lead to the solution of good governance to address food insecurity and to combat policy failures. Research findings indicate a favourable policy environment for harbouring UA as based on MacRae (1999:198) guidelines in section 3.6.2 is required to ensure a structural change is achieved.

7.3 Recommendations

Based on the findings in this study, the next section aims to provide recommendations. The recommendations provided are derived from a critical consideration of food insecurity and vulnerability identified in Stellenbosch, and are further motivated by the lack of a food policy for the area. The following recommendations focus on informing and providing a basis for advancing a holistic food policy and UA project:

a) Structure a holistic UA food policy

Policy is seen as a driver of change and based on the findings of food insecurity, vulnerability and the opportunity within Stellenbosch, a food policy will guide and direct the required development. The 12 Rs of sustainability are to serve as guidelines for increasing sustainability and a policy environment similar to that of MacRae (1999), needs to reform local aims. The Cape Town food policy can serve as a reference to the design and implementation of Stellenbosch food policy.

b) Establish a pilot UA programme aimed at achieving maximum success in a complex manner and ensure the three sphere of sustainability is embedded for maximum advantage.

Derived from the learnings, a module of UA needs to be tested that combines community and industrial-based UA or establish both of these and achieve a balance where maximum sustainability is realised. The resources available in Stellenbosch provide the ideal location for such a pilot study. Furthermore, focus must be placed on incorporating maximum employment opportunities and increasing capacity of existing community gardens. This will allow the employment of low income urban dwellers or it will provide training sessions with low income households to transfer the knowledge of growing food to increase nutrition. The module of success needs to incorporate the poor (social), stimulate local economy (economic) and lastly contribute to the ecology on a variety of levels (ecology).

c) Address obstacles related to UA as identified in Section 2.7 of the literature review.

Local government needs to guide and direct the design of UA. This will allow for all stakeholders (government, institutions and intellectual organisations) to combine resources and to work towards a holistic goal. Good governance will provide the cornerstone for innovation and will ensure that obstacles are addressed. Private institutes will provide the finances required and the university and research institutes will provide the knowledge and research required.

d) Urban food initiatives in Stellenbosch need to shift from an aid-based perspective to address urban malnutrition towards a perspective of structural change for long-term sustainability.

With the use of UA as a tool for sustainable development, emphasis must be placed on what type of design is to be implemented. Based on the technological opportunities showcased in Chapter 6, Stellenbosch's innovative perspective needs to be applied for long-term structural change instead of short-term aid-based solutions. Technology is identified as a method of achieving sustainability by building resilient infrastructure, promoting inclusive and sustainable industrialization and fostering innovation (SDG 9), increase competitive and responsive economic infrastructure network (MTSF 6), increase economic infrastructure (NDP 2), improve

education, training and innovation (NDP 7) and allow for investing in sustainable economic development and infrastructure (NFSD 3).

7.4 Opportunity for future research

The research process revealed that there are opportunities for future research.

a) *Identify crops that allow UA to deliver high yields and in doing so increase the financial and nutritional viability of the practice.*

UA crop production needs to become financially viable from the sub-cases in Chapter 6 the second category of industrial UA produce soft vegetables and leafy greens, these companies are focused on producing at a level to ensure financial viability and long term success. Furthermore, there needs to be an increase in nutrition and variety of crops. Building on these findings it is possible to identify which crop is most suitable for the urban space and allows for financial and nutritional viability. Further studies are required to indicate on a scaling system which crop allows for the best yield in the Stellenbosch area.

b) *Look at the open space opportunities of UA in the town of Stellenbosch.*

Incorporating UA into the structure of the town requires an analysis of the available space. This can either be Brownfield, Greenfield, corridors between areas as well as peripheral areas or rooftop locations. The SDF locates options on a larger scale but with the focus of reusing parks and other open space an in-depth selection is needed. The proposal will be to do this through a GIS mapping system categorising the available space and identifying those that provide the greatest opportunities.

c) *Identify opportunities for the redevelopment of the current urban structure to favour UA implementation.*

Although each urban area is unique, it is possible to identify which infrastructure and urban space will provide the ideal location for UA. This is dependent on not just the open space, but access to resources such as water and urban waste for reuse in the UA project.

d) *Assess Stellenbosch's level of dependency on conventional agriculture and the global logistical food system*

It is essential to identify the urban food security status based on the dependency on external food sources. This is required not only for those communities currently experiencing food challenges, but also for the entire urban sphere. This is possible by identifying the levels of dependency on global food logistical systems and mapping the gap between food production and consumption in detail. This research must include data collection of food miles, specifically the distance that food travels before reaching the consumer. If the distance that food travels to the consumer is identified in a collective urban concept, it is possible to motivate policy to invest in local alternative solutions such as UA.

e) Identify technology and innovation to address urban challenges

This study highlighted how UA projects in developing nations have used innovation to push the boundaries of urban food production. A deeper, more technical analysis is required to suggest innovative solutions which can be integrated into Stellenbosch's urban sphere for the development of viable and effective urban food production sites. Such studies could also focus on suggesting technologies that are particularly useful for assisting mass urban food production in constricted spaces.

7.5 Research Limitations

This research study is a result of pervious research conducted and is a resubmission of the thesis. Due to the wide range of criticism received in the previous attempt, this thesis focused only on UA and its possibilities. Although the urban food system is holistic, complex and consists of a variety of aspects, UA is focused on as a solution to urban food security.

One of the main research limitations was to locate literature on UA projects for both community-based UA and industrial-based UA. Organisations' and companies' websites were used as a basis to provide details on what contribution they provide in order to achieve sustainability. Although the structure and form of UA changes and broadens a variety of key concepts of UA was identified in this study.

7.6 Concluding Remarks

This thesis provides an example of how food supply and urban reality is to be re-imagined within a sustainability framework. Understanding the contribution that UA brings to the urban space

and overall food security, motivates for a political framework to ensure structural change. The approach of a productive urban space provides the opportunity for how the urban space, irrespective of the size of the town or city, needs to be re-imagined in order to increase sustainability and to address the vast urban challenges. UA provides the opportunity to contribute to sustainability, food security and is seen as a tool for increasing these aspirations.

The design and perspective driving UA lead to a differentiation between community-based UA and industrial UA, each of which contributes to sustainability on unique levels. This thesis identifies how Stellenbosch requires a food security policy or planning and has the capacity to implement a project that aims to contribute to sustainability. Stellenbosch has the available that needs to be utilised through partnerships as well as the research and knowledge resources to test and increase food security through UA.

This thesis does not provide a resolution for which UA type design ensures the maximum sustainability and how the policy needs to be structured, but rather provide an analysis of the importance of UA on urban space to address urban challenges, and the different factors contributing to the forming of a holistic, practical food policy. However, this insight can possibly increase the knowledge of how to combine resources to determine which UA project provides the maximum benefits when considering a variety of learnings presented in the study. While, the context and the elements presented in the case study of Stellenbosch make this a unique case, theoretical learnings and insight from the contribution of UA can be relevant for applying similar understanding, planning and urban sustainability in other towns and cities.

Bibliography

Abalimi Bezekhaya. 2013. *What We Do* [Online]. Available: http://abalimi.org.za/about-abalimi/what-we-do/ [2015, September 11].

Ackerman, K., Conard, M., Culligan, P., Plunz, R., Sutto, M. & Whittinghill, L. 2014. Sustainable Food Systems for Future Cities: The Potential of Urban Agriculture. *The Economic and Social Review*, 45(2):189-206.

Altieri, M.A., Companioni, N., Canizares, K., Murphy, C., Rosset, P., Bourque, M. & Nicholls, C.I. 1999. The greening of the "barrios": Urban agriculture for food security in Cuba. *Agriculture and Human Values*, 16(2):131-140.

Amust. 2015. *Food Ladder Oasis for Afghan Women* [Online]. Available: http://www.amust.com.au/2015/06/food-ladder-oasis-for-afghan-women/ [2015, September 16].

Armstrong, D. 2000. A Survey of Community Gardens in Upstate New York: Implications for Health Promotion and Community Development. *Health and Place*, 6(4):319-327.

Austin, D. 2015. *Historic Detroit* [Online]. Available: http://historicdetroit.org/building/hazen-s-pingree-monument/ [2015, June 16].

Bamsey, M.T., Zabel, P., Zeidler, C., Gyimesi, D., Schubert, D., Kohlberg, E., Mengedoht, D., Rae, J. & Graham, T. 2015. *Review of Antarctic Greenhouses and Plant Production Facilities: A Historical Account of Food Plants on the Ice* [Online]. Available: file:///C:/Users/ElzethJVV/Downloads/ICES_2015_60.pdf [2015, February 21].

Barthel, S., Folke, C. & Colding, J. 2010. Social-ecological memory in urban gardens - Retaining the capacity for management of ecosystem services. *Global Environmental Change*, 20(2):255-265.

Baudoin, W. 2015. *With mirco-gardens, urban poor "grow their own"* [Online]. Available: http://www.fao.org/ag/agp/greenercities/pdf/FS/UPH-FS-6.pdf [2015, August 8].

Beach, G. 2015. *Urban farmers in Sao Paulo are growing food in unexpected places* [Online]. Available: http://inhabitat.com/urban-farmers-in-sao-paulo-are-growing-food-in-unexpected-places/ [2015, September 16].

Bellows, A.C. 2004. One Hundred Years of Allotment Gardens in Poland. *Food and Foodways: Explorations in the History and Culture of Human Nourishment*, 12(4):247-276.

Bergamini, N., Blasiak, R., Eyzaguirre, P., Iachikawa, K., Mijatovic, D., Nanao, F. & Surbarmanian, S.M. 2013. *UNU-IAS Policy Report: Indicators of Resilience in Social-Ecological Production Landscapes (SEPLs)*. Yokohama: United Nations University. [Online]. Available: http://archive.ias.unu.edu/resource_centre/Indicators-of-resilience-in-sepls_ev.pdf [2015, October 26].

Briley, M.H. & Lock, K. 1998. Health and peri-urban natural resource production. *Environment and Urbanization*, 10(1):89-106.

British American Tobacco (BAT). 2015. *Socio-Economic Development* [Online]. Available: http://www.batsa.co.za/group/sites/BAT_7N3ML8.nsf/vwPagesWebLive/DO7NAGXB?opendocument [2015, August 26].

Brooklyn Grange. 2015a. *Education and Projects* [Online]. Available: http://brooklyngrangefarm.com/about/education [2015, September 16].

Brooklyn Grange. 2015b. *Farms* [Online]. Available: http://brooklyngrangefarm.com/about/farms [2015, September 16].

Brown, K.H. & Jameton, A.L. 2000. Public Health Implications of Urban Agriculture. *Journal of Public Health Policy*, 21(1):20-39.

Burleigh, J.R. & Black, L.L. 2001. Supporting Farmers towards Safe Year-round vegetables in Periurban Manila. *Urban Agriculture Magazine*, 15 March. [Online]. Available: http://www.ruaf.org/supporting-farmers-towards-safe-year-round-vegetables-periurban-manila [2015, August 21].

Cidades sem Fome. 2015. *Cities without hunger. Jobs, income, providing food: Everything starts with a garden* [Online]. Available: http://cidadessemfome.org/en/#projekt_gg [2015, September 16].

City Slicker Farms. n.d. *Our Programs* [Online]. Available: http://www.cityslickerfarms.org/our-programs [2015, September 15].

Cole, D., Smith, D. & Nasinyama, G. 2008. *Healthy city harvest: Generating evidence to guide policy on urban agriculture*. Lima: CIP/ Urban Harvest and Mekerere University Press.

Community-Wealth.org. n.d. *Victory Gardens Revision Urban Farm* [Online]. Available: http://community-wealth.org/content/victory-programs-revision-urban-farm [2015, September 15].

Craig, B. 2014. Personal Interview. 8 July, Stellenbosch.

CSIR. 2015. *About us* [Online]. Available: http://www.csir.co.za/about_us.html [2015, August 25].

Deelstra, T. & Girardet, H. n.d. *Urban Agriculture and Sustainable cities* [Online]. Available: http://www.ruaf.org/sites/default/files/Theme2_1_1.PDF [2015, August 13].

De Zeeuw, H. 2000. *Management of health risks associated with urban agriculture* [Online]. Available: http://www.ruaf.org/sites/default/files/Management%20of%20health%20risks%20HdZ.pdf [2015, September 12].

Dickie, G. 2014. *Q & A: Inside the World's Largest Indoor Farm* [Online]. Available: http://news.nationalgeographic.com/news/2014/07/140717-japan-largest-indoor-plant-factory-food/ [2015, September 21].

Distell. 2015a. *Corporate Social Responsibility* [Online]. Available: https://www.distell.co.za/corporate-responsibility/ [2015, August 25].

Distell. 2015b. *About the Distell Foundation* [Online]. Available: https://www.distell.co.za/corporate-responsibility/foundation/about/ [2015, August 26].

Drescher, A.W. & Holmer, R.J. 2005. Allotment Gardens of Cagayan de Oro: Their Contribution to Food Security and Urban Environmental Management, in Knie, C. (ed.). *Urban and Peri-Urban Development: Structures, Processes and Solutions*. Cologne: Southern Asian-German Summer School Programme. 149-155.

Đurić, A., Bogdanović, N., Petrović, V., Mihajilović, M., Bogdanović, G., Šušteršić, V., Pertrović, L. & Bodganović, A. 2015. New concept for cities that produce – food for billions. *9th International Quality Conference.* [Online]. Available: http://www.cqm.rs/2015/cd1/pdf/papers/focus_1/021.pdf [2016, February 8].

Dvorsky, G. 2012. *Worlds' first commercial vertical farm opens in Singapore* [Online]. Available: http://io9.com/5954847/worlds-first-commercial-vertical-farm-opens-in-singapore [2015, September 14].

Eisenhardt, K.M. 1989. Building Theories from Case Study Research. *The Academy of Management Review*, 14(4):532-550.

Ellis, F. & Sumberg, J. 1998. Food production, urban areas and policy responses. *World Development*, 26(2):213-225.

Esau, G. 2014. Personal Interview. 8 July, Stellenbosch.

Facebook. 2015. *Food Ladder* [Online]. Available: https://www.facebook.com/foodladder [2015, September 24].

Feagan, R. 2007. The place for food: mapping out the 'local' in local food systems. *Progress in Human Geography*, 31(1):23-42.

Five Families in Dubuque: The Urban Depression 1937-1938. 2003. [Online]. Available: http://www.uni.edu/iowahist/Social_Economic/Urban_Depression/urban_depression.htm [2015, August 21].

Flaherty, M. 2013. *Farm growth means more leafy greens for Oakland* [Online]. Available: http://www.berkeleyside.com/2013/02/04/bigger-urban-farm-means-more-leafy-greens-for-oakland/ [2015, September 15].

Fletcher, J. 2008. Sustainable Tourism, in Cooper, C., Fletcher, J., Fyall, A., Gilbert, D. & Wanhill, S. (eds.). *Tourism: Principles and Practice*. Harlow: Pearson Education Limited. 214-243.

Foley, J.A, Ramankutty, N., Brauman, K.A., Cassidy, E.S., Gerber, J.S., Johnston, M., Mueller, N.D., O'Connell, C., Ray, D.K., West, P.C., Balzer, C., Bennett, E.M., Carpenter, S.R., Hill, J., Monfreda,C., Polasky, S., Rockström, J., Sheehan, J., Siebert, S., Tilman, D & Zaks. D.P.M. 2011. Solutions for a cultivated planet. *Nature*, 478:337-324.

Food and Agriculture Organization (FAO). 1996a. Rome Declaration on World Food Security. [Online]. Available: http://www.fao.org/docrep/003/w3613e/w3613e00.htm [2016, January 27].

Food and Agriculture Organization (FAO). 1996a. *The State of Food and Agriculture* [Online]. Available: http://www.fao.org/docrep/003/w1358e/w1358e.pdf [2015, September 20].

Food and Agriculture Organization (FAO). 2008. *Urban Agriculture for Sustainable Poverty Alleviation and Food Security* [Online]. Available: http://www.fao.org/fileadmin/templates/FCIT/PDF/UPA_-WBpaper-Final_October_2008.pdf [2016, January 24].

Food and Agriculture Organization (FAO). 2009. *Food for the Cities* [Online]. Available: http://www.fao.org/docrep/011/ak003e/ak003e00.htm [2015, June 7].

Food and Agriculture Organization (FAO). 2011. *Food, agriculture and cities: The challenges of food and nutrition security, agriculture and ecosystems management in an urbanizing world* [Online]. Available: http://www.fao.org/3/a-au725e.pdf [2015, August 11].

Food and Agriculture Organization (FAO). 2012. *Growing Greener Cities in Africa*. First status report on Urban and Peri-urban Horticulture in Africa. Rome: Food and Agriculture Organization of the United Nations [Online]. Available: http://www.fao.org/docrep/016/i3002e/i3002e.pdf [2015, September 15].

Food and Agriculture Organization (FAO). 2015a. *The State of Food Insecurity in the World: Meeting the 2015 international hunger targets: taking stock of uneven progress* [Online]. Available: http://www.fao.org/3/a-i4646e.pdf [2016, January 27].

Food and Agriculture Organization (FAO). 2015b. *Urban and Peri-Urban Horticulture*: *FAO's Approach* [Online]. Available: http://www.fao.org/ag/agp/greenercities/en/approach/index.html [2015, August 8].

Food Ladder. 2014. *Food Ladder forms international alliance launches 'food ladder India'* [Online]. Available: http://foodladder.org.au/food-ladder-forms-international-alliance-launches-food-ladder-india/ [2015, September 16].

Food Ladder. 2015. *We work where the need is the greatest* [Online]. Available: http://us4.campaign-archive2.com/?u=c108911f4f9d3fac593d9d9f6&id=a8532454e3 [2015, September 16].

Forkes, J. 2007. Nitrogen balance for the urban food metabolism of Toronto, Canada. *Resource, Conservation and Recycling*, 52(1):74-94.

George, A.L & Bennet. A. 2004. *Case Studies and Theory Development in the Social Sciences*. Cambridge: MIT Press.

Girardet, H. 1996. *The GAIA Atlas of Cities: New Directions for Sustainable Urban Living*. London: Gaia Books Limited.

Gotham Greens. 2015a. *Our Greenhouses* [Online]. Available: http://gothamgreens.com/our-farm/ [2015, September 13].

Gotham Greens. 2015b. *Our Produce* [Online]. Available: http://gothamgreens.com/our-produce/ [2015, September 13].

Gotham Greens. 2015c. *Our Story* [Online]. Available: http://gothamgreens.com/our-story/ [2015, September 13].

Gotham Greens. 2015d. *Sustainable Agriculture* [Online]. Available: http://gothamgreens.com/sustainable-agriculture [2015, September 13].

Gray, J. 2015. *Sustainable Build: Brownfield Sites* [Online]. Available: http://www.sustainablebuild.co.uk/BrownfieldSites.html [2015, August 11].

Green Renaissance. 2010. *Abalimi Bezekhaya - first Nedbank Green Trust short film* [Online]. Available: http://www.greenrenaissance.co.za/blog/abalimi-bezekhaya-first-nedbank-green-trust-short-film [2015, September 24].

Greig, A., Hulme, D. & Turner, M. 2007. *Challenging Global Inequality: Development Theory and Practice in the 21st Century*. Hampshire: Palgrave Macmillan.

Halais, F. 2014. *Can urban agriculture work on a commercial scale?* [Online]. Available: http://citiscope.org/story/2014/can-urban-agriculture-work-commercial-scale [2015, September 21].

Hamm, M. W. & Baron, M. 1999. Developing an Integrated, Sustainable Urban Food System: The Case of New Jersey, United States, in Koc, M., MacRae, R., Mougeot, L.J.A. & Welsh, J. (eds.). *For Hunger-Proof Cities: Sustainable Urban Food Systems*. Ottawa: International Development Research Centre. 54-69.

Hart, C. 1998. *Doing a Literature Review: Realising the Social Science Research Imagination*. London: Sage.

Harvest of Hope. n.d. *Our Story* [Online]. Available: http://harvestofhope.co.za/about-us/our-story/ [2015, September 11].

Haysom, G. (ed.). 2011. *The Stellenbosch Food System: Towards 2030 - Draft Strategy Document*. Food Security Research Project. The Hope Project and Sustainability Institute, Stellenbosch.

Haysom, G. n.d. Urban Agriculture and Food Security, in *Sustainable Neighbourhood Design Manual*. Stellenbosch: Sustainability Institute. 121-135. [Online]. Available: http://www.cityenergy.org.za/uploads/resource_139.pdf [2015, August 17].

Haberman, D., Gillies, L., Canter, A., Rinner, V., Pancrazi, P. & Martellozzo, F. 2014. The Potential for Urban Agriculture in Montreal: A Qualitative Assessment. *Geo-Info*, 3:1101-1117.

Howard, C. 2014. *Guerrilla gardening: a report from the front line* [Online]. Available: http://www.theguardian.com/lifeandstyle/gardening-blog/2014/oct/10/guerrilla-gardening-a-report-from-the-frontline [2015, Augustus 9].

Howe, J., Viljoen, A. & Bohn, K. 2005. New Cities with more Life: Benefits and Obstacles, in Viljoen, A. (ed.). *Continuous Productive Urban Landscape: Designing Urban Agriculture for Sustainable Cities*. Oxford: Architectural Press. 56-64.

Hunt, C. 2012. *Brooklyn Grange, World's Largest Rooftop Farm, Gets Second Location and Bees!* [Online]. Available: http://gracelinks.org/blog/1072/brooklyn-grange-world-s-largest-rooftop-farm-gets-second-lo [2015, September 16].

Husbands, W. 1999. Food Banks and Anithunger Organizations, in Koc, M., MacRae, R., Mougeot, L.J.A. & Welsh. J. (eds.). *For Hunger-Proof Cities: Sustainable Urban Food Systems*. Ottawa: International Development Research Centre. 103-109.

Iles, J. 2005. The social role of community farms and gardens in the city, in Viljoen, A. (ed.). *Continuous Productive Urban Landscapes: Designing Urban Agriculture for Sustainable Cities*. Oxford: Architectural Press. 82-88.

Jonathan, C. & Frayne, B. 2010. *The Invisible Crisis: Urban Food Security in Southern Africa*. AFSUN: Cape Town.

Kaufman, J. & Bailkey, M. 2000. *Farming Inside Cities: Entrepreneurial Urban Agriculture in the United States*. Cambridge: Lincoln Institute of Land Policy.

Kelly, C., Schulschenk, J., Landman, A. & Haysom, G. 2012. Food: A sustainable system for Stellenbosch, in Swelling, M., Loots, R. & Sebitosi, B. (eds.). *Sustainable Stellenbosch: Opening Dialogues*. Stellenbosch: Sun Press. 102-116.

Koc, M., MacRae, R., Mougeot, J.A. & Welsh, J. 1999. Introduction: Food Security is a Global Concern, in Koc, M., MacRae, R., Mougeot, L.J.A. & Welsh, J. (eds.). *For Hunger-Proof Cities: Sustainable Urban Food Systems*. Ottawa: International Development Research Centre. 1-10.

Koch, J. 2011. *The Food Security Policy Context in South Africa*. Brasilia: International Policy Centre for Inclusive Growth [Online]. Available: http://www.ipc-undp.org/pub/IPCCountryStudy21.pdf [2016, February 2].

Lang, T. 1999. Food Policy for the 21st Century: Can It Be Both Radical and Reasonable?, in Koc, M., MacRae, R., Mougeot, L.J.A. & Welsh, J. (eds.). *For Hunger-Proof Cities: Sustainable Urban Food Systems*. Ottawa: International Development Research Centre. 216-224.

Lufa Farms. 2014. *Our Farms* [Online]. Available: http://lufa.com/en/our-farms.html [2015, September 14].

Lufa Farms. 2015a. *About the Farm* [Online] Available: https://montreal.lufa.com/en/about-the-farm [2015, September 14].

Lufa Farms. 2015b. *How it Works* [Online]. Available: https://montreal.lufa.com/en/how-it-works [2015, September 14].

MacNair, E. 2002. *The Garden City Handbook* [Online]. Available: http://www.polisproject.org/PDFs/the%20garden%20city%20handbook.pdf [2015, October 28].

MacRae, R. 1999. Policy Failure in the Canadian Food System, in Koc, M., MacRae, R., Mougeot, L.J.A. & Welsh, J. (eds.). *For Hunger-Proof Cities: Sustainable Urban Food System*. Ottawa: International Development Research Centre. 182-194.

Madaleno, I. 2000. Urban agriculture in Belem, Brazil. *Cities*, 17(1):73-77.

Markham, D. 2014. *Former semiconductor factory becomes world's largest indoor farm* [Online]. Available: http://www.treehugger.com/clean-technology/former-semiconductor-factory-becomes-worlds-largest-indoor-farm.html [2015, September 21].

Medium- Term Strategic Framework (MTSF) 2014-2019. 2014. *Pretoria: Department Planning, Monitoring and Evaluation* [Online]. Available: http://www.poa.gov.za/MTSF%20Documents/MTSF%202014-2019.pdf [2015, July 14].

Mellino, C. 2015. *World's largest 'Vegetable Factory' Revolutionizes Indoor Farming* [Online]. Available: http://ecowatch.com/2015/01/28/worlds-largest-indoor-farm/ [2015, September 19].

Metropolis. n.d. *Cities without Hunger - community garden* [Online]. Available: http://policytransfer.metropolis.org/case-studies/brasil-sao-paulo-community-gardens [2015, September 16].

Miles, L. 2007. Physical activity and health. *Nutrition Bulletin*, 32(4):314-363.

Miller, M.J. 2015. A *Farm Grows in Brooklyn – on the Roof* [Online]. Available: http://news.nationalgeographic.com/news/2014/04/140429-farming-rooftop-gardening-brooklyn-grange-vegetables-science-food/ [2015, September 16].

Mirai. n.d. *Characteristics of Vegetables* [Online]. Available: http://miraigroup.jp/en/vegetables [2015, September 21].

Mireri, C. 2002. Private Investment in Urban Agriculture in Nairobi, Kenya. *Urban Agriculture Magazine,* August: 19-21. [Online]. Available: http://www.alnap.org/resource/7733 [2015, July 15].

Mitchell, B. 2014. *The World's largest indoor farm produces 10000 heads of lettuce a day in Japan* [Online]. Available: http://inhabitat.com/the-worlds-largest-indoor-farm-produces-10000-heads-of-lettuce-a-day-in-japan/ge-mirai-lettuce-farm-4/ [2015, September 21].

Mok, K. 2013. *Fresh and city-grown: Montreal's second rooftop farm opens* [Online]. Available: http://www.treehugger.com/green-food/second-lufa-farms-rooftop-urban-farm-opens-laval-quebec-canada.html [2015, September 14].

Mougeot, L.J. 1994. *Urban Food Production: Evolution, Official Support and Significance*. Ottawa: International Development Research Centre.

Mougeot, L.J. 2000. Urban Agriculture: Definitions, Presence, Potentials and Risks, in De Zeuw, H. & Gudel, S. (eds.). *Growing Cities Growing Food: Urban Agriculture on the Policy Agenda*. Faldafing: German Foundation for International Development.

Mougeot, L.J. 2006. *Growing better cities: urban agriculture for sustainable development*. Ottawa: International Development Research Centre.

Mougeot, L.J. & Welsh, J. (eds.). 2000. *For Hunger-Proof Cities: Sustainable Urban Food Systems*. Ottawa: International Development Research Centre. 182-194.

Morris, A. E. 2003. *History of Urban Form: Before the Industrial Revolution*. 3rd Edition. New York: Routledge.

Murray-White, J. 2015. *Greenfield Sites* [Online]. Available: http://www.sustainablebuild.co.uk/greenfieldsites.html [2015, August 11].

Nasr, J. & Kaldjian, P. 1997. Agriculture in Middle Eastern Cities: Commonalities and Contrasts. *Arid Lands Newsletter*, (42). [Online]. Available: https://ag.arizona.edu/OALS/ALN/aln42/nasr.html [2015, July 21].

Obosu-Mensah, K. 2002. Changes in Official Attitudes Towards Urban Agriculture in Accra. *African Studies Quarterly*, 6(3):19-32.

Orlikowki, W.J. & Baroudi, J.J. 1991. Studying Information Teconology in Organizations: Research Approached and Assumptions. *Information Systems*, 2(1):1-8.

Pearson, D. & Hodgkin, K. 2010. *The role of community gardens in urban agriculture*. Canberra: University of Canberra.

Pearson, L.J, Pearson, L. & Pearson, C.J. 2010. Sustainable urban agriculture: stocktake and opportunities. *International Journal of Agriculture Sustainability*, 8(1-2):7-18.

Phakathi, B. 2013. *Stellenbosch the silicon valley of South Africa* [Online]. Available: http://www.bdlive.co.za/business/technology/2013/11/15/stellenbosch-the-silicon-valley-of-south-africa [2015, August 25].

Posthumus, C. 2013. Urban Agriculture: Guerrilla Gardening: Future trends. *SABI Magazine*, 5(6), August/September: 14-20.

Randolph, J.J. 2009. A Guide to Writing the Dissertation Literature Review. *Practical Assessment, Research & Evaluation*, 14(13):1-13.

Redwood, M. 2009. Introduction, in Redwood, M. (ed.). *Agriculture in Urban Planning: Generating Livelihoods and Food Security*. London: Earthscan. 1-19.

Reinhardt, C. n.d. *Farming in the 1940's: Victory gardens* [Online]. Available: http://www.livinghistoryfarm.org/farminginthe40s/crops_02.html [2015, August 9].

Remgro Limited. 2015a. *Environment* [Online]. Available: http://remgro.com/governance-and-sustainability/environment/ [2015, August 25].

Remgro Limited. 2015b. *Corporate Social Investment* [Online]. Available: http://remgro.com/governance-and-sustainability/corporate-social-investment/ [2015, August 26].

Republic of South Africa. 1996. *Constitution of the Republic of South Africa. Act 108 of 1996*. Pretoria: Government Printer.

Republic of South Africa. 2002. *Integrated Food Security Strategy IFSS of 2002* [Online]. Available: http://www.pmg.org.za/bills/municipalsystemsact.htm [2015, August 13].

Republic of South Africa. 2008. National Framework for Sustainable Development (NFSD). South Africa.

Republic of South Africa. 2012. National Development Plan 2030: Our Future-make it work (NDP). South Africa.

Resh, H.M., 2013. *Hydroponic Food Production: A Definite Guidebook for the Advanced Home Gardener and the Commercial Hydroponic Growers*. London: CRC Press.

Revision Urban Farm. 2013. *Victory Programs - Revision Urban Farm Brochure* [Online]. Available: https://www.vpi.org/wp-content/uploads/2013/05/2013-ReVision-Urban-Farm-Brochure.pdf [2015, September 15].

Rimol Greenhouse Systems. 2015. *Revision Urban Farms* [Online]. Available: https://www.rimolgreenhouses.com/revision-urban-farms [2015, September 15].

Rockström, J., Steffen, W., Noone, K., Persson, A., Chapin, F.S., Lambin, E., Lenton, T.M., Scheffer, M., Folke, C., Schellnhuber, H.J., Nykvist, B., De Wit, C.A., Hughes, T., Van der Leeuw, S., Rodhe, H., Sörlin, S., Snyder, P.K., Costanza, R., Svedin, U., Falkenmark, M., Karlberg, L., Corell, R.W., Fabry, V.J., Hansen, J., Walker, B., Liverman, D., Richardson, K., Crutzen, P. & Foley, J.A. 2009. Planetary Boundaries: Exploring the safe operating space for humanity. *Ecology and Society*, 14(2):32.

Schulschenk, J. 2009. Benefits and limitations of local food economies to promote sustainability: A Stellenbosch case study. Unpublished masters dissertation. Stellenbosch: University of Stellenbosch.

Seawright, J. & Gerring, J. 2008. Case Selection Techniques in Case Study Research. *Political Research Quarterly*, 61(2):294-308.

Shaw, D.J. 2007. *World Food Security: A History since 1945*. 1st ed. Hamsphire: Palgrave Macmillan.

Sky Greens. 2014a. *About Sky Greens* [Online]. Available: http://www.skygreens.com/about-skygreens/ [2015, September 14].

Sky Greens, 2014b. *Technology* [Online]. Available: http://www.skygreens.com/technology/ [2015, September 14].

Sky Greens. 2014c. *Sky Greens Vegetables* [Online]. Available: http://www.skygreens.com/skygreens-vegetables/ [2015, September 14].

Small, R. 2009. *Abalimi* [Online]. Available: http://www.farmgardentrust.org/resourcesdir/research/ABALIMICaseStudyJune09.pdf [2015, September 11].

Smith, J., Nasr, J. & Ratta, A. 2001. Urban Agriculture Yesterday and Today. in *Urban Agriculture: Food, Jobs and Sustainable Cities*. Urban Agriculture Network [Online]. Available: http://jacsmit.com/book/Chap02.pdf/ [2015, September 12].

Smith, J., Ratta, A. & Bernstein, J. 1996. *Urban Agriculture: An opportunity for Environmentally Sustainable Development in Sub-Saharan Africa*. Washington: World Bank.

Somerville, C., Cohen, M., Pantanella, E., Stankus, A. & Lovatelli, A. 2014. *Small-scale aquaponics food production. Integrated fish and plant farming* [Online]. Available: http://www.fao.org/3/a-i4021e/index.html [2015, September 22].

Statistics South Africa. n.d. *Stellenbosch Municipality* [Online]. Available: http://www.statssa.gov.za/?page_id=993&id=stellenbosch-municipality [2015, August 19].

Stellenbosch Municipality. 2012a. *"3rd Generation" Integrated Development Plan (2012-2017).* Stellenbosch: Stellenbosch Municipality.

Stellenbosch Municipality. 2012b. *Spatial Development Framework (SDF).* Stellenbosch: Stellenbosch Municipality.

Stellenbosch Municipality. 2014. *Integrated Development Plan (IDP) Second Review of the third Generation IDP (2012-2017).* Stellenbosch: Stellenbosch Municipality.

Stellenbosch University (SU). 2010a. *Hope Project* [Online]. Available: http://thehopeproject.co.za/hope/projects/Cross-cuttingInitiatives/CentreForStudiesInComplexity/pages/about.aspx [2015, August 25].

Stellenbosch University (SU). 2010b. *Policy: Integrated Management of Sustainability* [Online]. Available: http://www0.sun.ac.za/sustainability/media/policie%20documents/Volhoubaarheidsbeleid2010%20-%20Eng.pdf [2015, November 30].

Stellenbosch University (SU). 2013. *Stellenbosch University - Institutional Intent and Strategy (2013-2018).* Stellenbosch: Stellenbosch University [Online]. Available: http://www.sun.ac.za/english/management/src/Documents/Archive/Institutional%20Intent%20and%20Strategy%202013-2018.pdf [2015, October 30].

Stone, D. 2014. *When Gardening is Graffiti* [Online]. Available: http://onward.nationalgeographic.com/2014/04/16/when-gardening-is-graffiti/ [2015, August 9].

Swilling, M. & Annecke, E. 2012. *Just Transitions: Explorations of sustainability in an unfair world.* Cape Town: UCT Press.

Taha, H. 1997. Urban climates and heat islands: albedo, evapotranspiration, and anthropogenic heat. *Energy and Buildings*, 25(2):99-103.

Temp, H.D. 2015. International Urban Food Network (IUFN) [Online]. Available: http://www.iufn.org/en/iufninterview/dietertemp/ [2015, September 16].

Thomas, M. 2013. *City Slicker Farms breaks ground on new West Oakland urban farm* [Online]. Available: http://oaklandnorth.net/2013/02/04/city-slicker-farms-breaks-ground-on-new-west-oakland-urban-farm/ [2015, September 15].

Thone, F. 1943. Victory Gardens. *The Science News-Letter*, 43(12):186-188.

Tixier, P. & de Bon, H. 2006. Urban Horticulture, in Van Veenhuizen, R. (ed.). *Cities Farming for the Future: Urban Agriculture for Green and Productive Cities.* Philippines: IIRR/RUAF Foundation/IDRC. 313-446.

United Nations (UN). 2012. *The Future We Want* [Online]. Available: http://www.uncsd2012.org/content/documents/727The%20Future%20We%20Want%2019%20June%201230pm.pdf [2015, August 31].

United Nations (UN). 2015a. *The Millennium Development Goals Report 2015*. New York: United Nations.

United Nations (UN). 2015b. Transforming Our World: The 2030 Agenda for Sustainable Development [Online]. Available: https://sustainabledevelopment.un.org/content/documents/21252030%20Agenda%20for%20Sustainable%20Development%20web.pdf [2016, January 30].

United Nations Human Settlement Programme (UN-Habitat). 2013. *State of World's Cities 2012/2013: Prosperity of Cities*. New York: Routledge.

United Nations Sustainable Development (UNSD). 1992. UN Conference on Environment & Development, Agenda 21. 3-14 June, Rio de Janerio, Brazil.

Van den Berg, W. 2010. *Stellenbosch Food Security Initiative Food Aid Intervention Study Research Recommendations* [Online]. Available: http://www.wesselvandenberg.com/uploads/5/6/7/7/5677355/qualitative_synthesis_document_28.11.2010.pdf [2015, November 4].

Van Veenhuizen, R. 2006. Introduction: Cities, Farming for the Future, in Van Veenhuizen, R. (ed.). *Cities Farming for the Future: Urban Agriculture for Green and Productive Cities.* Philippines: RUAF Foundation, IDRC and HRR. 1-18.

Van Veenhuizen, R. & Dason, G. 2007. *Profitability and sustainability of urban and peri-urban agriculture*. Rome: Food and Agriculture Organization.

Verhoeven, J.T.A. & Meuleman, A.F.M. 1999. Wetlands for wastewater treatment: Opportunities and limitations. *Ecological Engineering*, 12(1-2):5-12.

Viljoen, A. & Bohn, K. 2014. *Second Nature Urban Agriculture: Designing Productive Cities*. New York: Routledge.

Viljoen, A., Bohn, K. & Howe, J. 2005. More Food with less space: Why bother?, in Viljoen, A. (ed.). *Continuous Productive Urban Landscape: Designing Urban Agriculture for Sustainable Cities*. Oxford: Architectural Press. 19-31.

Viljoen, A. & Bohn, K. 2005. More space with less space: An urban design strategy, in Viljoen, A. (ed.). *Continuous Productive Urban Landscape: Designing Urban Agriculture for Sustainable Cities*. Oxford: Architectural Press. 10-16.

Victory Gardens for 1943. 1943. *The American Journal of Nursing*, 43(4), April: 370.

Victory Programmes Incorporated. 2015. *ReVision Urban Farm* [Online]. Available: https://www.vpi.org/revision/ [2015, September 15].

Weaver, J.H, Rock, T.M. & Kusterer, K. 1997. *Achieving Broad-Based Sustainable Development: Governance, Environment and Growth with Equality.* Weat Hartford: Kumarian Press.

Welman, C., Kruger, S.J. & Mitchell, B. 2005. *Research Methodology*. 3rd Edition. Oxford: Oxford University Press.

White, B. 2008. *A Garden Grows in Oakland. The Wall Street Journal* [Online]. Available: http://www.wsj.com/articles/SB121926371492857735 [2015, September 15].

Woo, K.L. 2012. The New York City Laboratory: Science Discovery in an Urban Environment. *All about Mentoring*, 41:27-31. [Online]. Available: http://development.esc.edu/media/ocgr/publications-presentations/All_About_Mentoring-_Issue-41_Summer_-2012.pdf#page=29 [2016, February 21].

Woolley, H. 2003. *Urban Open Spaces*. London: Spon Press.

World Commission on Environment and Development (WCED). 1987. *Our Common Future*. Oxford: Oxford University Press.

World Health Organization (WHO). 2016. *Food Security*. [Online]. Available: http://www.who.int/trade/glossary/story028/en/ [2016, January 27].

Zimmer, L. 2012. *The World's first commercial vertical farm opens in Singapore* [Online]. Available: http://inhabitat.com/the-worlds-first-commercial-vertical-farm-opens-in-singapore/sky-greens-singapore-worlds-first-vertical-farm-2/ [2015, September 14].