Circular Economy in the Horticulture Sector

An exploratory study of the smallholder farmers in the horticulture sector in Kenya

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-Abstract-

The next decades, Kenya will experience one of the highest population growths in the world. This puts an enormous pressure on its agricultural sector in terms of producing enough food without undermining the environment and the country's resources. In order to address this challenge, circular economy has been presented as a promising approach incorporating both environmental, social and economic aspects. Circular economy in the agricultural sector is an understudied approach making it relevant to explore. On this basis, this study aims to investigate the main determinants and their impacts on the circular economy adoption amongst the smallholder horticulture farmers in Kenya. Through six interviews with Kenya horticulture farmers and four key informant interviews, we were able to identify seven main determinants including existing knowledge and awareness; social capital, norms and traditions; infrastructure; market conditions and information; institutions and knowledge transfer; financial access and incentives; and climate change. Analysing each determinant, we demonstrate how they act as drivers, barriers or both. We further illustrate their interconnectedness. It is revealed that the majority of the determinants impede the transition toward more circular practices. Particularly traditional farming practices, lack of governmental support and enforcement, poor infrastructure, climate change, lack of market for sustainable products and limited access to finance hinder the transition. Opposite, social capital, the engagement of NGOs and export companies as well as some traditional farming practices are found to be drivers of the adoption. Even though there is still a long way to go before a successful adoption is reached, the approach should not be neglected. The circular economy practices that are already adopted amongst the smallholder farmers are found to have several positive impacts related to the environment, productivity, food safety and the economy. However, the concept needs to be further developed within the agricultural sector. We emphasise the importance of taking the context into consideration in order to make the approach applicable. Concluding, our findings are revealed to have practical implications for the actors involved in the horticulture sector in Kenya as well as theoretical implications for future research.

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1 Introduction

The world's population continues to grow and is expected to increase one third by 2050 with more people looking for increased prosperity. The population growth is particularly going to take place in Africa. This development puts an enormous pressure on the environment and the world's resources, which are becoming more difficult to extract due to scarcity. As a consequence of the population growth, the global food demand will increase and the agricultural production has to keep pace (van Houten, 2014). It is well-known that farming needs to become smarter and more efficient to meet the global food demand, protect the environment, ensure safe food and combat commercial pressures on farmers. Worldwide, the agricultural production accounts for 70 percent of water use and more than 30 percent of greenhouse gas emissions. Furthermore, 50 percent of the world's habitable land is taken up by the agricultural sector (Ward, Holden, White & Oldfield, 2016). It contributes to and is at the same time threatened by climate change disproportionately affecting the 500 million smallholder farmers that produce 80 percent of the food consumed in developing countries (SNV World, 2018*)*. Thus, the agricultural sector is at the centre of various challenges.

The constantly increasing levels of development and urbanisation continue to add to the challenge of increased demand for food per person. Higher-income diets tend to consist of more calories and of fewer staple foods, which are instead replaced by more land-intensive food groups. This results in a much steeper increase in worldwide feed demand than suggested by the increase in population alone. Thus, it has been argued by observers that we need to produce more food in the next 40 years than we have done since the dawn of agriculture around 8,000 years ago. So far, the world's increasing food demand has to a large extent been matched by improved technology, increasing the areas of cultivated land and an increase in agricultural productivity. Developments through mechanisation, fertilisers, pesticides and specialist tools have generally meant a plentiful supply of feed for both human and animal consumption. However, these approaches are not sustainable long-term and bound to meet future challenges (Mottram, 2018).

There is theoretically enough land in the world to meet the increasing demand in the medium term, however, if you simply continue to expand the amount of cultivated land, specific and significant problems would arise from doing so. First, the amount of available arable land is in decline primarily due to erosion and pollution. Estimations show that as much as a third of arable land has been lost in the last 40 years. Second, the areas most suited for agricultural expansion lie in South America and Africa and lack the proper surrounding infrastructure to enable large-scale agriculture and distribution in the near-term. As there will always remain a degree of locality to crop food production, those areas that are not able to expand cannot be supplemented by land thousands of miles away. Third, conversion to cultivated land puts pressure on complex ecosystems, which can have serious consequences. Most new farmland is created by deforestation, which destroys natural habitats, increases carbon emissions and drives global warming. Increased emissions and global temperatures lead to more adverse weather patterns and in turn create a harder general climate to grow crops in. The changing nature of our environment emphasises a strong need for a change in production (Mottram, 2018).

1.1 Case Selection and Research Gaps

It is predicted that the highest damages from climate change will be experienced in the agricultural sector in Sub-Saharan Africa as this region already endures high heat and low precipitation (Kabubo-Mariara & Karanja, 2007). This coupled with the high population growth, resulting in an increased demand for food, make the region highly relevant to focus on. Kenya, in particular, has in recent years experienced a rapidly expanding population, which is set to continue, and a shortage of high potential arable land leading to imbalances between the national demand for food and supply. More specifically, Kenya is constrained by many inter-related environmental issues such as poor water management, soil erosion, declining soil fertility, frequent dry spells, flooding and land degradation (Kamwendwa, 2013). Traditional agricultural practices have diminished soil productivity to the extent that the soils are depleted of nutrients and therefore unable to naturally sustain crop productivity. This has resulted in declining productivity in the agricultural sector (Kabubo-Mariara & Karanja, 2007). Hence, a crucial challenge remaining for the agricultural sector in Kenya is to meet food demand without undermining the environment further. Besides the mentioned issues, Kenya also faces huge challenges managing the level of waste in the food chain. In

2013, an estimated 50 percent of production was lost in post-harvest manoeuvres. The urgency of the mentioned challenges makes Kenya an interesting and relevant case to study. Understanding these challenges and how they can be solved is therefore important for future agricultural policies and interventions in Kenya.

Agriculture remains one of Kenya's most important, but neglected, potential competitive advantages in the global economy (Byanyima, 2010). In 2017, the sector contributed to 25 percent of Kenya's GDP and employed 70 percent of the workforce (Export.gov, 2017). The sector has huge development potential due to the prevalence of smallholder and subsistence farmers in optimisation and aggregation of production as well as the connection to export markets, which have great economic implications for a large number of the poorest people in the world (Bouri et al., 2015). Due to the importance of the sector, it is crucial to make good use of its potential. Smallholders dominate the agricultural sector in Kenya accounting for at least 75 percent of the country's total agricultural output (Were, 2016). Thus, increasing productivity, efficiency and economic returns to smallholder farming in a sustainable manner becomes a central challenge to achieving global poverty reduction, meeting the increasing food demand and the environmental management objectives (Naab, Mahama, Yahaca & Prasad, 2017). Due to the importance of smallholder farmers in Kenya and their central role in addressing the challenges the country faces, they will be the focus of this project.

In order to respond to the pressing issues, focus has been directed toward sustainable agriculture, which is often understood to incorporate both social, environmental and economic aspects (Allen, Van Dusen, Lundy & Gliessman, 1991). Several approaches have been called attention to in the debate surrounding sustainable agriculture (Verhagen, Blom, van Beek & Verzandvoort, 2017). Finding the most appropriate way to solve the pressing issues is, however, difficult as many approaches overlap with each other. Further, certain methods and technologies are often not applicable in all contexts. Therefore, there are no clear evidence of which approach is better. Recently, circular economy has been promoted as another approach to sustainable agriculture. It has been emphasised as a way to address the challenges facing the agricultural sector. In particular, reusing livestock manure and organic material to improve the soil structure can help to maintain or even increase the productivity of the soil (Jun & Xiang, 2011). It contrasts with the linear economic model, which has been

dominating the production of food and proven particularly material and energy intensive. It is foreseen to not only involve more sustainable production and environmental benefits but can also entail business opportunities such as material savings, increased productivity and new jobs (van Houten, 2014). In agriculture, the core of circular economy is to promote the circular utilisation of agricultural resources as well as reduce, reuse and recycle activities in production (Jun & Xiang, 2011). Due to the recent focus on circular economy in agriculture, limited literature on the topic exists and few projects have been carried out in the name of circular economy. This research gap together with its promising potential to address the raised challenges makes circular economy in the agricultural sector in Kenya highly relevant to investigate.

Due to the fact that the agricultural sector entails various sub-sectors and different modes of production, we have chosen to specify our research to focus on the horticultural sector in Kenya. The horticulture sector is the largest sub-sector of agriculture, contributing to 33 percent of the agricultural GDP (Kangai & Gwademba, 2017) and is therefore an important part of the Kenyan economy. The promise of circular economy sounds immediate attractive but one needs to understand the practices of the horticultural smallholder farmers and the determinants affecting a transition toward more circular practices in order to implement it. Based on the aforementioned background, we have come to the following research question:

"What are the main determinants affecting circular economy adoption amongst smallholder farmers in Kenya's horticulture sector and how do these impact the adoption?

To answer the research question, we first start by reviewing the literature within circular economy in general and more specifically in the agricultural sector. We conclude on the concept and come up with an understanding that we use throughout the paper. Second, to form the basis of our research, we look at previous identified determinants for the adoption of circular economy and sustainable agriculture approaches, which help us construct a preliminary analytical framework. Third, we present and discuss our methodological approach. Fourth, our empirical data and key findings are presented followed by an analysis hereof. Fifth, we discuss our findings in the light of the practical and theoretical implications. Sixth, we give a short summary of the findings and conclude on the research question. Finally, we reflect on our methodological approach and further research.

2 Literature Review

This chapter aims to review the background, literature and discussion of circular economy and more specifically we will look into the concept within the agricultural sector. This allows us to conceptualise and delimit the variable to fit our research. We will cover the current state of knowledge within the field of circular economy relevant to our project, its limitations and how our research can contribute to develop new knowledge within the field. We cover the various definitions and the critical debate surrounding circular economy and its implementation. First, the linear economic model is outlined followed by the circular economy model. Second, the concept of circular economy in the agricultural sector is discussed drawing on various approaches within the field. Building on this, we conclude on the concept to formulate a unified understanding of circular economy in the agricultural sector that we use throughout the paper. Finally, literature examining the main determinants for the adoption of circular economy practices in general and for other sustainable agricultural approaches is reviewed and forms the basis of an analytical framework, which is formulated to guide our further research.

Organisational and industrial practices are occasionally ahead of academia in exploring new concepts, therefore, it sometimes makes sense to put academic corpus into perspective by making use of different sources. Therefore, literature used in this assignment include reports, policy papers, "think tank" institutions, and technical contributions, which are not necessarily published papers validated by usual scholarly procedures but still professional and research-based contributions. This literature is referred to as 'grey literature' by De Jesus & Mendonça (2017). Using a mix of academic and grey literature ensure a complimentary review from multiple types of documents and sources making the assignment methodologically robust. Moreover, examining both bodies of literature helps giving a picture of how the concept has been applied in practice globally.

2.1 Linear Economy

Linear economy has been the prevalent economic model since the early days of the industrialisation following a "take-make-dispose" system. Companies harvest and extract materials and manufacture them into products. The products are sold to consumers, who ultimately discard them when they no longer serve their purpose. In a model like this, raw

material is in constant demand. In 2010, 65 billion tons of resources were extracted globally and entered the economic system. In 2020, this number is expected to increase to 82 billion tons, which is an increase of more than 25 percent (Ellen MacArthur Foundation, 2013:15). The Ellen MacArthur Foundation argues that a system, which is based on consumption rather than on restorative use of non-renewable resources, leads to significant losses of value and have negative effects along the material chain.

The world is now consuming more than the productivity of the Earth's ecosystems can provide sustainably, which means that the Earth's natural capital is reduced. Examples of potential costs of this development include climate and water regulation, the depletion of timber and fuel supplies, losses in agricultural productivity, and the cost of nutrient cycling, soil conservation, and flood prevention. This is reflected in McKinsey's Commodity Price Index from 2011 in which the arithmetic average of prices for food, non-food agricultural items, metals and energy were at its highest level compared to any time in the past century. Companies are noticing higher risks following this economic model such as increasing resource prices and less predictable prices since the turn of the millennium. Unpredictable prices and resource scarcity are not the only negative outcomes of a linear model. The model also implies negative environmental impacts that leads to erosion of ecosystem services, climate change and the accumulation of waste. The estimated growth in population will furthermore significantly impact the demand of resources (Ellen MacArthur Foundation, 2013). These dynamics pose a serious threat to the existing linear economy model. The concept of circular economy is suggested to solve some of these challenges.

2.2 Circular Economy

2.2.1 Schools of Thought

The notion of circularity has both deep historical and philosophical origins, however, the concept itself cannot be traced back to one single scholar or a specific time of origin. Further, the idea of feedback of cycles in real-world systems is ancient and echoed in various schools of philosophy (Ellen MacArthur Foundation, n.d.A). Its practical applications to modern economic systems and industrial processes has however gained momentum since the late 1970s (Ellen MacArthur Foundation, n.d.B). Recently, the concept has become very

widespread and gained grounds in both businesses and politics and achieved great interest among practitioners. It is even argued by some scholars that it is an approach almost exclusively developed by practitioners. From a scholarly perspective, literature is still emerging and the schools of thought and principles of the concepts differ immensely (Korhonen et al., 2018). The concept of circular economy synthesises several major schools of thought. Among these are performance economy, industrial ecology, environmental economics and the Cradle-to-Cradle design philosophy.

It is argued that the emergence of the basic principles of circular economy can be traced back to the late 1970s. Here Stahel & Redal (1976) presented their vision of a circular or loop economy in a report to the Commission of European Communities (Geissdoerfer, Savaget, Bocken & Hultink, 2017; Hvass, 2016). With the paper *The Product-Life Factor,* Stahel made a significant contribution to the understanding of the principles of circular economy as he outlined how the extension of the total lifespan of goods influence both economic competitiveness and resources availability as well creates new job opportunities, all of which are also objectives of performance economy (Stahel, 1982). Stahel (2010) described performance economy as a concept that entails a shift in economic thinking towards a more sustainable economy. Further, it puts great emphasis on the importance of the service economy, which implies that services should be sold instead of products. This is meant to increase wealth and foster job creation while reducing resource consumption (Stahel, 2010).

Various scholars argue that circular economy was given a theoretical framework within the industrial ecology stream, which can be traced back to the late 1980s (Andersen, 2007; Bocken, de Pauw, Bakker & van der Grinten, 2016). In industrial ecology, circular economy is an industrial economy restorative by design and looks like the nature by actively enhancing and optimising the systems. Industrial ecology aims at closing the loop of materials and substances and reducing resource consumption and discharges into the environment. It focuses on the circular flow of materials and energy within industrial ecosystems. A key concept within industrial ecology is the concept of industrial metabolism, which concerns the idea of industrial systems working as natural ecosystems (Jurgilevich et. al, 2016).

Within the field of environmental economics, circular economy was first shed light on in 1990 by Pearce & Turner. The authors drew attention to the fact that the traditional linear economy did not offer any opportunities to recycle or reuse. By examining the functions of the environment from an economic point of view, Pearce & Turner (1990) seek to address this issue. By taking into consideration the first law of thermodynamics, in which aggregated matter and energy remain constant while the system is closed, the authors argue that the linear economic system should be transformed to a circular one (Su, Heshmati, Geng & Yu, 2013). Thus, from an environmental economics perspective, circular economy is founded on the principle of material balance (Andersen, 2007). Several scholars have acknowledged that by terming the circular system 'circular economy', Pearce and Turner were the first to coin the term (Priesto-Sandoval, Jaca & Ormazabal, 2018; Su et al., 2013).

The Cradle-to-Cradle (C2C) design philosophy is closely related to industrial ecology. It was developed by McDonough & Braungart in 2002 and aims to address the challenges of the linear economy with the application of a new product design perspective. In their view, a major issue with the linear economic stems from its striving for universal design solutions. This entails that products are designed for a worst-case scenario to always operate at same efficiency even under worst possible circumstances (McDonough & Braungart, 2002). Further, products are designed with the purpose of being affordable, well performing and meeting regulations. Thus, they are not designed for disassembly or recycling. Instead most products are down cycled, which not only reduces the quality of the material but can also cause harm to the biosphere. As a circular design philosophy, C2C represents a system with no waste. In the system, all materials flow within a biological or technical metabolism and products can be either biological or technical nutrients. On one hand, biological nutrients refer to natural and plant-based materials or biodegradable substances. On the other, technical nutrients refer to materials, primarily synthetic or mineral, that remain in a closed-loop system and thereby functions as nutrients for manufacturing of new products. The philosophy of the C2C framework is that with the right design, everything can function as a resource for something else. Hence, the issue is not scarcity but product design (McDonough & Braungart, 2002).

Each stream of circular economy proposes a different strategy for businesses that wish to make the transition from a linear to a circular economy. However, there is a general

agreement that the strategies of circular economy are represented by the mean of several material and energy loops (Geissdoerfer et al., 2017; Stahel, 2010; Urbinati, Chiaroni & Chiesa, 2017; van den Berg & Bakker, 2015).

As circular economy stems from various schools of thought, there is no clear definition of the concept in the scientific literature (Yuan, Bi & Moriguichi, 2006). Accordingly, the World Economic Forum (2014:15) defines circular economy as "...an industrial system that is restorative or regenerative by intention and design. It replaces the end-of-life concept with restoration, shifts towards the use of renewable energy, eliminates the use of toxic chemicals, which impair reuse and return to the biosphere, and aims for the elimination of waste through the superior design of materials, products, systems and business models", whereas the Ellen MacArthur Foundation (2015) defines it as "...one that is restorative and regenerative by design and aims to keep products, components, and materials at their highest utility and value at all times, distinguishing between technical and biological cycles" (p. 2). In addition, Geissdoerfer et al. (2017) defines circular economy as "a regenerative system in which resource input and waste, emission, and energy leakage are minimised by slowing, closing, and narrowing material and energy loops" (p. 766). In a systematic review of 114 definitions of circular economy, Kirchherr, Reike & Hekkert (2017) found that the most common conceptualisation of circular economy is the 3R framework (reduce, reuse, recycle). Even though the definitions seem similar, it is considered a weakness that there is no clear definition of the concept. This blurriness especially affects and complicates the practical application of circular economy. Thus, a deeper and more systematic analysis of the concept is requested by a number of scholars (Korhonen, Nuur, Feldmann, & Birkie, 2018; Priesto-Sandoval et al., 2018). Based on this, we deem it necessary to explore the concept specifically within the agricultural sector as the practices of circular economy might differ depending on the sector it is applied to. This will enable us to get a comprehensive understanding of the concept that can be used to help identify and analyse the determinants affecting the adoption.

2.3 Circular Economy in the Agricultural Sector

The agricultural production system is mainly linear in structure using high levels of inputs from which only a small proportion is converted into edible products and therefore leads to a high amount of waste and damages to the environment. In 2011, The United Nation Food and

Agricultural Organisation (FAO) estimated that inefficiencies in the global food economy cost between $1-2 trillion per annum and up to one third of the food produced for human consumption is wasted along the agri-food chain. This is a loss of both invested resources and money. More focus has therefore been directed toward circular practices in the agricultural sector to approach these challenges. However, other concepts and approaches with similar goals as circular economy in the agricultural sector also exist. Thus, circular economy can be operationalised through different theories, concepts, approaches and tools. The following sections will outline the various definitions and understandings of circular economy in the agricultural sector and include related sustainable agricultural approaches. Hereafter, we will come up with a unified understanding of circular economy in the agricultural sector that will be used throughout the paper. Finally, the debate surrounding the concept will be presented to shed light on its possible weaknesses that we need to consider when applying the concept.

2.3.1 Understanding Agricultural Circular Economy

In general, circular economy has focused less on the area of agriculture and it is only recently that governments, institutions and businesses have started to investigate the opportunities of the circular economy in relation to the biological cycle. This is a consequence of the pressures related to the increasing demand from a growing population and the competition for land, water and energy. Therefore, the regenerative services provided by the agriculture become even more central in a future with less access to non-renewable resources (Kristensen, Kjeldsen & Thorsøe, 2016).

According to Qi et al. (2016), agricultural circular economy is distinctive from ordinary circular economy in various ways. The main way the two differ is however in terms of focus. As an example, more value is attached to green production and product safety when applying circular economy in the agricultural sector. In order to develop green agriculture, the amounts of applied fertilisers and pesticides have to be controlled. Moreover, another focus is on ensuring clean production and consumption of agricultural products. After being used to the fullest, agricultural products and by-products are used as biomass. The function of soil and water purification is also emphasised as these are key factors affecting the agricultural production. Soil and water can enable the functions of percolation and purification. Furthermore, soil can decompose biomass and purify the organisms through the natural cycle

of water and soil. Finally, it is important that the circulation process includes not only the internal agricultural material recycling but also waste recycling after agriculture products processing (Qi et al., 2016).

The Ellen MacArthur Foundation argues that "in a circular economy, agricultural practices aim at optimising yields while also improving the quality of soil, water, and air. It views the long-term health of our agricultural systems as our best chance for long-term performance" (Kristensen, Kjeldsen & Thorsøe, 2016:10). The Foundation moreover argues that a circular development path would entail a situation in which "the food system would be generative, closing nutrient loops with minimal leakage and maximum long-term value extraction from each loop in short, local supply chains with almost zero waste" (Kristensen, Kjeldsen & Thorsøe, 2016:10). Further, the types of practices believed to foster a sustainable agricultural system, referred to as 'regenerative farming practices', are indicated including practices such as organic farming and no-till farming.

Jurgilevich et. al (2016) focus on circular economy applied in the agri-food sector at an industrial level using theory and principles from industrial ecology. The authors argue that circular economy is an industrial economy, which is restorative by design and looks like the nature by actively enhancing and optimising the systems. In this regard, circular economy in the food system implies reducing the amount of waste generated along the entire value chain, the reuse of food, the utilisation of by-products and food waste, nutrient recycling and changes toward a more diverse and efficient food pattern. Avoiding food waste and food surplus is also a matter of consumption issues. The loop of nutrients can potentially be closed by reusing food and utilise by-products and waste.

According to Ward, Holden, White & Oldfield (2016), circular economy within the agricultural sector centres around producing commodities with a minimal amount of external inputs, closing nutrient loops and reducing negatives discharges to the environment, involving avoiding waste and emissions. It moreover involves the use of precision agriculture techniques, recycling and utilisation of agricultural wastes. In circular economy, resources can be circulated in various ways using different technologies as well as creating new value chains. Much of the waste coming from agricultural production are ideal raw materials for

biological processes to either create new products or existing ones using new processes. Much of the waste is unavoidable and can be described as by-products or co-products residues (e.g. peels, leaves, crop residues, manures). These have often been categorised as 'waste' rather than 'resources', which affects how they are treated. Therefore, it is important to recognise the value and characteristic of each 'waste' element in circular economy. It must also be considered whether more value can be extracted from the unwanted resource stream. Examples of valorisation of agricultural organic wastes are composting, open-pond bioreactors, anaerobic digestion, pyrolysis and chemical extraction. These technologies have benefits such as energy production, return of organic matter, carbon sequestration and nutrient recycling (Ward et al., 2016).

Finally, Jun & Xiang (2011) argue that agricultural circular economy follows the 3R principle, namely reduce, reuse, recycle, and puts great emphasis on the principle of waste reduction. Reduce concerns reducing the input level of external and non-renewable resources and materials and production level of wastes in the process of agro-productions. Reuse refers to resources or products that can be used multiple times, e.g. waste water can be used for irrigation. Recycling refers to products becoming re-available after the completion of its function rather than useless garbage. The principle of waste reduction entails avoiding waste in the production, which is a priority of the economic activity. The mutual exchange of wastes between different levels of the agricultural production is also a core principle of agricultural circular economy as it entails that wastes are able to be used as resources, which minimises the discharge of wastes (Jun & Xiang, 2011).

2.3.2 Sustainable Agriculture Approaches

From the review, it is clear that other concepts and approaches are linked to or overlap with circular economy in the agricultural sector and share similar goals. We are aware of the fact that these approaches also might be able to rise the challenge. Therefore, we review the approaches we find most relevant in order to understand and operationalise circular economy in the agricultural sector. Certain approaches recur in the literature when investigating sustainable agriculture and circular economy including agroecology, sustainable intensification, climate smart agriculture, conservation agriculture and organic farming. These are argued to be the key approaches within sustainable agriculture (Verhagen et al., 2017).

Thus, we deem them important to understand in order to analyse circular economy adoption in the agricultural sector. Due to the scope of the paper and the complexity of analysing the differences in impact of each approach, we will not asses which pathway is better.

Agroecology concerns the application of ecology when designing and managing sustainable production systems. It is a whole-systems approach to agriculture and food systems development that is rooted in traditional knowledge, alternative agriculture, and local food system experiences. The approach links ecology, culture, economics, and society to sustain agricultural production, healthy environments, and viable food and farming communities (Verhagen et al., 2017). Agroecology is grounded in application of the following ecological principles: (1) enhancing the recycling of biomass while optimising nutrient availability and balancing nutrient flow, (2) securing favorable soil conditions for plant growth, particularly by managing organic matter and enhancing soil biotic activity, (3) minimising losses due to flows of solar radiation, air, and water by way of microclimate management, water harvesting and soil management through increased soil cover, (4) diversifying species and genetic variety of the agroecosystem in time and space, and (5) enhancing beneficial biological interactions and synergisms among agrobiodiversity components, thus, resulting in the promotion of key ecological processes and services (Amekawa, 2010). Agroecology has matured from being a scientific discipline rooted in the ecological sciences in the early 20th century to becoming a societal movement in the 1980s. The approach is currently looking for a stronger link with agricultural policies, however, the historical roots in the ecological movement and the many interpretations could prove to be to an obstacle for agroecology to become an overarching concept (Verhagen et al., 2017).

Sustainable intensification offers a pathway that strives to utilise the existing land to produce greater yields, better nutrition and higher net incomes while reducing over reliance on pesticides and fertilisers and lowering emissions of harmful greenhouse gases. It entails intensifying food production while ensuring the natural resource base on which agriculture depends is sustained, and indeed improved, for future generations. Thus, it has to be done in a way that is both efficient and resilient and contributes to the stock of natural environmental capital. Sustainable intensification is a product of the application of technological and socio-economic approaches to the task. There are two main technological approaches: one is the

application of agricultural ecological processes (ecological intensification), which includes approaches such as intercropping, integrated pest management, conservation farming and organic farming; the other is to utilise modern plant and livestock breeding (genetic intensification) to increase crop yields, enable nitrogen uptake and fixation, improve nutrition and enhance resilience to pests and diseases and climate change. Concurrent to these approaches is socio-economic intensification, which provides an enabling environment to support technology adoption and develop markets for the products (Montpellier Panel, 2013). The approach is a response to the challenges of increasing demand for food from a growing global population, recognising the overexploitation of land, water, energy and other inputs (Verhagen et al., 2017). Further, it has been emphasised as a new paradigm within African agriculture even though none of the components are new (Montpellier Panel, 2013).

Climate smart agriculture is concerned with developing the technical, policy and investment conditions to achieve sustainable agricultural development for food security under climate change. The aims of climate smart agriculture are to sustainably increase agricultural productivity and incomes, adapt and build resilience to climate change and to reduce and/or remove greenhouse gases emissions, where possible. The concept was coined by FAO in 2010 and was initially developed with a strong focus on mitigation and food security but has evolved towards an adaptation and food security focus. The holistic nature of the approach is also argued to be its limitation. It covers different types of actions, spatial scales and domains, relates to actions both on-farm and off farm, and incorporates technologies, policies, institutions and investment (Verhagen et al., 2017). Actions comprise management of farms, crops livestock and fisheries to manage resources better, ecosystem and landscape management and services for farmers and land managers (FAO, CGIAR & CCAFS, 2015). Due to the wide variety of actions in the form of management, organisation, policy and financing, the approach runs the risk of becoming a container term (Verhagen et al., 2017).

Conservation agriculture refers to a concept for resource-saving agricultural crop production that strives to achieve acceptable profits together with high and sustained production levels while concurrently conserving the environment. While aiming to achieve sustainable and profitable agriculture, conservation agriculture subsequently aims at improving the livelihoods of farmers through the application of the three conservation agriculture

principles: minimum tillage and soil disturbance, permanent soil cover and crop rotations. Conservation agriculture holds tremendous potential for all sizes of farms and agroecological systems but its adoption is perhaps most urgently required by smallholder farmers, especially those facing acute labour shortages. It is a way to combine profitable agricultural production with environmental concerns and sustainability and it has been proven to work in a variety of agroecological zones and farming systems (FAO, 2017).

On the side of the producer and/or farmer, conservation agriculture can eventually do all that is done in conventional agriculture, and it can conserve better than conventional agriculture. Producers will find that the benefits of conservation agriculture will come later rather than sooner. Since conservation agriculture takes time to build up enough organic matter and have soils become their own fertiliser, the process does not start to work overnight. However, if producers make it through the first few years of production, results will start to become more satisfactory. Conservation agriculture is shown to have even higher yields and higher outputs than conventional agriculture once it has been established over long periods. Also, a producer has the benefit of knowing that the soil, in which his crops are grown, is a renewable resource. As long as good soil upkeep is maintained, the soil will continue to renew itself. This is very beneficial to a producer who is practicing conservation agriculture and is looking to keep soil at a productive level for an extended time. The farmer and/or producer can use the same land in another way when crops have been harvested. The introduction of grazing livestock to a field that once held crops can also be beneficial for the producer and for the field itself. Livestock manure can be used as a natural fertiliser on the field and be beneficial for the producer the next year when crops are planted once again due to its ability to generate soil fertility. The practices of conservation agriculture and grazing livestock on a field for many years can allow for better yields in the following years as long as these practices continue to be followed (Corbeels et al., 2014; Naab et al., 2017).

Organic farming is a holistic production management system, which promotes and enhances agro-ecosystem health, including biodiversity, biological cycles, and soil biological activity. Even though many explanations and definitions exist, the overarching statement is that it is a system that relies on ecosystem management rather than external agricultural inputs. It is a system that begins to consider potential environmental and social impacts by eliminating the

use of synthetic inputs, such as synthetic fertilisers and pesticides, veterinary drugs, genetically modified seeds and breeds, preservatives, additives and irradiation. These are instead replaced with site-specific management practices that maintain and increase long-term soil fertility and prevent pest and diseases. Organic farming methods are internationally regulated and based on standards set by the International Federation of Organic Agriculture Movements, who also regulates which inputs the farmers can use. This provides clarity to farmers and consumers but also restricts the approach in adopting new technologies and methods (Verhagen et al., 2017).

The reviewed approaches enlarge on practices that can work as ways to implement and operationalise circular economy in the horticultural sector. Like circular economy, most of the mentioned approaches focus on increasing agricultural production without depleting or over-exploiting the natural resource base on which it depends. How the approaches differ in foci is however not always clear. Nonetheless, it is argued that the approaches differ in the extent to how broad or narrow sustainability is defined affecting choices in practical ways to reach sustainable food production (Verhagen et al., 2017). In regard to circular economy, the approaches add to the understanding and realisation of implementing circular economy practices.

2.3.3 Synthesising Circular Economy in the Agricultural Sector

From reviewing the literature on circular economy in the agricultural sector and the related approaches, we have obtained a comprehensive understanding of the topic. We discovered that certain principles and practices recur frequently, which we have gathered to come up with a unified understanding. The principles of reduce, reuse and recycle as well as the long-term health of the agricultural systems frame our overall understanding. More specifically, this has led us to understand circular economy as practices involving *minimising and controlling external inputs, closing nutrient loops, and maintaining the quality of soil and water.* These practices are not definite, but guide our research. The following section will elaborate on common practices to easier be able to identify them and thus enable an analysis of the main determinants affecting them and how.

Minimising and controlling the amount of external inputs imply various practices. In horticulture, external inputs often include inorganic fertilisers, pesticides, water and seeds (Audi Willis, email, 21 August 2018). The use of external inputs often implies various negative effects related to the environment, people and production. By controlling and minimising them by e.g. (re)using and recycling own resources to the extent possible, the potential negative effects can be decreased. By knowing the composition of the soil and initiating practices that enable the soil to be self-sustaining and robust to pest and diseases, the use of inorganic fertilisers and pesticides can be controlled and minimised (Appendix 9). Further, knowing how to apply the inputs as well as using high quality inputs will usually result in a controlled and minimised use. Introducing water management in which you know your crops, how much water they need and when, you can control and minimise the use of water (Audi Willis, email, 21 August 2018)..

Closing nutrient loops involves practices such as recycling nutrients by reusing food and utilising by-products and waste. This preserves the nutrient and carbon level in the soil and is a sustainable practice of production. Applying livestock manure on the crops leads to increased soil quality, soil structure and soil biota by returning organic matter to the soil. It moreover improves the soil-water holding capacity and the potential of the soil to sequester carbon is increased. Crop biodiversity is important in terms of food security as it provides a range of genetic raw materials which makes the food crops able to adapt to changing environmental conditions (Kurgat et al., 2018) Reusing by-products such as leaves, peels and other biomasses from plants on the fields releases nutrients for the crops planted and is hence recycled back into the system and used as an organic fertiliser (Ajayi, Akinnifesi, Sileshi & Chakeredza, 2007).

Maintaining the quality of soil can happen through soil conservation, which prevents soil loss from erosion and reduced fertility caused by acidification, over usage, salinization or other chemical soil contamination. One form of soil conservation is agroforestry, which is a form of intercropping where crops are grown interspersed with trees. The deeper-rooted trees can often exploit water and nutrients not available to the crops. The trees can also provide shade and mulch, creating a micro-environment, while the ground cover of crops reduces weeds and prevents erosion (Montpellier Panel, 2013). Other techniques imply crop rotations and

conservation tillage. These may improve the soil structure and fertility (Kabubo-Mariara & Karanja, 2007). Further, reduction of over-irrigation and seepage will prevent waterlogging and salinisation of the soil. The quality of water is another big concern before and after use as it affects the quality of drainage water, return flows and groundwater. These issues are closely related to the health of humans and the spread of waterborne diseases. Irrigations systems play a big role in order to maintain the quality. Irrigators must understand the total ecological system and thereby develop mitigating practices to reduce negative effects. They must reduce practices that contaminate the water such as use of waterways for waste disposal and the use of inorganic fertilisers and pesticides (Shady, 2013).

2.3.4 The Circular Economy Debate

As with any other concept, circular economy is not without critics. According to Preston & Lehne (2017), not all strategies and approaches under the 'circular economy umbrella' are necessarily optimal from an environmental and social perspective. There are cases with trade-offs between the benefits and drawbacks of circular economy. For example, waste-to-energy processes are sometimes included as a circular economy practice but whether these processes are appropriate depends on the context, the material used, the emission implications and alternative opportunities. Another challenge is that circular economy approaches only partially address well-known barriers to economic and industrial development. In agricultural value chains, circular economy principles offer a useful checklist of value-creation opportunities such as recycling and utilising agricultural waste, optimising the use of resources in the farm system, and creating closed loops to reduce water and fertiliser needs. In order to reduce post-farm food losses and increase productivity, a broader set of governance and market interventions are, however, needed. Therefore, the potential positive impacts of circular economy might in some cases be dismissed as naive and its benefits are missed. Another problem concerns the lack of an agreed tool to measure progress toward circular economy. Tools to track resource flows such as material flow analysis, input-output analysis and life cycle-assessment (LCA) are all useful metrics at national and city levels, however, they highly depend on data available, which is often not existing in developing countries (Preston & Lehne, 2017).

Ward et al. (2016) argue that in the agricultural sector circular economy should also include options that extend the linear economy such as utilising unwanted agricultural waste to produce for example bioplastics instead of only focusing on feeding the waste back into the agricultural production. Using renewable biological resources such as agricultural waste in order to produce food, materials and energy, also referred to as bioeconomy, does not necessarily close resource loops. Resources such as manure and crop residues can potentially remain within the agricultural system but can also be used to produce energy for the wider bioeconomy and it is therefore not circulated. Closed loop agriculture versus wider bioeconomy utilisation are two different pathways of sustainable agricultural systems, however, what is most effective is still hard to say and depends on how concepts such as circular economy and sustainability are viewed. Furthermore, there is a tendency to think systems in terms of energy flow. Protein, nutrient and water must also be considered in the circularisation as argued by Ward et al. (2016). This is particularly important when the early stage of the value chain takes place in regions with scarcity of one of the three resources. As an example, producing and transporting a product from an area with water scarcity to an area with low scarcity will only exacerbate the scarcity issue at the production point if the circulation of water is not addressed. Therefore, circular economy should also entail addressing the scale of loops and avoiding exploitation of resources in one area only to satisfy it in another area. In general, agricultural international trade implies a virtual trade of nutrients and water. Ward et al. (2016) further argue that the circular economy concept will benefit from acknowledging that system efficiency is important and moreover that due diligence require a risk assessment of resources supply and raw materials rather than just assuming that using waste is more sustainable. A more suitable approach might be a 'circular efficiency' approach in which upstream inputs are minimised and downstream residues/by-products are circulated. Therefore, simply assuming that a circular transition within the agricultural sector leads to clear economic, social and environmental benefits might be wrong. It is important to analyse whether circularisation could cause economic, social and environmental stress before it is implemented.

Korhonen et al. (2017) further argue that circular economy is a superficial and unorganised concept and that "it is a collection of vague and separate ideas from several fields and semi-scientific concepts" (p. 1). The authors specify some key questions related to circular economy

that are still open such as what is the actual environmental impact of utilising bio-based materials and eco-efficiency initiatives and is the common method of environmental LCA proper. Nevertheless, even though it needs more scientific research that can proof its actual environmental and business benefits, the authors argue that circular economy proves to be an important concept due to its power of attracting both the business and policy-making community based on its attractive promises.

Proponents of circular economy claim it to be a new important paradigm as it aims to generate social and economic value resulting in effectiveness that improve the state of the environment and goes beyond sustainability (Kopnina & Blewitt, 2015). Even though attitudes are gradually changing, it is important not to disregard the fact that both environmental protection and climate mitigation often have been portrayed as costs or burdens for society and indeed for businesses. Many businesses tend to perceive environment taxes and regulation as a threat to both competitiveness and employment. This is the main reason for the slow progress in terms of environmental policy-making in many areas. While competition in an increasingly globalised economy is a challenge, there are overwhelmingly good reasons not to view resource efficiency as a threat to neither competitiveness nor employment. On the contrary, it is demonstrated that there are several benefits of moving society and companies in the direction towards a circular economy (Wijkman & Skånberg, 2015).

As illustrated, there are both opponents and proponents of circular economy. Nevertheless, we deem circular economy to be an approach that is able to target some of the pressing challenges Kenya is facing in the agricultural sector. This is due to its promising potential to concurrently address both environmental, economical and social concerns. In agriculture, the principles behind the concept, particularly in terms of reusing resources, closing nutrient loops and reducing external inputs, are believed to have great benefits for both environment and the long-term health of the soil and thus the productivity, which can potentially improve financial and social activities. Moreover, it is an understudied approach in the agricultural sector making it relevant to explore.

2.4 Analytical Framework

In order to solve some of the raised challenges, it is important to analyse what leads the transition to a circular economy. To do so, an identification of the main determinants as well as an analysis of how these impact the adoption is needed. This section therefore reviews the literature on previous studies examining determinants, hereunder drivers and barriers, of circular economy and sustainable agriculture implementation. From our research, no literature exists that specifically relates to smallholder farming in the horticulture sector in Kenya. Therefore, we will start by reviewing the determinants of adopting circular economy on a more general level found from various studies in different countries and sectors. Following, we will review determinants found from sustainable agriculture implementation among smallholder farmers. Taking together, this will enable important insights into the field and help guide our research by providing us with potential determinants of circular economy implementation to be aware of.

2.4.1 Determinants of Circular Economy Adoption

In order to understand the current state-of-the-art determinants for circular economy adoption and how they relate to each other in the context of a supply chain, Govindan & Hasanagic (2018) present a multi-perspective framework, which takes into consideration different stakeholders' perspectives on drivers and barriers. The authors divide specific drivers and barriers into internal and external levels and relate them to the different stakeholders. The stakeholders are identified from the stakeholder theory and include consumers, society, the organisation, suppliers and the government.

From a systematic review of the literature, Govindan & Hasanagic (2018) have identified 13 motivational drivers for the implementation of circular economy in a supply chain. The drivers are classified into internal and external environments and related to one or more stakeholders. The internal level is related to the enterprise itself and the external level is related to the outside of the enterprise. The identified drivers were divided into five clusters based on the functional aspects of circular economy: *policy and economy,* including laws on product take back and economic growth; *health,* including increasing animal and public health; *environmental protection,* including regulations on climate change, quality of

agriculture and the protection of renewable resources; *society,* including population growth, urbanisation, job creation potential and consumers awareness; and *product development,* including improving the efficiency of materials and energy use and increasing the value of products. The main drivers were identified as being the potential to get more jobs by implementing circular economy, climate change and the ability to follow laws and policies. The authors further emphasised that governmental intervention particularly has a positive impact on the implementation of circular economy in supply chains by promoting circular economy through laws, policies, tax levies and strict governance.

Like the drivers, the barriers are classified as being internal to the enterprise or outside in the external environment and related to the different stakeholders. 39 barriers were identified and classified into eight clusters accordingly: *governmental issues,* including lack of standard systems for performance assessment, recycling policies that are ineffective to obtain high quality, new laws that are passed with insufficient coordination and existing laws that do not support the circular economy; *economic issues,* including financial and economic barriers related to the implementation of circular economy in a supply chain; *technological issues,* including technological limitations, managing uncertainty at the end-of-life phase for products, managing product quality through the lifecycle of a product, design challenges to create or maintain durability; *knowledge and skill issues,* including the lack of reliable information, lack of public awareness, lack of skills and the lack of consumer awareness of the value of refurbished products; *management issues,* including the lack of support from top management; *circular economy framework issues,* the fact that other solutions might be more favourable than the circular economy framework; *culture and social issues,* including the lack of enthusiasm toward enacting circular economy, consumer perception towards reused products and the thrill of purchasing a new product; and *market issues,* including the considerations such as externalities that prevent companies from taking advantage of refurbished products, regulations around ownership and no industry standards on refurbishment products. From the barriers and drivers identified, it became clear that all stakeholders play a role in terms of the implementation of circular economy in an enterprise (Govindan & Hasanagic, 2018).

In a study, Rizos, Behrens, Kafyeke, Hirschnitz-Garbers & Ioannou (2015) investigate the key barriers toward the implementation of circular economy practices for small and medium-sized enterprises (SMEs). The authors identified the following seven barriers. (1) Environmental culture: The choice of taking up a green solution for SMEs often depends on the attitude of the individual manager and often also on the owner. His or hers attitude is also dependent on the sector in which they operate. (2) Financial barriers: The upfront cost of investing in sustainable practices and the anticipated payback period is of great importance for the SMEs, which are usually more sensitive to additional financial costs compared to bigger companies. Moreover, SMEs often experience problems accessing finance and suitable sources of funding. (3) Lack of government support and effective legislation: Lack of encouragement from government through e.g. the provision of funding, training, taxation is widely recognised as a significant barrier to take up environmental investments. Also a lack of a strict regulatory framework influences the perception of SMEs in terms of the necessity of implementing green solutions. When no effective enforcement mechanisms are present, environmental improvements are usually driven by the managers attitude toward sustainability. (4) Lack of information: Information about the financial benefits from implementing circular economy is lacking. Some SMEs neglect the possible gains from improving resource efficiency and consider those practices to be costly for their business. (5) Administrative burden: A transition to green practices often incurs administrative burdens required by legislation. This involves monitoring and reporting of environmental data to various authorities. (6) Lack of technical skills: The lack of internal skills in order to identify and implement more advanced technical options that would help reduce environmental impacts while realising cost savings have been identified as a main obstacle preventing the SMEs to take advantage of green economy solutions. (7) Lack of support from the supply and demand network: A discouraging factor is the lack of suppliers' and customers' environmental awareness. Suppliers are reportedly reluctant to create a greener supply chain due to the potential cost (Rizos et al., 2015).

From analysing the literature, it is clear that there is simply not one important barrier or driver but rather a mix of facilitating and constraining factors specific to the local context. Taking together the different analyses, De Jesus & Mendonça (2017) work with a set of harder factors, which include technical and financial/economic/market, and a set of softer factors,

including institutional/regulatory and social/cultural, that affect the barriers and drivers. From a technical aspect, drivers include availability of technology, which facilitates resource optimisation, as well as remanufacturing of by-products as inputs to other processes, whereas barriers are related to inappropriate technology and lack of technical support and training. Economic/financial/market drivers are connected to pressures from both demand- and supply-side toward circular economy solutions. The barriers comprise large capital requirements and uncertain return and profit. Institutional/regulatory drivers are associated with increasing environmental legislation and standards whereas the barriers are related to lacking conducive legal systems and deficient institutional frameworks. Finally, social/cultural drivers are connected to social awareness, environmental literacy and shifting consumer preferences while the barriers relate to the rigidity of consumer behaviour and business routines.

Ranta, Aarikka-Stenroos, Ritala & Mäkinen (2018) focus on institutional theory in order to understand the implementation of circular economy practices. Up until now, the emphasis of the majority of the circular economy literature has been on technical issues, such as material flows and technologies. Therefore, the concept has also been criticised for basically excluding the societal factors of sustainability. Due to the relevance of societal factors for circular economy adoption, Ranta et al. (2018) argue that the absence of an understanding of institutional drivers and barriers in mainstream circular economy analyses constitutes an important research gap. Institutional theory examines the established, resilient social structures that provide societal stability (Ranta et al., 2018). According to institutional theory, external social, political, and economic pressures influence firms' strategies and organisational decision-making as firms seek to adopt legitimate practices or legitimise their practices in the view of other stakeholders. Institutions can define what is appropriate or legitimate and thereby make other actions unacceptable or beyond consideration. Further, it can be used to explain how changes in social values, technological advancements, and regulations affect decisions regarding 'green' sustainable activities such as circular economy (Glover, Champion, Daniels, & Dainty, 2014). According to Scott's framework of institutional theory, institutions are separated into three pillars: regulative, normative and culturally-cognitive. These are individually distinguishable but interdependently contribute to the resilience of the social structure. Through their indicators, the pillars tell the rules, norms and

beliefs that impact social behaviour and are reflected in activities, relations, and resources in a particular field, region or community (Ranta et al., 2018).

Institutional theory has recently been used extensively in studies exploring environmental management in organisations (Ranta et al., 2018) as well as to explain sustainable activities at both the firm and individual level. The strength is that it offers explanations of why certain practices are chosen without an obvious economic return (Glover et al., 2014). A range of studies on recycling and sustainable production, concepts both central to circular economy, have suggested ways in which institutions shape the diffusion and adoption of sustainable business. Altogether, studies indicate that the institutional environment both supports and inhibits the adoption of and transition to circular economy. Ranta et al. (2018) emphasise that a holistic institutional approach is required to advance the circular economy. Their key finding is that the general barrier for circular economy is the emphasis on recycling, which concurrently resonates with the lack of institutional support for reuse. The institutional perspective allows for the focus on the role of conformity, regulatory and social pressures in driving organisational actions (Glover et al., 2014).

2.4.2 Determinants for Sustainable Agriculture Adoption

McCarthy & Schurmann (2014) have investigated the barriers to the adoption of sustainable horticultural practices. Their study was carried out as a case study among growers in Queensland, Australia. According to McCarthy & Schurmann (2014), sustainable horticulture is a 'multifaceted concept' aiming to minimise environmental problems. It embraces motivations and practices such as integrated pest management, organic farming, biodynamic farming and local food supply. The study revealed four major barriers to the adoption of sustainable horticultural practices. The first barrier was associated with *financial* constraints. They found that farmers were faced with low profitability and high costs. Moreover, they were not able to afford the upfront costs associated with new technologies or precision agriculture. Consequently, it was argued that the effective extension services were those focusing on the economic dimension, in other words, the farmers would adopt certain practices if they saw the economic advantages of doing so. Furthermore, organic farmers faced numerous problems such as loss of income during the three-year conversion period to

become certified organic, concerns about how to pay existing overheads, the cost of compliance, high costs of organic inputs and labour costs (McCarthy & Schurmann, 2014).

The second barrier was related to *market demand and consumer behaviour*. As the organic food market was seen as niche and small-scale, the organic farmers had to target upper middle-class consumers by getting their product sold in non-local markets. The study argued that there was a limit to the price the consumers were willing to pay for organic produce and that the lack of premium prices restricted entry of more farmers into the sector. Further, one respondent expressed concern that widespread adoption of organic farming could result in price-drops, and as a consequence, it would not be economically viable. Third, *industry and structural* barriers were evident. Farmers were classified as price takers who were selling a commodity product and lacking power in the supply chain. This meant that farmers were willing to sell their produce below the cost of production rather than having to throw it away. The authors explained that there was a perception that the large gap between farm gate and wholesale prices was restricting consumer demand for organic products (McCarthy & Schurmann, 2014).

The final barrier was related to *lack of assurance in, or questioning, of sustainable farming system.* Among some of the farmers, the authors found a lack of acceptance, or at least, questioning of organic standards. One farmer explained how he found the local certifying body inflexible and not open to innovation as he was not allowed to use an input that was locally available. The barrier further included lack of support from accreditation bodies and government, learning by trial and error and the negative image associated with organic farming. The hard work related to organic farming was highlighted as a lot of farmers had given up because it was too hard in terms of physical labour and making money as inputs were just too expensive. Farm size was also mentioned as hindering the adoption of sustainable practices. As there was a lot more slashing and hand work, farm size played a big part in determining how you managed the different parts. For conventional farmers, chemicals were used as the primary tool to control pests and protect yield. Compared to softer approaches, the results were instant. Chemicals were thus seen as a cheap insurance as they did not make up a large part of production costs. Therefore, it was also argued that farmers were not really decreasing their chemical usage. This was perceived by some

agricultural professionals and organic growers as a major problem, i.e. increase in pest resistance, non-selective nature of chemical treatments, implications for soil fertility. The organic farmers expressed a strong believe in improving soil health and that there was no conflict between their environmental and business goals. They condemned the market-driven, "high-yield now, less-yield later" prevailing chemical practices and were instead inclined to adopt a long-term view (McCarthy & Schurmann, 2014).

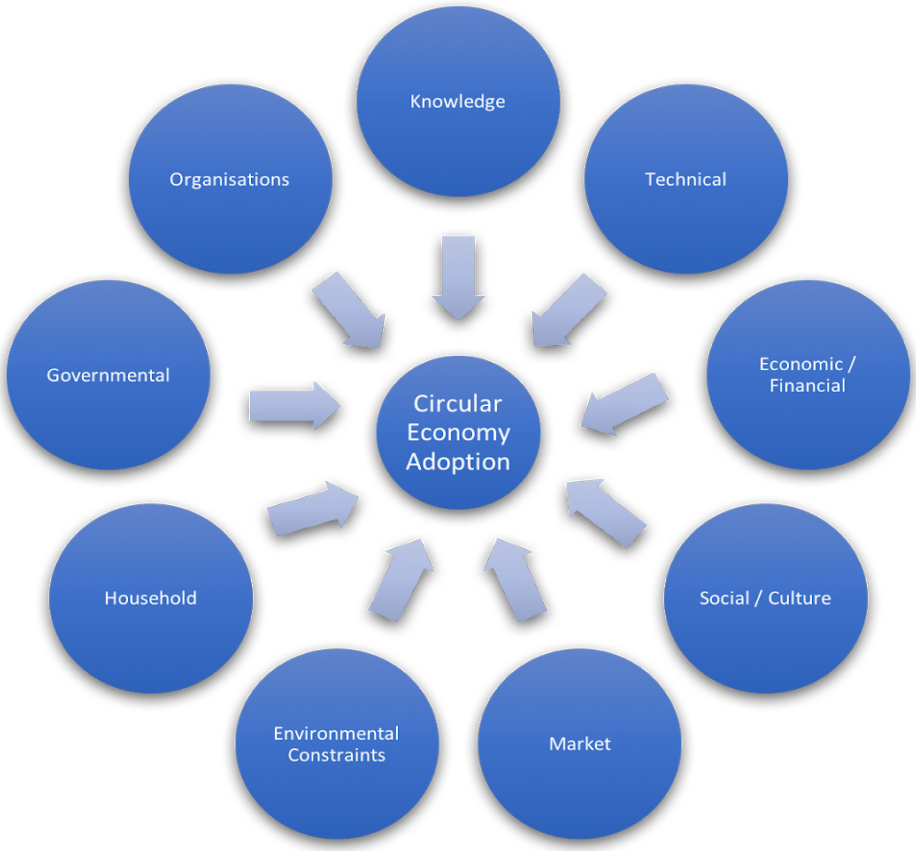
In a recent study, Kurgat et al. (2018) investigated the drivers of sustainable intensification in Kenyan rural and peri-urban vegetable production. Farm management practices suggested as being indicative of sustainable intensification practices (SIPs) include integrated organic and inorganic nutrient management, conservation agriculture, integrated pest management, crop diversification and sustainable water management (irrigation). Adopting of SIPs helps to improve yields and nitrogen use efficiency and conserve resources. The study examined the adoption rate of four interrelated SIPs (improved irrigation systems, organic manure, integrated soil fertility and diversification) and the factors influencing their adoption among smallholder farmers in Kenyan rural and peri-urban African indigenous vegetable (AIV) production. Kurgat et al. (2018) revealed that the adoption of organic manure and AIV diversification was high in both rural and peri-urban areas. However, adoption of improved irrigation systems and integrated soil fertility management was low, and even significantly lower in rural areas than in peri-urban areas. Social capital and farmers' groups were found to be major determinants of adoption of SIPs. Household characteristics, household income, market integration, level of urbanisation, environmental constraints and institutional factors were determined to influence the decision of adoption in a heterogeneous way. Moreover, the findings showed complementarities and substitutabilities between the SIPs. Improved irrigation systems and integrated soil fertility management were found to be positively correlated, as were use of organic manure and AIV diversification. Market integration, the farm location and household income were the major factors heavily influencing the adoption of most SIPs. In conclusion, it was argued that policies and programmes that seek to build household financial capital base and integrate farm households into effective and efficient vegetable markets were needed to enhance adoption of SIPs in AIV production (Kurgat et al., 2018).

Previous studies focusing on Africa have also examined the determinants of households' decisions to adopt SIPs. Marenya & Barrett (2007) found that household size, the household structure and education level of the household head, the size of farmland owned, the value of livestock and off-farm income significantly influenced smallholder farmers in western Kenya in the adoption of integrated soil fertility management, use of manure and agroforestry. Researching smallholdings in rural Tanzania, Kassie, Jaleta, Shiferaw, Mmbando & Mekuria (2013) reported several factors, such as environmental constraints (rainfall, insect and disease problems), government effectiveness in the provision of extension services, the size and tenure status of plots, social capital, plot location as well as household assets as influencing farmers' decisions to use improved seed, conservation tillage and legume intercropping. Only one study had previous focused on the adoption of safer irrigation technologies (e.g. sieving of irrigation water) and crop choices among vegetable farmers in urban Kumasi, Ghana, where it was found that household and farm characteristics such as extension agents, education level of household head, farmers' organisations and cropping patterns drive irrigation use (Abdulla, Owes & Baking, 2011).

Other studies have similarly investigated drivers and barriers of implementing more sustainable agricultural practices. In a study by Wheeler (2008), the primary barriers to the adoption of organic farming were found to be market issues such as lack of price premiums and small market size along with on-farm issues such as lower yields, pest and disease problems. Ecker, Kancans & Thompson (2011) mentioned financial benefits and environmental factors (i.e., improving soil quality) as key drivers of implementing more sustainable practices, where lack of funds, age and lack of time and workload were found to be limiting factors. Multiple authors have highlighted the "cost-price squeeze" on farmers and reducing inputs as the main reasons for converting to low-input farming (Sutherland, 2011). Rodgers (1999) referred to this as the 'relative advantage' of adopting a new farming method. However, it also includes other factors such as labour intensity, risk of low yields and uncertainty about one's ability to learn a new system of farming (de Buck, van Rijn, Roling & Wossink, 2001). A UK study found that attitudes to the environment as well as information networks (e.g. reliance on other farmers) and gender (e.g. being female) influence the adoption of organic farming (Burton, Rigby & Young, 2003).

2.4.3 Analytical Framework

Reviewing the literature on the determinants of circular economy adoption from the main circular economy field as well as from the sustainable agriculture field has given us a comprehensive understanding of the topic. The presented literature looks at the determinants as well as drivers and barriers at various levels and from different perspectives that are useful in guiding our research. Nevertheless, they are carried out in diverse country contexts and within different sectors. Therefore, they do not serve as definite answers but the help to direct our research. Given the fact that we have not been able to encounter any literature on our topic specifically, we have deemed it necessary to develop a guiding framework that will lead our research. The framework looks as follows:



3 Methodology

This section presents and argues for the applied methodological approach and strategies in order to answer the research question in the most complete way. First, our research approach is explained by positioning it within a philosophy of science. Second, the chosen research design and its strengths and limitations are presented. Third, our empirical data and the data collection procedures are reviewed including a critical assessment of the reliability of the collected data.

3.1 Research Philosophy

Doing research implies a philosophy of science, which holds assumptions about how the world is perceived and what knowledge is considered acceptable within the given research. The philosophy of science informs about the nature of the phenomenon examined, ontology, and the methods for understanding it, epistemology (Bechara & Van de Ven, 2007). It, moreover, guides how we interpret meanings and logical relations. Ontology refers to the assumptions researchers make about how the world operates. There are two main stances of ontology; objectivism and subjectivism. Objectivism represents the view that "social entities exist in reality external to social actors" (Saunders, Lewis & Thornhill, 2009:110) whereas subjectivism holds the assumption "that social phenomena are created from the perceptions and consequent actions of those social actors concerned with their existence" (Saunders et al., 2009:110). Epistemology relates to what constitutes acceptable knowledge within a given field of study and how it is obtained. The debate usually centres between the positivists, commonly emulating the natural sciences, and interpretivists, commonly using a more humanistic form of inquiry. Competing interpretivist and positivist epistemologies have comprised using distinctive methodologies and different methods of data collection, and moreover the debate of the value of quantitative versus qualitative data. Recently, more researchers have situated themselves and their research in neither of the two camps, as they refuse to limit their research to either a positivist or interpretivist methodology. They argue the importance of a problem-driven rather than theory-driven research and therefore speak in favor of mixed-methods if relevant for the research (Schram, Flyvbjerg & Landman, 2013).

Our topic has been chosen due to our interest in solving various challenges related to the agricultural sector in Kenya in terms of climate changes, increased food demand and resource

scarcity and argue for circular economy as a possible way to approach it. Thus, this paper follows a pragmatic research philosophy as the theories and methods applied are a consequence of the research question and their relevance in answering it. We believe that there are various ways of interpreting the world and conducting research. Further, no single point of view can give the complete picture of a problem and multiple realities might exist. Our research has been guided according to our research question and the approaches we have deemed most appropriate to comprehend the problem.

3.2 Research Approach

The chosen research approach is an important determinant of the entire research process. A research project involves the use of theory, however, the theory is not necessarily made explicit in the design of the research. The research approach depends on the extent to which you are clear about your theory when you start your research. This affects whether your research should follow a deductive, inductive or abductive approach. A deductive approach involves the development of theory and hypothesis that is subsequently tested thoroughly to explain relationships between the chosen variables. This research approach is often applied in the natural sciences following quantitative methods as it requires data that can be measured and generalised. Contrary, using an inductive approach data is collected and analysed resulting in the development of a theory. The aim of induction is to comprehend the nature of the problem and formulate a conceptual framework from the analysed data which is usually qualitative. Existing literature is only used as a starting point to guide the general direction of the study, which is contrary to a deductive approach. The use of an abductive approach implies the process of combining a theoretical framework, empirical fieldwork and case analysis. The research problems and the analytical framework are simultaneously reoriented when they are confronted with the empirical world. The process goes back and forth from data to theory in order to find the most suitable framework to investigate and analyse the problem (Dubbois & Gadde, 2002).

As we are researching a topic that is relatively new, is exciting much debate, and on which there is little existing literature, we have mainly worked inductively. In general, induction emphasises a close understanding of the research context, the collection of qualitative data and the researcher is part of the process and is less concerned with generalisations (Saunders

et al., 2009). We did not start our data collection with a predetermined theory to test. However, existing literature gave us an understanding of the topic and indications of determinants that might be important to look into and reflect upon. This was the starting point for our interview guide, which throughout the process was continuously adjusted according to the new knowledge obtained. Based on our collected data and existing literature, we were able to identify and explain the main determinants affecting the adoption of circular economy practices among the horticulture smallholder farmers in Kenya. Doing this, we expand on existing theories and seek new insights that can be used inductively to create propositions or recommendations. We do not seek definite conclusions on what are the specific determinants for adopting circular economy.

3.3 Research Design

The research design contains the plan for answering the research question, specifies the sources for data collection and considers the constraints and ethical issues. With our research, we seek an analysis that addresses the underlying determinants for implementing circular economy in the horticultural sector, which to our knowledge is an area that has only been very limited studied and discussed. Thus, our research qualifies as exploratory. An exploratory study is a valuable mean of finding out what is happening, seeking new insights, asking questions and assessing phenomena in a new light. Therefore, it is also very flexible and adaptable to change, which is likely to happen as a result of new data and insights appearing along the research process (Saunders et al., 2009). Given the lack of previous work and theories in this field, it is beyond the scope of this paper to draw concrete and generalisable conclusions of the implementation of circular economy in the horticultural sector. Instead, the paper seeks to shed light on a widely unstudied area within circular economy.

To carry out our research, we followed a grounded theory strategy. Grounded theory is often applied when working inductively and is helpful to develop new theories. Data collection starts without a specific theory, however, through various observations and further knowledge building, predictions are generated and developed. The reference to the data to develop predictions and build new theories is the key of grounded theory (Saunders et al., 2009). Nevertheless, as earlier mentioned, it is beyond the scope of this study to develop new

theories. Instead we aim to develop a guiding framework that can predict and indicate important determinants and their impact on the smallholders' adoption of circular economy practices. According to Suddaby (2006), it is important to emphasise that literature should not be ignored using grounded theory as a strategy and needs to be reviewed before collecting data and analysing it. The data further needs to be presented at a conceptual level in order to draw conclusions and give theoretical insights. Further, there are no prescribed number of interviews or certain ways to code data. Grounded theory is an interpretive process and not a logico-deductive one. Our research strategy follows a grounded theory strategy, as we, as previously mentioned, did not have a predetermined theory to test but instead used existing literature to guide our research and explore the phenomenon. We come up with a framework based on our findings highlighting the key circular economy determinants and their impacts which can add to new theoretical insights.

Our study has been carried out using multiple qualitative methods as we have deemed this method most appropriate to answer our research question in the most comprehensive way. We believe that quantifying such a contextual and complex phenomenon is not adequate in order to answer the research question. By using qualitative methods, we accept that we are not able to create hard theories or social laws and hence we are not able to make definite statements. Multiple methods refers to combinations of more than one data collection technique, however, it is restricted to using either quantitative or qualitative methods. We conducted unstructured and semi-structured interviews as well as observations. By using different data collection methods, triangulation of the data is possible, which adds to the validity of the data. As we are studying a particular phenomenon at a particular time, we are doing a cross-sectional study. This is due to the natural time restrictions of the research process, which have meant that our interviews have been conducted over a relative short period of time (Saunders et al., 2009). This implies that our findings and analysis are constrained to being a "snapshot" of the conditions at the given time when the data collection was conducted.

3.4 Data Sources and Collection

From the reviewed literature, we derived a unified understanding of circular economy in the agricultural sector and a range of proposed determinants. This has formed the foundation of

our research and guided our data collection. Our data consists of primary and secondary sources. According Saunders et al. (2009), primary sources is classified as first occurrence of a piece of work whereas secondary sources is classified as subsequent publications of primary literature. Our primary sources consist of six interviews with smallholder horticulture farmers in Kenya and four key informant interviews (Appendix 1-10) as well as observations. The secondary sources consist of journals, reports, textbooks, news articles, academic articles and indexes, which have been used to substantiate the findings from our primary sources.

As we are doing an exploratory study, we want to find out what is happening and seek new insights. Therefore, our main method of collecting our primary data has been through semi-structured interviews. These are a non-standardised form of interview that follows some key questions and themes central to the study. However, the questions might vary from interview to interview. We deemed semi-structured interviews the best tool for data collection as it assured that our key topics were covered while the interviewees also had a chance to develop their own ideas and arguments. Nevertheless, before going into the field, we conducted some informal and unstructured interviews in order to get advice on doing research in the Kenyan context as well as to establish contacts we could use during our fieldwork. As these interviews were used mostly as background knowledge and to get started with our research process, they have not been included in our findings. In addition to our interviews, we have also collected primary data through observations. We have done participant observations, which is a research strategy in which the researcher immerses in the research setting with the objective of sharing in people's lives while attempting to learn their symbolic world. Participant observations are qualitative and works with the meaning of people's actions (Saunders et al., 2009). We have used the observations as it was important for us to observe people in their social setting and understand what is going on. Especially observing the farmers' farms, fields and how they arranged their production were very insightful observations as it shows working conditions that might affect drivers and barriers and that we would not have realised or asked in to without physically being present on the farms.

3.4.1 Sampling Method

The population from which our sample is drawn consists of the horticulture smallholder farmers in Kenya and experts working within the field. As it has not been possible to

interview the entire population, we have selected a non-probability sample for our interviews. Non-probability sampling is of more qualitative character and may be used when there is only access to a limited number of the entire population. Even though no statistical conclusions can be drawn, you still may be able to generalise from non-probability samples just not on statistical grounds (Saunders et al., 2009). Our key informants were chosen by purposive sampling as these were selected to be cases, or informants, that would best enable us to answer our research question. This form of sampling is used when you want to select cases that are particularly informative and may also be used by research adopting a grounded theory strategy like in this paper. Nonetheless, purposive sampling does not allow for generalisation about the total population but helps to provide an understanding of the topic and context (Saunders et al., 2009). Due to time and cost constraints, it has not been possible to interview farmers from all counties in Kenya. Nevertheless, with the assistance of prior contacts, we ended up having access to farmers in three counties. Operating in the horticulture sector with smallholder farmers entailed various barriers hindering accessibility. This meant that our research participants were primarily selected by convenience sampling. We are aware of the fact that the counties in Kenya differ in various ways in regard to regulations, crops grown and climate. This might entail different barriers and drivers in terms of implementing circular economy practices. Therefore, our findings might not be applicable to all counties.

3.4.2 Interview Process

In order to ensure completeness in our data collection as well as to increase the reliability of our findings, we constructed an interview guide (Appendix 11) for our interviews with the smallholder farmers as recommended by Yin (2003). Throughout the data collection process, we adjusted the interview guide several times as we discovered new areas and points that needed to be included and elaborated on. The interview guide included an introduction to our research and us in which we made it clear that the interviewees were anonymous and could stop the interview at any time. This is very important, as the informants usually will feel more relaxed in the situation and will speak more openly. Moreover, we explained our research purpose and the principles of circular economy in the agricultural sector to the interviewees. The main part of the interview guide contained our key themes related to agricultural and circular economy practices and the drivers and barriers that might affect the implementation

of circular economy provided by existing literature. Further, the interview guide served the purpose of ensuring that our interviews were conducted in a uniform fashion. As we wanted different things out of our interviews with the key informants and the smallholder farmers, the process of these interviews differed. In relation to the key informants, we did not have a uniform interview guide that we utilised for all four interviews. As the key informants had different backgrounds and expertise areas, we would prepare a set of questions or areas that we wanted covered in each interview to make sure we would get the needed information. Moreover, conducting the interviews semi-structured allowed the informants to shed light on and cover some topics that we might otherwise not have discovered in our research.

Throughout the interviews with the smallholder farmers, we tried to formulate questions in a neutral way and to avoid leading questions in order to assure validity and comparability between the interviews. Due to the technicality of the topic, we tried to simplify the concept and made sure to frame the questions in an easily understandable way. We realised that the understanding and talkativeness of each informant varied a lot and hence questions in some of the interviews were leading, which we deemed necessary in order to grasp and understand the informant as complete as possible. After each interview, we offered our contact information so they could contact us in case of any further questions. From the informants that agreed, we recorded the interviews in order to assure that no points were missed. For the ones that did not want the interview recorded, extensive notes were taken throughout the interviews. However, we know that this puts the data at risk of interviewer bias, as the notes reflect our interpretations of the information provided by the informants.

3.4.3 Data Processing and Coding

To ensure that we got the most out of our data and that it was available for a comprehensive analysis, we transcribed the interviews shortly after they were conducted (Appendix 1-10). This meant that our memories were still present and it decreases the risk of missing important points. In order to analyse our data systematically, we coded our farmer interviews (Appendix 12). We divided our findings into seven main determinants that we considered the most important for the smallholder farmers' adoption of circular economy from the interviews. Having identified the seven main determinants, we were able to more precisely categorise our findings in terms of the main determinants' impact on circular economy

adoption. Coding our data, we had in mind our unified understanding of circular economy practices in the agricultural sector. Our secondary data has been used to support or oppose the findings from our primary data.

3.5 Credibility of Findings

Doing research can entail various threats to reliability and validity that one needs to consider. Reliability refers to the extent to which one's data collection techniques or analysis procedures will yield constant findings whereas validity is concerned with whether the findings are really about what they appear to be about (Saunders et al., 2009). According to Robson (2002), there are four possible threats to reliability. The first one involves participant error, which concerns the importance of conducting the interview at a more "neutral" time to avoid the participant being affected by e.g. a certain event. The second one involves participant bias in which the interviewees might consciously or unconsciously act or answer the questions in a way that they think the researcher want them to. The third one, observer error, entails that researchers doing a project together conduct interviews with different structures and different ways of asking questions. Lastly, observer bias relates to the different ways researchers can interpret the replies. In order to avoid these four threats to reliability, we had to take some precautionary measures.

Given the sensitivity of some of our questions including corruption and unsustainable practices, we were aware of the risk of participant bias. Some of the farmers might not have told us the entire truth as they might be afraid of getting punished by authorities not living up to certain standards as well as passing on information about corruption. Nevertheless, we tried to avoid this bias by getting the trust of the smallholders by offering anonymity as well as using diverse data sources. Further, we explained that we were students and not from a company or an NGO able to support them financially to ensure that they answered our questions in the most complete way and did not understate or exaggerate points. In terms of observer error, we developed an interview guide and established a structure for conducting the interviews with the smallholder farmers beforehand to ensure alignment. This meant that one was the main conductor in all interviews, asking the questions in the same manner whereas the other would primarily take notes and add comments or questions if needed. In order to decrease observer bias, we recorded most of the interviews and took extensive notes.

Furthermore, we made sure to transcribe the interviews immediately and compare with the notes to ensure alignment. In terms of participant error, we were not able to change the time we conducted the interviews and we might therefore have interviewed the participants at a time which was not representing their daily practices.

The validity and accuracy of the research is determined by the research design. To increase internal validity, we used multiple sources to support our findings. In doing so, it was possible for us to perform "quality checks" of our findings (Pauwels & Matthyssens, 2004). Circular economy in the horticulture sector is a widely understudied and complex concept, which poses a threat to achieving validity in the research. To address this challenge, we defined circular economy in the horticultural sector prior to the data collection by reviewing existing literature to establish operational measures and avoid subjective or biased judgements of what circular economy practices are. By defining some key indicators of circular economy practices in the horticulture sector, we were able to more precisely relate key determinants to the studied subject. The external validity is concerned with the generalisability of the findings, which is related to whether your findings are equally applicable in other settings. As previously mentioned, the aim of our research is not to produce a theory that is generalisable to all. Instead, we are investigating and trying to explain what is going on in our specific research context. Thus, in doing so, we address the challenge of external validity.

4 Empirical Data Presentation

This section presents our primary and secondary data, including our key informant interviews, to provide insights into the Kenyan context and the characteristics of the Kenyan horticultural sector. This is followed by a presentation of our interviews with the six horticulture farmers. By first presenting the context of our research and the characteristics of the horticulture sector, we construct a baseline for the conditions for the smallholder farmers and it thus enables us to link our findings to the context in the analysis.

Informant	Field
Raphael G. Wahome (Appendix 7)	Professor specialised in analysis of food production (University of Nairobi, Faculty of Agriculture)
Josphat Njenga (Appendix 8)	Phd student at University of Nairobi MSc on 'Network analysis and traceability along organic kale value chains' as part of the ProGrOV programme
Leah Murimi (Appendix 9)	Extension service officer in Kiambu County PhD on 'Market governance for growth of the domestic organic value chain' as part of the ProGrOV programme
Leah Mwaura (Appendix 10)	Advisor for 'Kenya Market-led Horticulture Programme (HortIMPACT)' at SNV (Netherlands Development Organisation)
Farmer 1 (Appendix 1)	Farmer and chairman of 'Aberdare Fresh Produce Cooperative' (AFPC) from Nyandarua County
Farmer 2 (Appendix 2)	Farmer and member of AFPC from Nyandarua County
Farmer 3 (Appendix 3)	Farmer and member of AFPC from Nyandarua County
Farmer 4 (Appendix 4)	Farmer and member of AFPC from Nyandarua County
Farmer 5 (Appendix 5)	Farmer from Bungoma County
Farmer 6 (Appendix 6)	Organic farmer from Kiambu County

4.1 Context of Kenya and Characteristics of the Horticulture Sector

In the past decade, Kenya has made significant political, structural and economic reforms, which have led to sustained economic growth, social development and political gains. In 2016, Kenya accessed the status of becoming a mid-income country. Despite severe drought experienced in 2016 and a hectic presidential election in 2017, the growth in Kenya has remained strong. It was measured to be 4.8 percent in 2017 and is expected to end at 5.5 percent in 2018. However, Kenya still experiences great development challenges including poverty, inequality, high unemployment, poor governance and climate change (World Bank, 2018). Corruption is another big issue in Kenya penetrating every sector of the economy. According to Transparency International's Corruption Perception Index from 2017, Kenya ranked 143 out of 180 countries. This has great human and economic consequences for Kenya (Transparency International, 2017). In 2010, a new constitution was introduced in Kenya, which introduced a bicameral legislative house, devolving 47 county governments, a constitutionally tenured judiciary and electoral body. The devolution introduced a new political and economic governance system meant to strengthen accountability and public service delivery at local levels (World Bank, 2014). The agricultural sector was one of the first to fully devolve the function of service provision to the county governments (FAO, n.d.).

Agriculture in Kenya remains a large and complex sector influenced by a multitude of public, parastatals, non-governmental and private actors. Operating in such a complex sector is not easy for smallholders. However, in Kenya, the smallholders have prospered in non-traditional markets by turning from staples to horticulture – a sector which has quadrupled in value since 1975 (Ashurst & Mbithi, 2010). The sector is defined broadly to include processed fruits and vegetables, fresh fruit and vegetables, and cut flowers. In 2009, Kenya had 240 large-scale producers and roughly 150,000 smallholder farmers and the sector employed 1.5 million labourers and supported up to 4.5 million dependents. While large commercial estates dominate the flower production, two thirds of Kenyan vegetables are grown by smallholders (Muuru, 2009). The practices are capital intensive and a lot of farm inputs are required. Moreover, it is also labour intensive considering that much of the farm work is done using human labour (Information Cradle, n.d.). Kenyan smallholders work almost entirely by hand, from the first preparation of soil for planting to the final harvest. They usually have no

tractors or other machinery and crops are sprayed by hand-operated pumps. In order to maximise the produce, land is intensively used. This is mainly because horticulture is practiced in areas with land scarcity. The plots of the smallholder horticulture farmers are small and commonly vary in size from around half an acre to five acres (Muuru, 2009). Further, farms and fields are often not connected and because of the distances between them characterised by poor infrastructure, this affects the practices of the farmers (Kiprono & Matsumoto, 2014). The lack of adequate infrastructure similarly makes it difficult for the farmers to get their produce to the markets (Appendix 10). Moreover, the farmers are highly influenced by culture and neighbours in terms of how they grow their land and farmers often do what they have been taught by their parents or what are the common practices in the area. They tend to copy practices from each other if they see that they can generate a higher income. Thus, if practices are effective, they will spread quickly. Further, farmers also sometimes rely on each other for exchange of resources, e.g. if one has surplus of manure then he will sell it to another instead of discarding it (Appendix 7; 9).

According to Muuru (2009), different crops require different nutrients. Maize, for example, drains nitrogen from the soil, whereas beans add nitrogen to the soil. If a single crop is continuously planted on the same plot of land, high quantities of fertiliser are needed to maintain a healthy balance of nutrients in the soil. It is therefore common among the Kenyan farmers to divide their fields into quarter-acre or half-acre plots, rotating crops to maintain soil quality. Moreover, it is argued that diversifying crops also helps to reduce the build-up of pests and diseases as the ones that attack green beans, for example, will not harm maize or sweet potato harvests. Therefore, the smallholder often plants different crops next to one another to guard against the spread of diseases, which can be classified as a form of integrated pest management (Muuru, 2009).

As mentioned, Kenya is facing struggles related to its low agricultural productivity. The low productivity is among other things due to the fact that the majority of the farmers are working on over-worked, nutrient-depleted, small pieces of land that have been subdivided for generations. The agricultural labour productivity (the amount of output per unit of input) has been declining for the last three decades even though advancements have been made in the provision of secondary and tertiary education. The low labour productivity in the horticulture

sector is characterised by a mismatch between educational training, research and industry requirements; and inadequate access to capital for investment to expand production or labour-enhance technologies (Kangai & Gwademba, 2017). Another factor affecting productivity is the fact that all farmers do not think of their agricultural production as a business. Instead, some perceive it more as a side business and therefore many do not think of it as something that could be improved. This is also reflected in the fact that many farmers do not keep records and, thus, are not aware whether they are making a profit or a loss. Profit is not pivotal factor as long as they are able to feed their family, pay rent, etc. However, the farmers within the horticultural sector are in general thought to be more business aware as the crops grown in this sector are more demanding compared to other sectors (Appendix 9; 10).

4.1.1 Rules of the Game: Governance and Institutions

Governance and institutions form the basis of the enabling environment for the horticultural sector in Kenya through different agendas. Institutions include the national government, county governments, governmental parastatals, non-governmental organisations (NGOs), export companies and financial service providers.

To ensure a functioning agricultural sector, it is important to have the relevant policies and regulations in place. The State Department of Agriculture, operating under the Ministry of Agriculture, Livestock and Fisheries, is responsible for the agricultural policy formulation in Kenya (Appendix 13) and for ensuring an enabling environment for a successful agricultural production. The counties are the ones responsible for the facilitation and implementation of these. Moreover, several functions within the agricultural sector have been devolved to the counties. The operationalisation of the these are up to the county itself, which leads to differences in terms of focus and policies among the counties. It is also a result of the fact that the agricultural production varies in each county and, thus, different initiatives are needed (Council of Governors & Ministry of Planning and Devolution, 2018). Nonetheless, even though the devolution sounds to have promising potential, it has been argued that it in practice has led to slow policy processes partly due to the time it takes to introduce a new system and partly because of the fact that the members of the county government changes.

Processes initiated might be stopped as an outcome hereof which can have a negative impact on the agricultural production (Appendix 7).

The horticultural sector is also influenced by other institutions such as the government parastatals, which include the Pest Control Product Board (PCPB), the Kenyan Plant Health Inspectorate Service (KEPHIS) and the Horticultural Crops Directorate (HCD). These help execute the law at national and county level. PCPB serves to execute the Pest Control Products (PCP) Act of the government and hence "to ensure access to safe, quality and efficacious pest control products for animal, plant and human health while safeguarding their health and the environmental protection" (PCPB, n.d.). PCPB sets the regulatory framework for the use of pesticides and serves to guide the farmers in the use of chemicals (PCPB, n.d.). KEPHIS is the regulatory body whose aim is "to assure the quality of agricultural inputs and produce to prevent adverse impact on the economy, the environment and human health" (KEPHIS, n.d.). It offers services related to various inspections and monitoring, facilitates trainings and technical support and enforcement of specific requirements (KEPHIS, n.d.). HCD is established under the Agriculture Act and the body responsible for promoting, developing and coordinating the production and marketing of horticultural produce (HCD, n.d.). An interview with Leah Mwaura (interview, 31 August 2018), advisor for agricultural sector programmes for SNV (Netherlands Development Organisation, summed up their functioning as follows: KEPHIS is mainly in charge of doing the controlling, PCPB is meant to set the standards and HCD is supposed to facilitate knowledge of the standards to the farmers especially for the export farmers as standards are very important in this area (Appendix 10).

According to Leah Murimi (interview, 18 June 2018), an extension officer for Kiambu County, the parastatals often lack resources and do not reach many smallholder farmers. She argued that the smallholder farmers producing domestically are not prioritised and controlled, which is causing various challenges related to food safety and sustainable production (Appendix 9). Mwaura moreover mentioned that the parastatals do not write out fines to farmers not living up to the required standards, which decreases the incentive to produce sustainable and live up to standards (Appendix 10). Similarly, Josphat Njenga (interview, 12 June 2018), PhD student within agriculture at University of Nairobi, argued that for the farmers, it is a problem that there often is no follow up on pesticide level from the regulating institutions. He argued

that even though the national government is focusing more on food safety, there is no enforcement of it. Instead, they only regulate for the bare minimum of pesticide levels and food safety, nonetheless, some counties have gone a step further and started to regulate more strictly and put even more focus on cleaner production (Appendix 8). However, according to both Mwaura and Njenga, different rules apply when the produce is meant for export. Here, the enforcing parastatals control and ban products if these are not up to standards. The rejected products often end up being sold in the local market instead and pose a threat to the quality of food sold domestically (Appendix 8; 10). Mwaura and Raphael G. Wahome (interview, 12 June 2018), professor at University of Nairobi, argued that policies are generally in place but enforcement is the problem hindering the production of sustainable products (Appendix 7; 10).

Export companies also play an important role in the horticultural sector. The horticulture sector is the second largest foreign exchange earner, and thus very important to the Kenyan economy. The export companies are essential in the facilitation of the export (Kangai & Gwademba, 2017). Rising demand has prompted exporters to turn to smallholders to increase volumes and now smallholders produce 60 percent of exported fruit and vegetables (Muuru, 2009). Commonly, small-scale farmers working with export companies get certain advantages from these agreements. The exporters will often develop an out-grower scheme to increase the productivity of the farmers (Banson et al., 2014). Exporters provide smallholder farmers with resources to enable them to meet production targets. Seeds, fertilisers and other farm inputs are made available to smallholders before planting and at the moment of purchase the value of inputs is deducted (Muuru, 2009). In return for providing the export companies with a certain quantity of a specific product at a certain time meeting the quality standards, the farmer has improved access to assured markets and prices with relatively higher returns. Further, export companies will often also commit to support through e.g. training, supplying farm inputs, land preparation, technical advice and arranging transport (Banson et al., 2014).

A large number of NGOs are similarly present in the Kenyan agricultural sector providing various services such as the introduction to new technologies and trainings of farmers. Therefore, they are of great importance for the sector (Ndungu, De Groote & Danda, 2005). Professor Wahome further experienced that NGOs have a big influence on the farmers in

Kenya. He explained that they often come with many incentives and inputs that can lead to long term impacts. Furthermore, he argued that they have a bigger impact than the policies that are in place as they have direct contact with the farmers (Appendix 7). Murimi similarly explained that a lot of NGOs were involved in Kiambu county offering different services to the farmers (Appendix 9).

Extension services in the agricultural sector play an important role in sharing knowledge, technologies and information as well as to link the farmer to other actors in the economy. It is provided by the various institutions. According to the Agricultural Sector Coordination Unit (ASCU), several constraints have hindered the proper functioning of the extension system. The most critical ones are declining human, capital and financial resources for public extension without a corresponding private sector input, uncoordinated pluralistic extension service delivery, and poor linkages with extension facilitating factors. An overriding challenge for both public and private sector extension provision has therefore become how to mobilise sufficient resources to provide the required services. There are currently no formal guidelines governing code of ethics and working standards for extension service providers. Instead, each service provider applies what they regard as appropriate. The extension services have been able to respond to some of the pressing environmental concerns. However, despite the progress made, challenges remain in embracing sustainable environmental management. The extension service providers have therefore been required to address mainstream environment and natural resources-related issues by using sustainable, dynamic, innovative and effective extension approaches and methods (ASCU, 2012).

In the interview with Murimi, she explained that county extension services are supposed to be offered to all farmers and their aim is to reach every farmer in the county. The farmers can contact the officers when they face issues such as pests that require outside guidance. In addition, they offer trainings and demonstrations for groups of farmers. She mentioned that circular economy practices were not a specific focus for the county government and its extension service officers. However, the national government has started to focus more on improving agricultural practices as they have become aware of population growth, climate changes and food security issues. Another service the county extension services offer is soil sampling. The extension officers facilitate getting the samples and analysing them. On the

basis of that, they can advise on which fertilisers to use and when as well as which type of crops would grow better given the condition and fertility of the soil. However, this is not a free service offered to farmers (Appendix 9). A study of the horticulture sector in Kenya by the Embassy of the Kingdom of the Netherlands (EKN) revealed that the extension services are, however, inadequately leading to a lack of requisite knowledge and skills production. There are not enough adequate extension personnel to reach all. The unorganised programmes of all extension providers lead to poor delivery and non-standardised extension messages (EKN, 2017). Further, in our interview with Mwaura, she explained that the county extension officers generally are very strained and not able to reach all the farmers as there are simply too many farmers in relation to officers (Appendix 10).

The banking and financial institutions play an important role providing finance for the smallholders. A study by the Embassy of the Kingdom of the Netherlands (EKN) (2017) found that horticultural farmers in Kenya had low availability of capital and limited access to affordable credit. It was revealed that the low productivity in the horticulture sector was caused by inadequate credit to finance purchase of inputs and capital investment, which resulted in unaffordability, adulteration and consequently low application of key inputs (EKN, 2017). Further, a household survey of Kenya from 2016 by FinAccess found that 87.7 percent of the finance sources in agriculture came from own savings and/or last harvest's surplus and very few were using formal credit (FinAccess, 2016). A report on financial inclusion for smallholder farmers highlighted some of the existing challenges for the farmers in accessing loans in Kenya. It was found that the farmers generally had insufficient volumes of produce and inadequate connections with the markets. Thus, they were not able to generate enough cash flow and hence 'bankability' (Dalberg, 2015). In the interview with Mwaura, access to finance and high interest rates were also emphasised as big issues for farmers in Kenya. She explained that farmers often were not keeping records of their business, which did not help their case (Appendix 10). Another condition impeding their access to finance is the fact that many smallholder farmers do not have title deed to the land. Even though their community may generally acknowledge that the land they farm is indeed theirs, the costs related to registering land and acquiring titles are too high for the majority of the smallholders. This means that the farmers do not legally own the land and therefore cannot use it as collateral to access credit that can allow them to improve to their farming practices (Were, 2016).

4.1.2 Access to Quality External Inputs

To realise high crop yields and reduce expenses, the access of quality farm inputs is an important factor in the horticulture sector. However, the markets for farm inputs lack transparency in Kenya and, thus, this remains a challenge for many of the smallholder farmers. Seeds, fertilisers, pesticides and water are some of the most common external inputs.

The seed industry in Kenya is comprised of both a formal and an informal sector. The formal seed sale takes place through registered agro-vet stores that are regularly inspected by PCPB and KEPHIS. It is thereby possible to know the quality of the seeds beforehand (Sikinyi, 2010). However, according to Audi Willis (email, 21 August 2018), HCD compliance officer, poor quality seeds problems still arise. Besides offering the farm input, the agro-vet stores are also able to advice the farmers on which inputs are best suited for their needs as well as how much to apply. Mwaura explained that many farmers would consult their local agro-vet regarding problems or questions about their practices (Appendix 10). The informal seed sector is run by various local actors. The source and quality of the seeds sold by the informal sector is often not known. According to Willis, the smallholder farmers often deal with the informal traders (email, 21 August 2018). This means that they are exposed to several uncertainties, which might ultimately pose a threat to their production.

According to Ariga & Jayne (2011), the use of fertilisers among the farmers are notably higher in Kenya compared to other countries in the region due to a liberalisation of the fertiliser market in 1990s. The authors emphasised that a study from 2007 found that 70 percent of the smallholders applied fertilisers. This number is expected to be even higher today as the Kenyan government initiated a national fertiliser subsidy programme in 2009 to ensure access to quality fertilisers for the farmers. The programme has been regulated various times since its introduction. After the devolution, it has been operationalised at county level. In the interview with Murimi, she argued that the government's fertiliser programme had made fertilisers more affordable and available for the smallholder farmers and consequently increased the usage (Appendix 9). However, Banson et al. (2016) argue that subsidising fertiliser is often only a quick fix in terms of increasing productivity. If the problem is related to low soil fertility, the fertiliser can help to lead to good yields provide a security of quality

but only short-termed. The side effects of the farmers experiencing good result from these inputs is that they will develop a wrong perception of producing quality, which will ultimately reduce the support for integrated resource management. Therefore, it is important that policies specify whether they are merely treating the symptoms (poor fertility) or addressing the root cause of the problem (depletion of good soil structures) (Banson et al., 2016). Besides this, the subsidised fertilisers were supposed to be sold at specific stores, run by the National Cereal Produce Board (NCPB) depots through the county governments. According to Mugai (2018), it has been a general problem that NCPB has not been able to procure the government subsidised fertilisers on time. Moreover, the author states that several rumours have indicated that traders buy huge amounts of the subsidised fertilisers, which they repack, mix and sell for the double price to the farmers (Mugai, 2018).

The usage of pesticides is widespread among the horticultural producers, which is a market controlled by private actors. It is estimated that pests and diseases cause around 30 percent crop yield loss at farm and market levels in Kenya. Thus, pests and diseases are one of the most important factors leading to losses in the horticultural sector. Larger growers are usually knowledgeable in terms of the use of pesticides and are more commonly controlled compared to the small-scale farmers. Even though the small-scale farmers often have directions on what to use and when, there is a lack of knowledge of best practice among this group. As there is a wide range of chemical products available, this makes it difficult for the farmers to choose the right product. There is a lack of comprehension of the classification of pesticides product, which means that they often choose chemicals restricted for the use on fresh produce. As many of the smallholder farmers do not record their activities, it is difficult for the regulators to control their practices. Finally, they use poorly designed equipment hampering the spraying (EKN, 2017). According to the Agro-chemical Association of Kenya (AAK), farmers are exposed to counterfeit pesticides products that are widespread in the market (Rading, 2018). This was further supported by Mwaura, who mentioned the sales of counterfeit products as being a big issue (Appendix 10). It is estimated that 15-20 percent of the agrochemicals distributed in Kenya today are fake. The sales are facilitated by unauthorised dealers that have found ways to sell these products by generating labels similar to the genuine product. It is estimated that the country annually losses KSH 100-120 billion due to the trade of counterfeit pesticides products (Rading, 2018).

Kenya consists of 90 percent arid or semi-arid land with highly unstable rainfall patterns which is further exacerbated by climate change and various water intensive activities. Water management is therefore a big challenge in the country. Huge potentials of irrigation and agricultural water storage exist, however, lack of investment in this area leaves the opportunity unexploited (Royal Tropical Institute, 2016). This often leaves water management as a challenge for the smallholder farmers and their production as they do not have the resources to invest in smart irrigation systems.

4.1.3 Market Conditions

The market conditions are an important determinant for the smallholder farmers. Horticulture smallholder farmers are flexible and dynamic and the choice of crops is based on market demand. When prices change, farmers act quickly. By sharing infrastructure and know-how, smallholders can be responsive to the commercial priorities. Until recently, the production has been dominated by large commercial farms but in the past two decades smallholders have gained a larger share of the market (Muuru, 2009). However, it is still argued that one of the largest barriers for farmers is related to access to markets as horticultural marketing information and infrastructure are poorly organised (EKN, 2017). Mwaura followed-up by explaining that the farmers are not always able to get their products to the market and there is usually not a ready market waiting for them, which often leads to food losses. She further mentioned that stable markets in general was a big issue in Kenya (Appendix 10).

Another factor related to market is consumers. Mwaura argued that if there was more demand among domestic consumers for safe quality food, there would arguably be more enforcement of the standards already in place as with the export produce (Appendix 10). Njenga further argued that the incentives still lack for the farmers to change their practices as the demand from consumers is not present (Appendix 8). More focus and information about food safety from the government is therefore key in order to change the consumers' mind-sets and behaviour. Further, Njenga argued that a barrier to increase sustainable production is due to the fact that the majority of the consumers are not financially able to buy e.g. organic products. Moreover, they can also not be sure that what they actually buy is organic as the

labelling system is not effectively working (Appendix 8). However, the Productivity and Growth in Organic Value Chains (ProGrOV) project (2017) found that there had been an increase in consumer awareness as the consumption of organic products had begun to increase in recent years in Kenya. The project revealed that the demand for organic products outstripped the supply in some areas. Nonetheless, they also discovered that many farmers were not aware of the increase in demand, which was a reason why they did not respond to it (ProGrOV, 2017).

4.1.4 Climate Change

Ochieng et al. (2016) argue that the climate variability and changes adversely have affected the horticulture sector in Kenya. The situation is only expected to get worse in the future as temperatures are expected to become more unstable and rainfalls more unreliable. These changes pose a threat to the horticulture practices. According to Murimi, climate changes have led to more pests and ultimately caused a general increase in the use of pesticides among smallholder farmers (Appendix 9). The changing and unpredictable raining seasons have further affected the farmers' ability to plan farming activities, especially due to the dependence on rain-fed agriculture. Areas that used to receive adequate rainfall now receive insufficient amounts, which have increased the need for more irrigation. Flooding and erosion have further removed nutrients from the soil resulting in declining soil fertility (Farmers Trend, 2016). Mwaura explained that the farmers are trying to become more resilient to respond to these changes. This is done by storing rainwater, either in tanks underground or on land or in water ponds, as most farmers rely on rain in their production, intercropping, and going back to producing local vegetable crops that are more resilient (Appendix 10).

Ochieng et al. (2016) similarly argue that the challenges of climate change can be overcome by adapting to the situation. This can be done in a number of ways, including "the growing of alternative crops, intercropping different crop varieties, use of drought tolerant seed varieties, employing irrigation and water harvesting techniques, crop insurance, early warning and monitoring systems, construction of dykes, human migration, changing planting dates, diversifying in and out of agriculture, reliance on safety nets and social networks and sale of assets" (Ochieng et al., 2016:72). However, one constraint that immensely impede the implementation of more sustainable practices is that some of the adaptation technologies,

such as irrigation systems and dykes, require huge capital outlays. Thus, it has been emphasised that there is a need to integrate the likely harmful effects in the agricultural and environmental policy formulation processes (Ochieng et al., 2016). Murimi experienced that farmers have become more environmentally aware as they are feeling its consequences first-hand. They know how certain practices can affect the climate and the environment negatively. Moreover, they have seen how the water is getting more polluted and that friends and family are getting sick (Appendix 9). Nevertheless, in an investigation of the effect of climate changes on farmers' production strategies, it was revealed that singling out climate as a direct driver of implementing more sustainable production in Africa was not that simple. Instead, the farmers attributed a mix of economic, political and social factors as reasons for change (Mertz, Mbow, Reenberg & Diouf, 2008).

4.2 Interviews with Smallholder Farmers

This section presents the findings from our interviews with the six smallholder farmers. It will be divided into seven determinants, which are based on what our findings have revealed to be most important and what have been recurring themes in the data collection. We found existing knowledge and awareness; social capital, norms and traditions; infrastructure; market conditions and information; institutions and knowledge transfer; financial access and incentives; and climate change to be the most important determinants of adopting circular economy practices. Thus, our findings have been coded according to these (Appendix 12).

We conducted interviews with six smallholder horticulture farmers respectively four from Nyandarua county, one from Bungoma County and one from Kiambu County in Kenya. Except for the farmer from Kiambu, who produced organically, they were all conventional farmers. The four farmers from Nyandarua County were a part of the Aberdare Fresh Produce Cooperative (AFPC), whereas the organic farmer was a part of a self-help group and the Central Organic Farmer and Consumers Organisation (COFCO). The size of the farms ranged from 0.5-5 acres. The farmers produced more or less the same products including different kinds of peas, sugar snaps, potatoes, carrots, beans, mangos, avocados, tomatoes and kales.

4.2.1 Existing Knowledge and Awareness

Knowledge is a broad and complex term as it entails various forms and is obtained through different providers. As we analyse determinants affecting a transition to circular economy, we found the existing level of knowledge of the farmers in terms of agricultural practices and what is needed in order to change to circular economy to be an important determinant. Moreover, awareness of their own level of knowledge and of the impact of their practices were found important in order to drive change.

From the interviews with the six farmers, diverse knowledge existed on how to control and minimise the use of external inputs. The four AFPC farmers had received training on how to use pesticides from the export company they were connected to and from KEPHIS. Receiving training, they explained that they now knew the amount of chemicals to apply as well as when to apply it (Appendix 1; 2). Some of the farmers mentioned that they were taught in school about the risks of not using pesticides with care and therefore were aware of the use to avoid negative discharges to the environment. The organic farmer mentioned that he was informed about the various threats of using pesticides and inorganic fertilisers, which made him concerned about the health of the Kenyan population and the nature. He had obtained knowledge on how to convert. The awareness and knowledge made him convert his practices to organic production (Appendix 6). The rest of the farmers generally expressed that they would like to reduce the use of chemicals and eventually similarly convert to organic production, however, they did not have the adequate knowledge to make the transition. The organic farmer supported this by arguing that lack of knowledge was a big barrier for farmers to become organic (Appendix 6). Two farmers had gotten their soil sampled and tested which meant that they had obtained valuable knowledge of their soil (Appendix 1; 3). The remaining lacked knowledge of their soil. They expressed that they were aware of the importance of obtaining this to be able to control their external inputs better. This would enable them to know which fertilisers and chemicals to use and how much. However, they could not afford one. Further, they were aware of the importance of getting their own soil sampled and not just receiving the test results from another sample from the area as soil fertility and the nutrients in the soil can differ a lot. The AFPC farmers had sprinklers to irrigate their fields, nevertheless, the farmers expressed a general lack of knowledge of this practice. They said

that they had little information on how to use the right amount of water for each crop (Appendix 1; 3).

Among the farmers, there seemed to be a basic knowledge of recycling nutrients and reusing different agricultural by-products. A few farmers mentioned that they had received training on recycling plant crops and how to compost. They had learned the importance of not putting the by-products back on the fields immediately as it might contain diseases after harvesting. Instead, the farmers kept it in another place for some time in order for it to dry before they could use it as compost. Their knowledge was reflected in the fact that they had various waste disposal pits in order to separate their wastes. However, their processes of composting differed in practice, primarily in terms of how long they would leave it to dry before spreading it back on their fields. Knowledge about closing nutrient loops by using manure was found among all of our participants. They expressed awareness about the several benefits of using manure from their livestock. Farmer 2 explained that he was taught about the advantages of using a polythene bag in the process of drying his manure. This was something that had been very beneficial to his production as he got increasing output from the manure (Appendix 2). The majority of the farmers were acquainted with the benefits of using the polythene bag, however, financial constraints prevented them of this practice. Farmer 3 explained that he instead put his livestock manure in a hole, where he would let it dry with the sun for approximately three months before taking it back to his field to feed nutrients back to system (Appendix 3). Farmer 5 explained how he could use the remains from crops as compost and then mix it with livestock manure to get the most out of his resources and close the nutrient loop (Appendix 5). Even though basic knowledge existed about the benefits of reusing crop remains and manure to close nutrients loops, most of the farmers explained that their knowledge was mostly obtained through family practices and they therefore lacked more specific understanding of the nutrient system.

The farmers exercised varying knowledge in terms of maintaining the quality of the soil and water. Most of them were aware of the benefits of intercropping, diversifying and rotating their crops to keep the soil healthy and applied these in practice. Further, a few had grass strips planted in order to avoid erosion and avoiding excess chemicals spreading to the water. Farmer 1 told that the AFPC farmers were aware of the importance of the water quality and

that they had had the water quality in their area tested by KEPHIS in order to know whether the water was clean or too contaminated for them to use it (Appendix 1).

4.2.2 Social Capital, Norms and Traditions

Our interviews revealed the importance of social capital, norms and traditions. This section focuses on how the farmers were influenced by social capital in terms of social relations such as family, neighbours and farming groups. Further, it focuses on how the farmers are bound by certain norms and traditions in terms of their practices.

From our research, it became clear that the farmers in general greatly influenced each other. The farmers explained that it was common to copy each other's practices. When the organic farmer was convinced about converting to organic practices and avoiding the use of pesticides and fertilisers, many of the farmers in his area changed to organic production as well. He explained that producing sustainable and ensuring food safety were key issues in his area. He had started a self-help group with other organic farmers in the area to be able to advice each other, however, they also hoped to be able to assist other farmers that would like to avoid the use of chemicals and convert to organic practices. He explained that if one from the group would experience problems with diseases or pests in their farm, they would visit each other and help find a solution to the problem. Furthermore, he mentioned that the self-help group was part of a larger organic organisation that was made up of several self-help groups from different counties in Kenya. The different groups had got together to form the organisation as they believed they would have more power together both in terms of spreading organic practices and selling their produce (Appendix 6).

Similarly, the AFPC farmers were a part of a cooperative, which enabled them to export, receive training together, exchange knowledge and resources often leading to more circular practices. Besides being a part of the cooperative, farmer 2 stated that he and his neighbours would help each other and give each other advice in terms of new fertilisers and the use of pesticides. He mentioned that he was a part of a small self-help group. Recently, he had introduced the group to a new crop and taught them how to spray and use water on it. Finally, he pointed out that some farmers might be hesitant to change practices but "if one or two changed practices in the community, then everybody in the village would change if they saw it

worked well" (Appendix 2:76-78), which is in accordance with the organic farmer's experience. In continuation of the influence of self-help groups, the organic farmer mentioned that he was reliant on his network to be able to produce organically. As he had had to sell his livestock a while back to be able to afford the treatment for his wife's illness, he was now selling or exchanging the waste from his production to neighbours and others in the area in exchange for manure. He explained "what I do, I exchange sometimes with my waste and some manure from my neighbour. He needs my leaves for example for his cows and then we exchange for some manure" (Appendix 6:33-35).

In general, the farmers explained that they in many ways were affected by what had been the traditions and production practices of their families. Recycling crop remains and manure seemed to be the norm and something they had always done. Farmer 5 argued that farmers in general were aware of reusing their resources and feeding it back to the system. He would use all of the manure he had and often mix it with the remains from his maize production. He had a specific place on his farm, where he would always keep the manure and where he would let it dry. He explained that it was the same procedure every year and something his father had been doing it as well (Appendix 5). However, the farmers' fathers and grandfathers did not know adequately how to preserve the soil by bringing back nutrients to it. This meant that the farmers had to use more fertilisers and pesticides today in order to satisfy the soil and avoid diseases to sustain a stable production. Further, rotating and diversifying crops as well as using intercropping were common practices among the farmers. It was explained that this was something they had always been doing as it is a way to spread out risk. In general, the farmers expressed an awareness of the importance of taking care of the soil and water and many mentioned their families and friends as reasons to care. Farmer 1 emphasised that the farmers in his area had to protect Aberdare Mountain to be able to get continuous supply of water to be able to sustain their production (Appendix 1).

4.2.3 Infrastructure

Our findings revealed that infrastructure affected the farmers' practices and possibilities of adopting more circular practices. This was particularly related to the poor network of roads in the local areas. Further, there was a lack of a national waste management infrastructure impeding the handling of waste disposal.

It was explained by many of the farmers that farms and fields often were spread out and that the distance between livestock and the fields sometimes made it too complicated to transport and reuse their by-products. A process such as drying manure demanded that the manure would be collected from fields with the livestock, brought to a spot for drying before it was brought back to the fields again to be spread out. For the farmers, who had livestock, crops and drying spots spread out at different locations, this process would be very time consuming. One farmer told that his farm and fields were 3 km apart and due to the poor infrastructure in the area, it proved very difficult for him to transport the manure from one place to another (Appendix 3). This was further supported by another farmer, who told that his livestock was placed at his father's farm, which was far away. Therefore, it did not make sense to transport the father's manure to his fields. It would be too complicated and take too much time. As he said "the problem here is that the distances sometime are too big or the roads are too bad to transport it. Then it is easier just to use the fertilisers you have bought, even though that is also expensive" (Appendix 4:52-54). For the AFPC, farmer 1 told that the bad infrastructure sometimes impeded them in collecting and transporting their produce to the domestic market resulting in food losses and a financial loss for the farmers (email, 15 September 2018).

Our findings furthermore revealed that the poor infrastructure affected their waste handling. As there was both a lack of adequate waste disposal systems as well as means and ways to transport the waste, the farmers explained that they did not know what to do with their plastic wastes. Farmer 3 expressed that the farmers were often left with empty plastic containers from the chemicals, which they would not know exactly how to get rid of. Therefore, they either buried or burned them even though it was risky to the livestock and the groundwater (Appendix 3). This was a practice of many of the farmers and was explained as a normal thing to do.

Finally, farmer 1 explained that water supply had not been a problem for the farmers in the Aberdare area until now since they had been able to tap water from Aberdare Mountain through gravity. However, he explained that water was starting to run short. Therefore, they had sought help from the county government for them to help invest in water infrastructure and drill boreholes to potentially avoid future water shortages (email, 19 August 2018).

4.2.4 Market Conditions and Information

Our findings revealed that market conditions in terms access to markets and consumer demand as well as available information about the market conditions played an important role for the farmers' adoption of circular economy.

In relation to market conditions, the organic farmer initially explained that he did not have any problems in terms of accessing and finding markets for his organic produce. He mentioned that before the products were matured and when he knew which products he would have, he would go out and look for the market, talk to people and tell them what he had. Nonetheless, as the conversation evolved he did reveal that he sometimes experienced a gap in the market in terms of interest in organic products. To the extent possible, he would sell his produce to wealthier private consumers in Nairobi and certain hotels that were willing and able to pay the premium price for organic products. As he was not a part of a distribution system, he would have to go himself to Nairobi from Kiambu, which made the distribution more complicated. He would sell his surplus produce at the conventional markets as conventional produce and thus not get the premium price. He expressed that the insecurities about the market and the risk of not getting the premium price was a barrier for some farmers to convert. Nonetheless, he explained that many consumers had become more aware of food safety. However, they were still not able to demand it because most cannot afford the premium prices. The organic farmer explained that this imply that many farmers do not have any incentives to control and minimise their use of chemicals (Appendix 6). Even though the organic farmer had found a market and a group of consumers to sell his produce to, he was still not able to fully rely on it. It also meant that he had considered going back to conventional sometimes. Besides accessing unstable domestic markets, the AFPC farmers also had access to more stable markets through the export companies. Some of the conventional farmers explained that they lacked adequate information about the market for organic products. They explained that the lack of information about the market conditions made it difficult for them to assess whether a transition would pay off financially.

4.2.5 Institutions and Knowledge Transfer

We found institutions to influence the smallholders' practices in various ways through policies, regulations, standards and enforcement. Further, they impacted the farmers' practices through knowledge transfer by offering trainings, seminars and general advising. The smallholder farmers were primarily found to be engaged with or influenced by national and county governments, government parastatals, export companies and NGOs.

The farmers explained that they had received training and participated in seminars usually offered by county government, export companies or NGOs. The trainings would primarily be centred around good agricultural practices often related to pesticides or fertiliser usage. One farmer also explained that his knowledge on reuse of manure was something he had learned through agricultural training offered by the county government. A few also mentioned that they had been taught about agricultural practices in school. The AFPC farmers that were engaged with export companies received considerable more training and support. Moreover, engaging in export, the farmers automatically got further support from government parastatals such as KEPHIS who would advise on good agricultural practices in order to attain the required standards. Further, their products were regularly controlled. Oppositely farmer 5, who was not engaged with an export company, told that he had never received support or control of his produce from the government parastatals (Appendix 5). It was generally expressed that the farmers would like more support and engagement from the county governments in terms of extension service.

The support provided by the export companies was related to safe spraying of chemicals as well as to help the farmers attain requirements such as not exceeding specific pesticide levels. The export companies further encouraged the farmers to reuse their waste by making them do waste management plans in which they would document their practices for reuse and recycling. The documentation would later be controlled by the export companies. Farmer 1's waste management plan (Appendix 14) showed that his household wastes were disposed in the one disposal pit, whereas plant remains would be disposed by incorporating them into the soil, which was a practice that improved soil moisture. The lack of a national waste management infrastructure was a concern for many of the farmers. However, farmer 1

explained that the export companies were trying to fill this void by picking up the empty chemical containers from the farms. The farmers from AFPC also explained that they had become more aware of disposing plastic waste and chemical containers in a safer way due to their work with the waste management plans (Appendix 1).

Farmer 1 explained that NGOs were present in his area to support and educate the farmers in practices coping with climate changes. He mentioned that World Wildlife Fund (WWF) Kenya was funding a project called Payment for Environment Service (PES) that helped conserve soil in steep areas. The farmers that had fields on steep areas were planting grass strips on the slopes with help from the project to avoid erosion and protect it from chemicals to go in the rivers to maintain clean water (Appendix 1). The organic farmer mentioned that he had received a lot of support and training from NGOs in relation to his organic practices. He emphasised that SACDEP, the NGO that introduced him to organic farming, had been a great support. As he explained, "they came and pitched the idea. They told us about the kitchen garden. They told us don't put any chemicals in that. And from the kitchen garden, we just moved on to the farm" (Appendix 6:49-51). The organisation had given them a lot of knowledge and provided them with materials to build cages and even supplied them with rabbits to produce manure. Furthermore, he mentioned an organic organisation called Biovision Africa Trust as another support system. The organisation published a magazine that would include advice and recommendations for organic farmers. For example, he mentioned that "if you get some pest in your farm, they can tell you what to do. They do also have some special "chemicals" that are intended for organic farmers" (Appendix 6:184-185) Thus, he expressed this as being a big help to him. However, he experienced that one of largest barriers to organic production was the fact that there was no support from the governmental institutions in Kenya. He explained that "in Kenya, from the highest officer in the national government to the ground officer, they are not supporting organic farming" (Appendix 6:202-203).

It was mentioned by the farmers that the government had initiated a fertiliser subsidising programme that made it cheaper for the farmers to buy fertilisers. However, as explained by farmer 1, the supply was not something the farmers could completely rely on. "The county is doing a bit of effort to buy fertiliser for the farmers on subsidiary costs. So, at the shop, we are

getting it at KSH 3,000 per bag but we are getting the same quantity from the county government at KSH 1,500. So, it is half the price. So, the farmers are moving in that direction to get the fertiliser from the county. But also, the fertiliser from the county is not reliable because it is not continuous. It comes once per year so if you don't have cash on that time that means that you won't get the fertiliser" (Appendix 1:162-167). Farmer 5 said that he had experienced the county government reselling the fertilisers to middlemen, who would randomly mix the fertilisers and sell it at a premium price (Appendix 5). This meant that the farmers did not know which product they were actually getting. As he expressed, "I have tried many times to use fertiliser where nothing happened even though I used a lot. You don't know what you get and it might be bad for the crops" (Appendix 5:34-36). He continued by saying "when the fertilisers don't work as they should because you don't know what you get, you automatically use more because you think more is needed or you try another fertiliser" (Appendix 5:48-50). Moreover, the organic farmer argued that the government was connected to the chemical producers selling pesticides and therefore did not always have the right intentions to promote organic farming (Appendix 6). In terms of seeds, it was explained that the farmers usually bought it from certified agro-vet stores. The AFPC farmers explained that they were also able to buy seeds through the export companies. However, getting high quality seeds was often a problem experienced by the farmers.

4.2.6 Financial Access and Incentives

From our findings, access to finance, related to the ease of obtaining loans, was found to be a key determinant affecting the farmers opportunities to change practices. Further, financial incentives influenced the farmers' choice of practices.

Generally, the farmers shared the opinion that fertilisers and pesticides were expensive. This made them cautious about their use. This was further a reason why many considered to change to organic farming as they believed they would be able to save money. As farmer 2 explained "they are expensive. Therefore, I try to use my own resources" (Appendix 2:71). The organic farmer mentioned this was "one of the benefits of organic farming. The costs are less than with conventional farming because you don't need to buy pesticides and fertilisers. You use only compost and manure from cows. Thus, the expenses are less than with conventional. You have larger gains than with conventional. So, since I started to farm

organically I have never needed help. I am suiting myself" (Appendix 6:72-76). Nonetheless, he explained that he had to pay annually for an inspection to get an organic certification, which was done by a private company. He found the certification expensive but it was quite important for him as he would use it when selling his products to prove that he was certified organic. He told, however, that the certificate was too expensive to obtain for some farmers (Appendix 6). This meant that they could not prove that they were organic farmers and thus sell their produce at a premium price. This impeded some farmers' transition to organic production.

In spite of the fact that the farmers found fertilisers expensive, buying fertiliser was still cheaper than investing in livestock. Several farmers expressed a wish to invest in more livestock, however, none of them had enough cash to be able to do so and obtaining a loan was too expensive. Farmer 5 explained that he would like to buy more livestock and convert to more organic practices, however, "it is too expensive and I need more knowledge. I would need more livestock and I cannot afford to buy more. Therefore, I continue to buy fertilisers instead because the investment is not as big" (Appendix 5:63-65). In terms of soil sampling, farmer 5 expressed that he anticipated a more efficient production if he knew exactly which nutrients his soil needed. However, again, soil sampling and testing were too expensive for him even though he deemed it would pay off in the long run since it would allow him to reduce the use of fertilisers and pesticides (Appendix 5).

A driver for closing nutrient loops and recycling for the majority of the farmers was related to the financial aspect. Using manure and crop remains instead of solely relying on inorganic fertilisers would allow them to save money. The farmers expressed that they would like to rely more on manure to ensure nutrients getting back to the soil. However, as mentioned, they did not have the means to invest in more livestock and instead they had to supplement with inorganic fertilisers. Farmer 2 told "to invest in livestock is more expensive but in the long run it is advantageous if I could afford it. If I could buy three cows, I could for example use them for 10 years, but the fertiliser I buy all the time" (Appendix 2:39-41). Apart from not having sufficient cash, the farmers explained that obtaining a loan was simply too difficult or too expensive and, thus, it was not a possibility for them. Farmer 2 explained that even though he was a customer at an equity bank, the interests were still very high for farmers. Furthermore,

you would need to able to come up with some sort of guarantee, which most farmers usually do not have (Appendix 2). Nonetheless, it was explained that it would be easier for them to obtain a loan as a group. Farmer 5 told that he had had to sell some of his livestock because he needed money. He argued that this was a common practice among farmers. He explained that "the livestock is very important for them but they cannot get any loans so this is the only way for them to get cash if they need it" (Appendix 5:8-9). The organic farmer had had to sell his livestock as well to get money to afford the treatments for his ill wife. If he had had money now, he would buy two cows, which he estimated would be enough to sustain his production. However, even though he was not able to afford any livestock, he would never consider getting a loan. "As a small-scale farmer that is very difficult. Because the interest is incredible. It is just too much. Otherwise they will come and sell your land. So, loans are too expensive. It is not an option" (Appendix 6:280-282).

Another determinant of keeping nutrients in a loop is related to investments in systems or methods that ensure more efficient recycling. To be able to get as much as possible out of the manure and feed nutrients back in the system, many of the farmers had discovered the benefits of using polythene bags in the drying process. However, they explained that these were quite expensive. Farmer 4 explained that he had heard about the polythene bag and that the manure would dry better, however, he was simply not able to invest in one (Appendix 4). Farmer 2 told that he had had to go to Nairobi to get one that was functioning. As he was the only one in the area that had been able to afford one, he would let other farmers use the bag for their manure as well. Prior to buying it, he had been told that it was a good investment and after getting it he almost got double the amount from his crops. So, for him there was a financial incentive as "it was not difficult to see the benefits of drying the manure this way" (Appendix 2:90-91).

4.2.7 Climate Change

Our findings revealed that climate change affects the smallholders in terms of adopting more circular economy practices. Change in climate such as more extreme weather was emphasised by the farmers as a reason for various changes in their practices.

In recent years, it was a general observation that the climate had become more extreme. This had affected the farmers' production negatively. The conventional farmers explained that they had experienced more diseases and pests, which had led to an increased use of pesticides. Further, it was mentioned by farmer 2 that the fertility of the soil had gone down. This meant that he had had to use more fertilisers than previous (Appendix 2). The changes in the soil was attributed to climate changes such as flooding and erosion that had removed nutrient from the soil. This meant that the soil now needed more added nutrients to compensate for the lost ones. The organic farmer told that one of the reasons why he changed to organic production, and stopped using pesticides and fertilisers, was due to environmental concerns and because of the climate changes he had experienced in recent years. For him, it was very important to take care of the nature and ensure that the next generation can live healthy (Appendix 6). At the same time, some of the farmers had started to prevent their production against extreme weather by implementing more sustainable practices such as erosion prevention (Appendix 1).

5 Analysis

This section analyses the presented findings of the project. It will be carried out in accordance with the seven identified determinants derived from our findings. From our primary and secondary data, we will analyse the identified determinants as well as how they impact the smallholder farmers' adoption of circular economy practices and relate it to existing literature within the field.

5.1 Existing Knowledge and Awareness

The farmers generally expressed a certain level of awareness of the need to change to more circular practices to sustain their production and reduce the negative environmental impacts of it. They all possessed a general level of knowledge in terms of basic agricultural practices and also performed practices adding to circular economy. However, in order to implement more circular practices through changes in their daily production, their existing knowledge was not extensive enough.

The AFPC farmers possessed knowledge on the handling of pesticide as farmer 4 expressed "...I try to avoid the use [of pesticides] by applying practices learned from the export company. For example, my planting times have now been adjusted to avoid some pests. But I would like more information on what is needed for my soil to produce in a way that hurts the environment the least" (Appendix 4:35-38). This example indicates that knowledge has led to a better control of pesticides. However, it also shows that more knowledge is needed in order to better control and further minimise the use. Contrary, farmer 5 expressed that he did not possess specific knowledge in this area (Appendix 5). Thus, it is arguable that he might not apply pesticides in the most efficient and least harming manner.

As most of the farmers did not know the fertility of their soil, it is arguable that they did not know how to control and minimise the use of fertilisers. Instead, this eventually led to an increased use of fertilisers, depletion of soil, potential discharges to the groundwater of excess fertilisers as well as increasing gas emissions. This gap of knowledge hampered the transition to more circular practices. The organic farmer had become aware of the benefits of organic production in terms of both environmental and financial gains. As he possessed more specific

knowledge on how to convert, he had changed his entire production and stopped the use of chemicals. He pointed out that being aware but not possessing knowledge or not being aware but possessing knowledge would not lead to change (Appendix 6). This highlights the importance of possessing both knowledge and awareness in order to drive change. Govindan & Hasanagic (2018) similarly found lack of awareness to be a barrier for circular implementation. However, our findings revealed that the farmers possessed awareness that acted as a driver for them to change practices. The conventional farmers expressed views such as "...I am still trying to take care of the environment. I know it is not good if the pesticides residues gets into the spring, because it will affect the people here and our children in a bad way" (Appendix 4:33-35) and "we have to protect that mountain [Aberdare Mountain] for us to be able to get continuous supply of water. If you destroy it, it means water will stop" (Appendix 1:205-206), which further reflected their level of awareness.

Recycling nutrients from organic matter was a practice all the farmers exercised. They were well aware of the benefits of reusing manure and crop remains on the fields as fertilisers. Their knowledge was reflected in various practices such as e.g. drying the manure in order to use it more efficiently on the fields. Farmer 2 had further invested in a polythene bag to dry the manure and explained "after getting the polythene bag, then I banned the manure and covered it with the polythene bag, I almost got the double amount from my crops. It was not difficult to see the benefits by drying the manure this way. And as I told, I let some of the other farmers use it as well as they have seen the benefits. It also means that we use less fertilisers" (Appendix 2:89-93). This example shows how the farmers' knowledge of practices to close nutrients loop reduced the use of inorganic fertilisers. Nevertheless, by contrast, one farmer had never heard about the polythene bag for drying manure and did not possess knowledge of optimising drying processes. It is therefore arguable that his lack of knowledge was impeding him from having an efficient nutrient recycling, which is an important part of a circular economy.

The farmers explained how they would remove crop remains from the fields to avoid spreading diseases and spread it back to the fields as compost and reuse all the by-products from their production. This knowledge enabled the farmers to reduce the use of inorganic fertilisers while feeding nutrients back in the loop. Nevertheless, the lack of existing

knowledge of their soil meant that they did not know which nutrients were actually needed for their soil. Even though a few soil samples and tests had been carried out in their area, this was not reliable information for them to change their practices. Govindan & Hasanagic (2018) similarly underpinned the lack of reliable information as a barrier to the implementation of circular economy. Thus, if they had had more adequate knowledge of their soil, this could have worked as a driver for them to change their practices. This indicates that the lack of knowledge in one area can lead to negative effects or impede the implementation of existing knowledge in another.

When asked about converting to organic production, and thereby more circular practices, the majority of the farmers confirmed they had considered it both because of environmental concerns but also due to the potential financial benefits. However, they did not possess sufficient knowledge about the actual conversion and also expressed that they lacked knowledge about the financial aspects. In this regard, farmer 4 explained "I know it and know some farmers are doing it but I don't have any knowledge of the practices and what the change involves, if its economically beneficial, so I have never considered to change" (Appendix 4:45-47). The ProGrOV project (2017) similarly emphasised lack of knowledge as a key barrier to organic conversion. It was argued that the limited information available among the farmers about the profitability of producing organically discouraged them from converting. Again, the project highlighted that the financial aspect should be emphasised further. In this regard, it was suggested by both literature and Mwaura that extension services should focus on the economic dimension. It was argued that if the farmers experienced and were educated about the economic advantages of adopting more sustainable practices, they would be more likely to do so (McCarthy & Schurmann, 2014; Appendix 10). This again shows that awareness and knowledge need to be equally present in order to drive change.

Our findings showed that the farmers in general were aware of the damaging effects of not producing circularly and, thus, it acted as a driver to change practices. Nevertheless, it was evident that existing knowledge also needs to be present in order to turn awareness into practice, which the organic farmer was an example of (Appendix 6). Thus, existing knowledge acted both as a driver and a barrier. Some farmers already exercised circular practices, however, it was clear that the lack of adequate knowledge often impeded further changes.

Furthermore, they expressed that they could not afford to invest in more knowledge themselves such as in a soil test, a polythene bag or consultancy in general.

According to Murimi, many smallholder farmers still lack knowledge about basic agricultural practices partly explained by the fact that most schools have cut down on education related to agricultural practices. This is also the reason why the county extension services are primarily focused on basic practices, instead of practices related to circular economy or organic production, which explains the farmers' level of knowledge (Appendix 9). Our findings related to how existing knowledge impede circular economy are also consistent with the study of Rizos et al. (2015), who found key barriers to include the lack of internal skills to be able to identify more advanced practices that can reduce environmental impact and the lack of knowledge about the financial benefits from implementing circular economy practices. If the farmers for example were better informed on how a sample and test of their soil could benefit them economically, more would likely consider investing in one.

Our findings revealed that knowledge to a high degree is affected by institutional support in terms of the level of knowledge transfer as well as to the farmers' financial constraints impeding them obtaining further knowledge. Moreover, our findings also emphasised the importance of the farmers having a broad knowledge concerning all aspects of their production as the lack knowledge in one area can affect existing knowledge in another. Thus, even though the farmer might have a substantial amount of knowledge in one area of production, and know how to do this process in the most efficient and sustainable manner, this can be immediately offset by the lack of knowledge in another area as the different process of production are highly correlated.

5.2 Social Capital, Norms and Traditions

Social capital is emphasised as an important determinant both by literature and our findings. Our findings revealed that the majority of the farmers were involved in some sort of group with other farmers. The farmers emphasised that the groups allowed them to share concerns, advice each other and share information on good agricultural practices. Being a part of these groups also made the farmers more exposed to information and training regarding more sustainable production. Furthermore, group helped ease access to loans and enabled table

banking. Similarly, Kurgat et al. (2018) argued that social capital and farmer groups are major determinants of the adoption of SIPs. The AFPC farmers explained that their volume had open doors and allowed them to engage with various stakeholders that had encouraged more circular practices through trainings, waste management plans, etc. In addition, Burton et al. (2003) argued that information networks, where farmers are able to rely on each other, greatly influence the adoption of organic farming. This was also stressed by the organic farmer who was very preoccupied with extending people's knowledge of organic practices and how these could be beneficial to both the farmers, their health and the overall environment. He was very reliant on both the self-help group and the organic organisation as networks to advocate and assist people to convert to organic practices (Appendix 6). Thus, groups and organisations were found to have a big impact on the adoption of more circular practices among farmers. They helped expose the farmers to information and training and worked as a support network. Further, they worked as a tool to promote and spread knowledge of for example circular economy.

The farmers were, not only in terms of the groups but in general, reliant on social capital to sustain their production. Our interviews suggested social capital to be an enabler for reusing and recycling by-products and wastes. Professor Wahome explained that it was common practice that farmers would sell these to each other when they had surplus of for example manure or crop remains (Appendix 7). For the organic farmer, this trading practice was pivotal for him to be able to sustain his production. If he was not able to exchange some of his by-products for manure with his neighbours or others close by in the area, this would complicate and increase the price of his production immensely. However, the exchange was not only a benefit for him but also for the neighbours who were able to use his by-products as feed for their livestock. It is a great example of circular economy in terms of closing nutrient loops, reducing external inputs and potentially improving soil fertility resulting in increased productivity (Appendix 6). Similar to what our findings suggest, Kassie et al. (2013) also found social capital to be an influencer on farmers' opportunity to adopt more circular practices.

A further example of social capital as a driver was related to the fact that the farmers would often affect and copy each other. Our findings revealed that even though the farmers initially

could be hesitant to change their practices, they would be more likely to convert if they could see the benefits of the practices implemented in practice. Practices would spread quickly in cases where they proved effective and helped to increase income (Appendix 7). The organic farmer told that once a few farmers in his area had successfully converted to organic production, more farmers followed and copied the practices (Appendix 6). This is also an example of how conformity and social pressures can drive action towards adoption of circular economy as has been emphasised by institutional theory (Glover et al., 2014). Nonetheless, it is arguable that social capital in terms of copying each other also can have a negative influence on farmers in relation to adopting more circular practices. If, for example, one farmer starts to increase his usage of inorganic fertiliser and pesticides, and this in turn increases the productivity of his production, this might cause more farmers to do the same because of the strong influence the farmers have on each other. If the use is not controlled, it will have various negative consequences for the environment and the long-term health of the soil and, ultimately, impact productivity negatively. However, taken together, we found that social capital mainly acted as a driver of the farmers' decision to adopt more circular practices. Further, it was found to be an important driver for the farmer to be able to sustain these practices.

Another determinant of adopting more circular practices is related to norms and traditions. Generally, the farmers followed what had been the traditional practices of their families or what was common in their area. When asked about certain practices, the farmers often responded, "I just do what my father has been doing" (Appendix 5:15-16). From our findings, it appeared that the practices of using manure from their livestock and reusing crop remains in the agricultural production were common among the farmers and traditional practices their fathers had passed on as well as rotating and diversifying crops. Thus, in this case, norms and traditions worked as a driver for circular economy. Nevertheless, in other cases, they worked as a barrier. As it is common to take over the family's fields in Kenya, the farmers were sometimes impeded by the unsustainable methods applied by their fathers, which had left their soil depleted due to lack of knowledge on practices keeping the soil healthy. This meant that the farmers had to use more fertiliser and pesticides today. Thus, these examples show how norms and traditional practices can both drive and impede the adoption of circular practices.

In relation to the influence of norms, literature suggests that business routines work as a barrier for implementing circular economy (De Jesus & Mendonça, 2017). Our findings revealed that, in general, it is common for smallholders to perceive their agricultural production more as side business and thus not their main source of income. Marenya & Barrett (2007) similarly found that off-farm income significantly impeded the adoption of circular practices, such as integrated soil fertility management, the use of manure and agroforestry, amongst smallholder farmers due to their ability to afford fertiliser. Thus, if farmers have other sources of income, they might not consider the possibilities of changing their production and making it more sustainable. As long as they get what they need from their production, they do not seem to care about the monetary or environmental incentives of improving or changing their practices (Appendix 9; 10). Hence, even if they were more informed about the financial gains of implementing more circular practices, it could still prove challenging to get them to change their practices due to their attitude about their whole production. What would normally work as an obvious enabler would not necessarily be the case here. However, it was argued that horticultural farmers often are more business aware due to the higher demands of the sector. Similarly, for our informants, their main source of income was their horticultural production. This was also reflected in the fact that the farmers expressed an eagerness to optimise their production and get more knowledge about sustainable practices.

As previously discovered, the lack of knowledge often impedes the adoption of circular practices. It was clear that social capital was able to close the gap of knowledge to a certain extent and overcome various barriers by generating knowledge, support and volume, which increased the leverage of the farmers. Being a group entails closer collaborations and knowing each other's location, production, resources and potential trading products. Thus, it is a powerful mean to extend and improve the implementation of circular practices. Moreover, it can help to attract and engage with institutions that can drive the implementation further by offering support such as knowledge transfer and financial resources. We also learned that farming groups can be a way to overcome some of the constraints the farmer experience related to access to finance. This can either be on a small-scale level by initiating table banking among the self-help group member or more large-scaled as groups often have easier

and better access to obtain loans since they can be collaterally liable. Norms and traditional practices both hindered and facilitated circular economy adoption. The farmers' families had depleted the soil, which increased the need of using external resources to sustain production. However, it was also revealed that reusing resources and crop rotations were common practices and something they had always done. Thus, some aspects of norms and traditional practices worked as drivers.

5.3 Infrastructure

Poor infrastructure was found to have a negative effect on the farmers' possibilities of adopting more circular practices. Infrastructure in particular played a restrictive role for the farmers whose farms and fields were not immediate connected, which was common among the Kenyan smallholders. It was pointed out that the transportation of manure from farms to fields often was too difficult and time consuming due to the poor roads and lack of appropriate transportation options. Instead, the farmers would buy inorganic fertilisers that were easier accessible. Thus, infrastructure acted as an impediment of the adoption of more circular practices and led to an increase in the use of external inputs, which may harm productivity long-term. Similarly, literature has also suggested that poor road infrastructure in Kenya has negative impacts for the farmers in terms of access to inputs, markets and productivity (Kiprono & Matsumoto, 2014). Furthermore, because of the lack of services or solutions for waste disposal in rural areas, partly caused by the poor infrastructure, some of the farmers were not able to recycle or get rid of their plastic wastes. Instead they would either burn or bury the waste, which pollutes the soil, and possibly also the groundwater, and is ultimately against the principles of circular economy.

Mwaura explained that poor infrastructure would sometimes impede the farmers in transporting their produce from the farms to the markets. In continuation, she argued that this often led to large food losses (Appendix 10). This was an experience that the AFPC farmers similarly recognised. These examples indicate that food supply might be able to meet demand, nonetheless, the redistribution challenges, related to the poor infrastructure, are impeding it from actually doing it in practice. Finally, farmer 1 explained that investment in water infrastructure from the county government was needed in order to sustain the production in the Aberdare area since their supply of water from the Aberdare Mountain

would soon run short. Thus, if proper investments in sustainable water management and infrastructure were not made, it would have negative consequences for the production as well as the adoption of circular economy practices. Related to this, Royal Tropical Institute (2016) argued water management to be a big challenge in Kenya. Huge potentials of water storage exists but the lack of investments in this area leaves the opportunities unexploited, which ultimately affects the farmers negatively if they cannot afford to invest in solutions themselves.

Our findings emphasise that adequate infrastructure is an important factor to ensure efficient use of resources as well as to secure timely transportation of the produce to the markets and steady supply of water. In Kenya, rural areas are often poorly connected, which makes the already long distances even longer. It is clear that especially the reuse of manure and by-products, a key practice of the circular economy in the agricultural sector, is impeded by the poor infrastructure as well as the transportation of produce to domestic markets.

5.4 Market Conditions and Information

Our findings revealed that market conditions in Kenya affected the adoption of circular economy practices mainly in a negative way. This was primarily related to access to and lack of market as well as limited market information. In relation hereto, Kurgat et al. (2018) argued that market integration was a major factor that influenced the adoption of most SIPs. If the farmers have inadequate access or connections to the markets, this can lead to difficulties in getting their produce to the market, which ultimately may lead to large food losses. Furthermore, if the farmers do not have secured access, this immensely decreases the incentives to produce higher quality products as they run the risk of not being able to get them to the markets. A way some of the smallholders manage to address the issues of market access is through contracts with export companies. We found that four of the interviewed farmers were a part of a cooperative engaged in export in addition to their operation on the domestic market. They explained that they had been able to access new stable markets through their collaboration with the export companies. Banson et al. (2014) argued that a contract with an export company entails certain standards and requirements the farmers need to live up to in order to get access to the export market. Therefore, it is arguable that access to export markets act as a driver for implementing higher standards and more control

with external inputs, which are fundamental steps towards a circular economy. This is in accordance with our findings. Furthermore, it can also lead to positive spill-overs for the domestic production.

We found lack of market and consumer demand for sustainable products to be a barrier to adopting more circular practices. Specifically, the organic farmer explained that he sometimes experienced a gap in the market in terms of interest in and willingness to pay premium for organic products (Appendix 6). Similarly, Wheeler (2008) emphasised that market issues, such as lack of price premiums and small market size, are the primary barriers to the adoption of organic farming. Furthermore, McCarthy & Schurmann (2014) argued that there is a limit to the price consumers are willing to pay for organic produce and that the lack of premium prices restrict entry of more farmers to the sector. The organic farmer experienced uncertainty and a lack of market as he from time to time would have surplus of organic produce that he would have to sell at conventional markets instead (Appendix 6). Hence, he ended up being a price taker with lack of power in the supply chain, as suggested by literature, since he was willing to lower his price to the minimum rather than throwing it away (McCarthy & Schurmann, 2014). These findings suggest that the market in various ways might hinder the adoption of more circular practices. If the farmers are experiencing uncertainty and lack of market, this will diminish or completely eliminate the incentives to produce more organic or circular as Njenga also argued (Appendix 8). Further, as the production is far more labour-intensive and you risk not being able to get the premium price for your products, this undoubtedly discourage a change of practices unless they, like the organic farmer we interviewed, generally are passionate about food security and overall well-being of people and the planet. However, even he mentioned that the discouragement of the market sometimes had made him question whether it was really worth it (Appendix 6). Thus, the uncertainty and lack of market can act as barriers for circular the smallholders.

Opposed to the experience of the organic farmer, the ProGrOV project (2017) found that the consumption of organic products was increasing in Kenya and that the demand for organic products had outstripped the supply. They further found that farmers producing organic vegetables in Nairobi achieved a higher gross profit margin attributed to the conversion to organic production. The problem is, however, that many farmers are not aware of this

development. This can be related to the lack of market information as has been highlighted and, further, it emphasises the importance of establishing an effective market information system and infrastructure (EKN, 2017). Thus, if this information was enclosed to the farmers, it would likely work as a driver for them to change practices. If a more effective system was in place, this would diminish the uncertainties surrounding the market and whether a market exists or not as well as where the potential market is. This would extensively increase the incentives of the farmers to change their practices given that they would know with certainty that there would be a market out there ready for them. Concluding, the establishment of an effective market information system is foreseen to work as a driver for the smallholders to adopt more circular practices.

The rigidity of consumer behaviour has proved to be a common barrier to the implementation of more circular practices (De Jesus & Mendonça, 2017). De Jesus & Mendonça (2017) found market drivers to be connected to pressures from demand-side toward circular economy solutions. As the consumers are ultimately the ones to decide how much they are willing to pay and if they are willing to pay extra for higher quality, they play a pivotal role. Rizos et al. (2015) argued that the lack of suppliers' and customers' environmental awareness is a discouraging factor for implementing circular economy practices. Nonetheless, we found a general awareness among the farmers concerning more sustainable agricultural practices. Moreover, our key informants argued that consumers had become more aware as they had experienced people getting sick from the consumption of certain food. However, even though it is supposedly up to the consumers to demand higher food safety, the majority in Kenya do not have the bargaining power to do so as they cannot afford to buy it. The premium price point, for e.g. organic products, is simply out of reach for the average Kenyan's disposable income. According to institutional theory, it is argued that external social, political and economic pressures influence firms' strategies and decision-making as they seek to adopt legitimate practices or legitimise their practices in the view of other stakeholders (Glover et al., 2014). Similarly, it is arguable that the lack of these discourage the farmers to act sustainable. We found that the consumers did not demand sustainable products to a high enough degree to affect the farmers, which further might explain the lack of enforcement by the regulators since they will feel no pressure to allocate resources to this. This is might be a reason why some farmers maintain unsustainable practices since they lack the incentives to

change. Thus, this highlight the importance of consumer behaviour and emphasises it to be an overriding determinant for the smallholders to adopt more circular practices.

The findings of this section emphasise the power of the market as a determinant for circular practices. It was revealed that the impact of the market differs to a great extent depending on the farmer and his production. The farmers producing for the domestic market on one hand face insignificant incentives to change practices due to the lack of enforcement of standards. The farmers that produce for the export markets are on the other hand encouraged to produce more circularly because of the market's high requirements and the consequences of not complying because of the increased focus on enforcement. Finally, lack of reliable market information as well as a lack of consumer demand for sustainable products discourage the farmers to change to circular practices.

5.5 Institutions and Knowledge Transfer

From our findings, it was revealed that green policies and regulations within the agriculture sector are in place in Kenya (EKN, 2017; Appendix 7; 10), however, the lack of resources, enforcement and coordination of these for the domestic production are often discouraging smallholder farmers from producing more circularly. It was clear that the county governments were not able to offer extensive support to the farmers to help change their production. Some of the farmers had attended trainings facilitated by the county governments, which included education on sustainable practices, however, the farmers generally requested more support from county governments. Both McCarthy & Schurmann (2014) and Rizos et al. (2015) argued that support from accreditation bodies and government are important determinants for adopting circular economy practices. Kassie et al. (2013) emphasised that government effectiveness in the provision of extension services influence farmers' decisions to adapt to more sustainable practices. Both our findings and the literature questioned the effectiveness of extension services offered by the county government primarily due to the lack of resources. This impeded the scope and scale of the services offered to the farmers and meant that they did not have a big influence on the farmers' decisions to adopt more sustainable practices. Further, it was argued that many farmers still needed training in basic agricultural practices, which meant that the extension services were not able to focus on circular economy or sustainable practices. In that respect, we learned, as

previously mentioned, that education on basic agricultural practices used to be part of the curriculum in school, however, this had been changed since less people were getting employed in the agricultural sector compared to earlier. Additionally, literature has found educational training, or the lack of, to be a factor contributing to the low labour productivity in the horticulture sector (Kangai & Gwademba, 2017). The lack of support from the different governmental authorities proved to impede the adoption of more circular practices among the smallholders.

Farmer 5 who solely produced for the domestic market had never engaged with any regulators or enforcers (Appendix 5). Rizos et al. (2015) argued that the lack of encouragement and effective legislation were significant barriers to adopt more circular practices. As mentioned, our findings revealed that standards and policies were in place, however, these were primarily enforced in relation to large-scale producers and export farmers. It was explained that the lack of resources of the government parastatals prevented them from enforcing the standards for domestic and small-scale producers. Even if too high levels of contaminants are found, no fines are given. This lack of support and enforcement is a big discouragement to the farmers and leaves them with no incentives to produce more sustainable or buy quality and safe inputs. Similarly, Govindan & Hasanagic (2018) argued that regulations related to environmental protection must be existing and enforced in order to drive change. Rizos et al. (2015) found that in cases where no effective enforcement mechanisms are present, managers attitude toward sustainability can instead act as a driver of environmental improvements. This was found to be the case for the organic farmer we interviewed. Even though, there was no policies or standards forcing him to change his practices, he still went ahead with it because of his own environmental concerns. Nonetheless, if the manager, or in this case the farmer, does not hold a positive attitude toward sustainability then the conditions around him, including enforcement, need to be effectively in place in order to drive the change.

Our findings revealed that management of waste was a major issue in Kenya since no adequate waste disposal or recycling services have been implemented on a national level. This means that only few people can afford to have their waste collected by private actors, whereas the rest is forced to bury or burn hazardous wastes such as plastic (Soezer, 2016). The lack of

an efficient waste management system immensely impeded the implementation of circular practices since the farmers told that they often had to burn or bury their plastic wastes harming the environment. Literature has further underlined the importance of governmental services and frameworks to support more circular practice as it has been revealed that ineffective recycling policies and the lack of encouragement from government are barriers to circular economy (Rizos et al., 2015; Govindan & Hasanagic, 2018; De Jesus & Mendonça, 2017).

Our findings indicated that programmes initiated by the government intended to help the farmers were impeded by corruption, which hindered the adoption of circular practices. The fertiliser subsidy programme, initiated in 2009, was supposed to make inorganic fertilisers easier accessible and cheaper. From a circular perspective, an increased use of inorganic fertilisers is undesirable. However, it can be useful if the inorganic fertilisers are able to close nutrient loops that can otherwise not be closed by organic fertilisers and increase the food production. Furthermore, a controlled supply might ensure the quality of the input and the knowledge of its origins and what it contains. This is important to know before applying it on the soil and it can also help to increase productivity. Nevertheless, various problems existed in this regard. First of all, it was argued that the unsteady supply of the fertilisers led to an inappropriate use. Moreover, the subsidised fertilisers were resold to middlemen selling it at a higher price and as an unknown mix. Farmer 5 explained "the fertiliser prices are changing a lot. The county government is in charge of it but they often sell it to middlemen who mix different kinds of fertilisers and other stuff so you don't get what you need. I have tried many times to use fertiliser where nothing happened even though I used a lot. You don't know what you get and it might be bad for the crops" (Appendix 5:32-36). He further stated "the middlemen have some contacts in the county government and get the license to sell it and can sell it for an over price. The county government also earns money that way by being paid by the middlemen. That is why I would like to produce more organic but I cannot afford to change" (Appendix 5:38-41). This shows how corruption acts as a barrier to produce more circular. It further entails that farmers might increase their use of fertilisers and get a mix that can potentially damage soil fertility and thus decrease productivity and supply of food. The farmer's experience is supported by various investigations of the subsidy programme that points towards the fact that challenges and corruption are related to the governance system

in Kenya (Mugai, 2018). This can be explained by the fact that Kenya ranks as number 143 out of 180 countries according to the 2017 Corruption Perception Index (Transparency International, 2017), indicating corruption to be a general problem in the country.

To fill the gap of lacking governmental management, other stakeholders were supporting the farmers. The engagement with export companies especially seemed to be impactful in regard to knowledge transfer of circular economy practices. Engaging in export entails stricter control with external inputs such as pesticides and fertilisers levels, which forces the farmers to be more aware of their practices often implying more circular practices. It was also found that being connected to the export market automatically led to engagement with the government parastatals as they would help the farmers attain the standards and requirements. Further, we also found NGOs to have a positive impact on the adoption of circular practices. It was even suggested by Professor Wahome that they have a bigger impact than the policies in place because they have direct contact with the farmers. Due to their capabilities and substantial levels of inputs, they can offer long-term impacts, which all go a long way in providing the farmers with incentives (Appendix 7). Our findings seemed to substantiate this as the farmers demonstrated their knowledge and implementation of various circular practices facilitated by NGOs, such as prevention of soil erosion and conservation of soil, that are expected to have long-term impacts.

Our findings emphasise the important role of institutions and support previous studies that have indicated that the institutional environment both supports and inhibits the adoption of and transition to circular economy (Ranta et al., 2018). From institutional theory, we learned that change in social values and regulations as well as external social, political and economic pressure all influence decisions regarding activities such as adopting circular economy (Glover et al., 2014). These influences were also clear among our findings. Moreover, our findings revealed that the lack of governmental support and enforcement impeded the adoption of circular practices. The lack of existing knowledge among the farmers, as discussed previously, can further be attributed to the absence of governmental support and knowledge transfer. Nevertheless, it was found that the export companies and NGOs to a certain degree were able to fill out this gap. This is also consistent with literature that have found governmental ineffectiveness to generally act as a barrier, whereas private stakeholders and

NGOs are found to be drivers (Rizos et al., 2015; Govindan & Hasanagic, 2018; De Jesus & Mendonça, 2017). The connection to export companies in particular proved to be a driver. It is important to consider our findings in the light of the economic and political context of Kenya in which governance systems and institutions are impeded by corruption, weak coordination and lack of resources (Transparency International, 2017; World Bank, 2018).

5.6 Financial Access and Incentives

Our findings revealed that financial determinants often impede the implementation of circular practices. We found that the farmers often were not able to undertake investments related to circular practices that otherwise would be financial beneficial long-term. Due to their limited resources and the difficulties in obtaining a loan, they were often forced to prioritise short-term solutions. Every farmer interviewed expressed a wish to invest in more livestock in order to decrease the use and expenses of fertilisers. Further, they believed that manure worked better and would increase productivity. Farmer 2 said "...to invest in livestock is more expensive but in the long run it is advantageous if I could afford it. If I could buy three cows, I could for example use them for 10 years but the fertiliser I have to buy all the time" (Appendix 2:39-41). Furthermore, farmer 3 mentioned that he knew that investing in more livestock would be the best and cheapest option in the long run but he could not obtain a loan to be able to do so (Appendix 3). These examples clearly indicate that the desire to change to more circular practices, because of anticipated financial benefits, is highly influenced by the lack of access to finance, which ultimately cause them to act short-termed. Thus, not being able to afford more livestock immensely increases their use of external resources harming the environment and further hindering long-term financial benefits. However, we also found that lack of financial resources automatically can result in more circular processes as the farmers are forced to reuse as much as possible of their own resources and reduce the use of external inputs in order to reduce expenses. For example, the farmers generally explained that they were aware of their use of external inputs in order to save money.

One farmer had invested in the polythene bag to dry his manure more efficiently. It was generally recognised that the polythene bag would be beneficial for the production as it enabled nutrients to efficiently be brought back to the soil and increase productivity. However, the investment was too expensive for the majority of the farmers. "I have heard that

it should be better to dry the manure with that, however, I am not able to invest in one and I need some knowledge so I know how to use it" farmer 4 pointed out (Appendix 4:23-24) emphasising both lack of resources and knowledge. Another investment out of reach for most was related to soil sampling and testing. Many farmers explained that they could not afford or did not prioritise investing in a sample test. Thus, financial constraints impeded them from accessing valuable knowledge about their soil which could potentially reduce their expenses on external inputs and increase productivity resulting in financial gains. Farmer 5 expressed "it would be more efficient if I knew exactly which fertiliser to use and when. But I have never got a sample of my soil. It is expensive even though it might pay off. But I have never made the investment. This would also be better for the environment. And I could maybe even avoid to buy fertilisers or pesticides" (Appendix 5:53-56). These examples further underpin the importance of finance. Even simple and relatively small investments were out of reach for the farmers even though these would have made a huge difference for their production in terms of productivity and optimal reuse of resources.

The negative consequences extracted from the lack of finances are further reflected by the fact that many smallholder farmers, not connected to export companies, get their production inputs from informal markets in order to save money as argued by Willis (email, 21 August 2018). This was also a practice mentioned by farmer 5 (Appendix 5). As previously mentioned, differences between the quality of the inputs sold at the informal markets exist. This means that bad quality seeds, unknown mixes of fertilisers as well as counterfeit pesticides are commonly found in these places (Rading, 2018; Appendix 10; Mugai, 2018). This have great negative impacts on the farmers' production and can possibly also increase the use of inputs and harm the soil fertility and thereby affect circular practices negatively.

Financial constraints were also stressed by Njenga emphasising the difficulties for the smallholders to get access to inputs and finance (Appendix 8). The farmers themselves also highlighted these issues as they told that the interests for farmers were way too high, which meant that most were unable to obtain loans. Similarly, Rizos et al. (2015) argued that SMEs often experience problems accessing finance and suitable sources of funding when wanting to convert to more circular practices. One determinant hindering the access for farmers in particular, which is also emphasised by the literature, is related to tenure statuses of the

farmer's land. Kassie et al. (2013) reported that the size and tenure status of plots influence farmers' decisions to use improved seed, conservation tillage and legume intercropping. The reason being that many smallholder farmers do not have title deed to their land. This means that the farmers cannot use it as collateral to access credit (Were, 2016). To overcome this challenge, the organic farmer said that he was a part of a group that wanted to start table banking in order to make future long-term investments possible. Previously, he had to sell his livestock to get cash in order to pay for treatments for his sick wife. Being a part of the group, he hoped to be able to avoid a similar situation (Appendix 6). Another factor argued to impede their access to finance further is the fact that many farmers do not keep records and, thus, know if they are making a gain or a loss. Both Mwaura and Murimi argued that some farmers do not see the business case of their agricultural practices and only used it as a mean to help them sustain their living diminishing the incentive to change to more circular practices that might provide a higher economic benefit (Appendix 9; 10).

Several of the farmers had considered to change to organic production, however, they were not acquainted with the financial aspects and did not have resources for the investment. McCarthy & Schurmann's (2014) findings revealed that some farmers that had already converted to organic farming had given up because the inputs were too expensive as well as other costs such as loss of income during conversion period, costs of compliance and labour cost. This is consistent with the arguments about "cost-price squeeze" on farmers highlighted by multiple authors (Sutherland, 2011), which entails a period of increasing costs and simultaneously decreasing or stable prices on produce. Even though converting to low-input and more sustainable farming entail reducing inputs long-termed, and thereby expenses, the possible loss of income during conversation and that some of the inputs needed, though fewer, are often more expensive are often not considered. Rizos et al. (2015) further emphasised that the initial cost of investing in sustainable practices and the anticipated payback period is of great importance to the SMEs as these, like smallholder farmers, are usually more sensitive to additional financial costs compared to bigger companies or farms. Therefore, in spite the fact that it might be more financial advantageous in the long run, the farmers also need to be able to afford the costs required in the conversion period for them to adopt the practices.

Contrary to common believe, the organic farmer did not see any incompatibility between his environmental and business ambitions. He expressed that since he had started to farm organically, he had never needed any help (Appendix 6). McCarthy & Schurmann (2014) similarly found that organic farmers did not experience conflicts between their environmental and business goals. In their study, the farmers condemned the market-driven, "high-yield now, less-yield later" prevailing chemical practices and argued that a healthy soil would eliminate major pest problems whereas an unhealthy soil could jeopardise the financial viability of the business. Thus, according to the organic farmers, improving and maintaining soil health was the key to success (McCarthy & Schurmann, 2014). In addition to this, the ProGrOV project (2017) found that farmers producing organic vegetables in Nairobi achieved a higher gross profit margin attributed to the conversion to organic production. Nevertheless, the conventional farmers in our study regularly applied pesticides and inorganic fertilisers. Among conventional farmers, chemicals are often seen as a cheap insurance to control pests and protect yield as results are instant and they do not represent a huge cost compared to other approaches. Therefore, it is arguable that farmers are not decreasing their chemical usage. This represents a major problem as it can lead to increase in pest resistance, non-selective nature of chemical treatments, implications for soil fertility, which can have huge consequences, especially financially, long-term (McCarthy & Schurmann, 2014).

Many of the farmers generally sought access to more knowledge but explained that it was too expensive to obtain. When the farmers cannot afford to invest in the knowledge themselves, this means that they miss out on important information. Farmer 2 told us "in fact, at some point I considered to change to organic farming but I needed someone that could train me. It is better because the chemicals are affecting the people and the environment. It is only that we had no one to sponsor and lacked information" (Appendix 2:71-74). This again shows that the lack of access to finance acted as a barrier for farmers that considered to convert to more circular practices as they could not afford the knowledge needed.

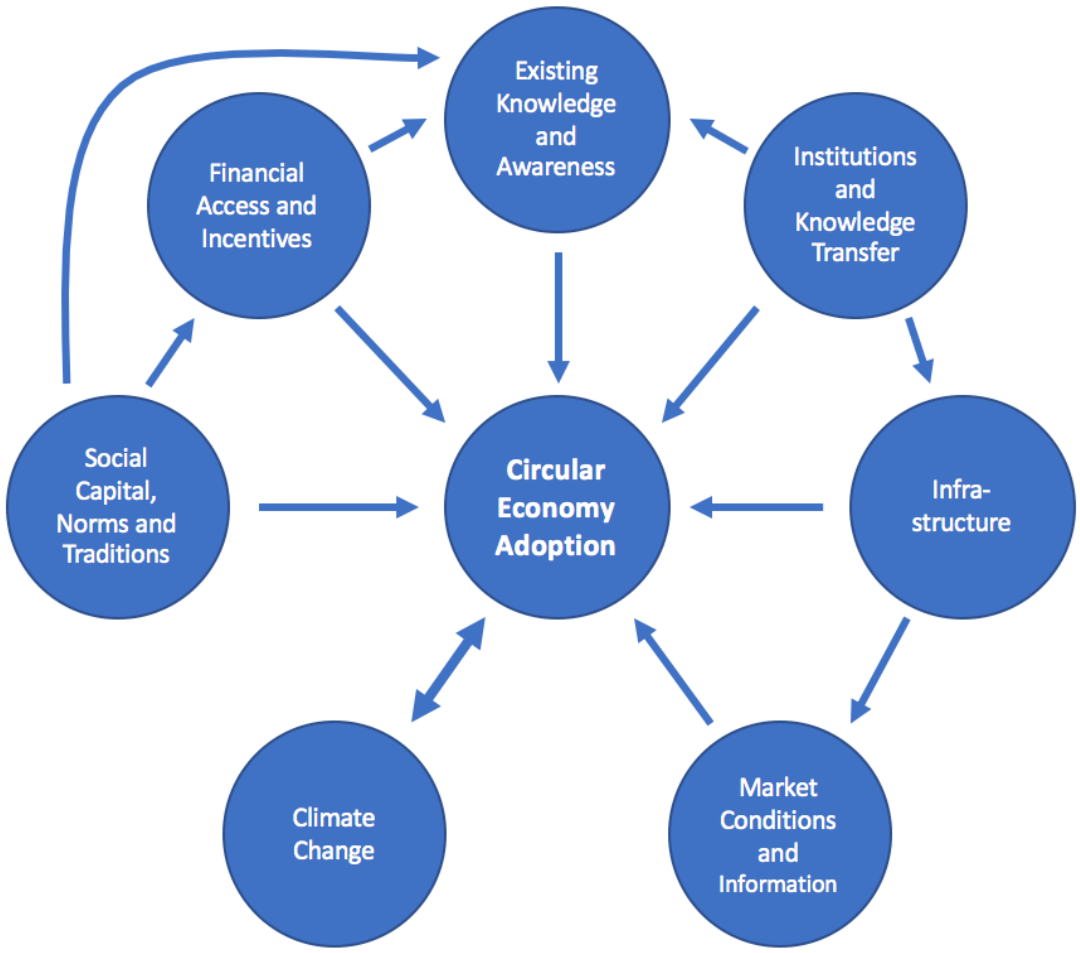
It can be concluded that the inefficient finance options for the smallholder farmers act as an immensely barrier to the adoption of circular economy practices. The farmers were often not able to make investments related to circular economy and they might be exposed to bad quality inputs from informal markets to save money. Further, they could often not afford to

invest in knowledge needed for a circular transition. However, it was also revealed that the farmers themselves can change practices such as keeping records making it easier for them to obtain a loan. Financial incentives such as saving money by reusing resources encouraged the farmers to act more circularly, however, the investments from which the farmers would see a financial incentive long-term were usually not possible to undertake due to the lack of access to finance often hindering circular solutions.

5.7 Climate Change

Throughout the research, it was revealed that environmental factors had a big impact on the farmers' practices and the likelihood of circular adoption. The farmers explained that they had experienced changes in the climate especially in terms of more extreme weather conditions. This had resulted in a higher occurrence of pests and diseases leading to an increased use of chemicals, which ultimately impeded a cleaner production. The problems of climate change and increasing use of chemicals are interconnected. As an example, inorganic fertilisers are said to release greenhouse gases into the atmosphere adding to climate change, which, again, causes an increase in the use of chemicals. Moreover, the fertility of the soil has gone down over the last years partly due to continuous cultivation and traditional farming methods but also because of changes in soil moisture due to the extreme weather events. The farmers said that they more often experienced erosion impeding soil fertility. The negative effects on the agricultural production in Kenya caused by changing weather conditions are highlighted by the literature (Ochieng et al., 2016; Mertz et al., 2008). Farmer 1 told that various NGOs were present in the area to help the farmers to adopt new practices that prevent the negative effects of climate changes including soil conservation and prevention against erosion (Appendix 1). This is an example of how climate change similarly forced some farmers to think more sustainable and long-term. The organic farmer expressed that the biggest challenge for him to sustain his organic production was because of the climate: "The most challenging factor is weather. Climate you know. And sometimes it is not good. Sometimes the rain is too much and I cannot use chemicals" (Appendix 6:245-246). This indicates that climate act as barrier in terms of producing more circularly and e.g. sustaining an organic production.

By analysing the seven most important determinants of circular economy adoption, derived from our findings, and how they impact the adoption of circular economy in the horticulture sector in Kenya, we have laid the foundation for answering our research question. We found that many of the determinants acted as both drivers and barriers depending on the degree to which they were present and how. However, it was clear that the barriers outweighed the drivers. Furthermore, we found that the determinants influenced each other and that various stakeholders influenced each determinant in different ways. By synthesising our primary and secondary data and relating it to existing literature, we have aimed at incorporating as many aspects as possible to get the most comprehensive understanding of the problem as possible. This will help us to answer our research question in the most complete way. The following illustrates an overview of the analysed determinants and their connectivity.



6 Discussion

This section serves to first discuss our findings and their practical implications and, second, discuss the applicability of circular economy as a development tool.

6.1 Practical Implications

Our analysis of the determinants influencing the adoption of circular economy practices has shown that while some determinants act as drivers, the majority ultimately appear to impede the transition. Thus, these need to be addressed in order to move forward. We have up until this point mainly analysed the determinants and their influence separately, however, we found them to be highly correlated and we therefore deem it necessary to discuss them collectively in order to fully grasp their impact on the adoption of circular economy among the smallholder horticulture farmers in Kenya.

Our findings have shown that several determinants interconnectedly impede the adoption of circular economy. We have found that some of the issues Kenya faces in terms of producing enough sustainable food is due to the fact that traditional farming practices have depleted the soil, which has been further reinforced by climate changes. The deficiencies in the educational system alongside a lack of governmental support and access to credit have left the farmers lacking the knowledge and resources needed to fully change to a circular economy. At the same time, there is a lack of demand of sustainable produce among consumers eventually resulting in weak enforcement of standards. The absence of adequate local infrastructure has similarly prevented the farmers from reusing resources and getting their produce to the market. These conditions were found to ultimately discourage the farmers from changing their practices to a circular economy. Thus, the farmers have had to explore other options in order to fill the highlighted voids.

As pointed out, we also learned that certain determinants act as strong drivers and are able to positively influence other determinants. Further, some even seek to address and overcome existing barriers for the adoption. We found that both the private sector, typically in the form of export companies, and NGOs act as important drivers. Their resource-intensive foundation enables them to fill the void from the lack of government support to a certain degree. What in

particular makes a difference are these institutions' abilities to transfer knowledge through varying activities, which have shown to lead to more circular practices among the farmers. The export companies have further helped the farmers to overcome common barriers related to market and infrastructure as they have provided the farmers with access to secured markets and ways to get rid of chemical containers. Another significant driver for circular practices was social capital. This was typically leveraged through self-help groups and cooperatives, which showed to have a positive impact on their practices. By enabling the farmers to advice and share experiences related to good and sustainable practices, they were able to learn from other's mistakes or successes. Further, the groups allowed the member to e.g. engage in table banking or to potentially get easier access to finance. Thus, the groups seek to overcome the voids from the lack of support from both government and financial institutions. Some farming traditions, such as reusing resources to the extent possible as well as crop diversification and rotations, were also found as a driver. Another driver emphasised by our findings was related to financial and environmental incentives. The farmers were not only encouraged by the financial benefits of transitioning to a circular economy, they also expressed awareness about how circular economy could help to address environmental concerns, which motivated them even further. However, as mentioned, the determinants are highly interconnected, which often means that the drivers are impeded by stronger barriers. Altogether, this leaves room for improvements and the development of possible intervention points.

In order to fill the gap of knowledge not only related to the farmers but also in terms of public awareness of food safety, institutions and especially the government need to play a bigger role. Our findings emphasised the importance of educating the public about food safety and environmental concerns as this awareness can prove to be an important step toward circular economy. If the government starts to focus and campaign more about the importance of food safety, this will lead to more awareness among the public and get them to start demanding more food safety. This, in turn, will force the government to focus more on enforcement of standards and, ultimately, this will pressure the farmers to change their practices. Nonetheless, for the farmers to be able to attain the standards, they need more knowledge and tools, which demands more resources as well as a better coordination of extension services. Thus, it is clear that the determinants are highly interconnected and have the ability

to affect each other positively. However, achieving this spiral of events requires a coordinated and prioritised effort.

We found self-help groups and cooperatives to have a significantly positive impact on the adoption of circular economy. Thus, these and especially the benefits they entail should be promoted further. Groups in this setting not only entail benefits in terms of circular practices but also for the general production of the farmers. By giving the farmers more specific training about the advantages of engaging in groups and tools that they can use in practice through extension service, this will create a better foundation for a circular production. Further, it would be advantageous for the farmers to receive more training related to the financial aspects of having and running a horticulture production including training on how to keep records. By providing the farmers with education in finance, the farmers are ensured the best prerequisites for their future practices. It is hoped that the farmers then might be able to invest in solutions that would lead to more circular practices. A way to realise the suggested intervention points is by ensuring more efficient and affordable extension services. Rethinking the provision of extension service, by e.g. offering and developing e-extension platforms, makes it is possible to reach a broad range of farmers even in remote locations and it enables urgent questions to be answered immediately. As 90 percent of the population in Kenya own a mobile phone (Kuo, 2017), this might be one way to overcome some of the barriers. However, we are well aware of the fact that some issues still require personal assistance.

Our findings have highlighted the importance of institutional influences and their ability to shape both the diffusion and adoption of circular economy. By addressing the impact of institutional drivers and barriers in circular economy, we seek to address an important research gap as has been emphasised by Ranta et al. (2018). According to institutional theory, institutions are individually distinguishable but interdependently contribute to the resilience of the social structure (Ranta et al., 2018). Our findings similarly showed how the determinants related to institutions influenced each other, often either as a domino effect of support or impediment. Our findings emphasise that a holistic institutional approach is required to advance circular economy implementation. Ranta et al.'s (2018) similarly found a holistic institutional approach to have most impact in furthering the adoption of circular

economy practices as the institutional perspective allows the role of conformity, regulatory and social pressures to be the focus in driving change. However, it is no secret that many of the solutions to encourage circular economy in the horticultural sector necessitates a certain amount of financial resources, stressing the importance of private actors, NGOs and governmental resources. Furthermore, it is arguable that many of the mentioned barriers are related to structural issues that will not be changed within a foreseeable future. Thus, a holistic approach might seem unrealistic both in terms of finance and the challenge of changing deep structural problems. Therefore, we argue that it is important to direct focus towards the determinants that realistically can be addressed and the ones that have the capabilities of driving the transition and, ultimately, making a difference. Finally, as pointed out, the interconnectivity of the determinants must be thoroughly analysed to ensure more efficient interventions. Our findings can be used as recommendations for practical interventions at various levels in Kenya within the horticultural sector. Both government, governmental parastatals, county government, NGOs and private actors can use these insights to not only develop policies but also to coordinate initiatives.

6.2 Circular Economy as a Development Tool

In order to address the pressing issues Kenya is facing related to insufficient sustainable food supply, resource scarcity, food safety and climate change in the horticultural sector, circular economy has been promoted as a development tool. It is believed to represent a broader agenda that, like the sustainability approach, embraces both environmental, economic and social development. From our literature review, it was revealed that there is no clear definition of circular economy and that various understandings exist. In relation to the agricultural sector, the concept is even less clear. However, from reviewing literature, we came up with a unified understanding of the concept including the principles of reduce, reuse and recycle and more specifically the practices of minimising and controlling external inputs, closing nutrient loops, and maintaining the quality of soil and water were present. The question is whether this approach is suitable as a development tool in the horticultural sector.

In general, circular economy entails no clear ‘rules’ or ‘instructions’, which is also the case in the agricultural sector. This is both viewed as a strength and a weakness of the concept. Not having clear rules or instructions can complicate the operationalisation due to the lack of

transparency and differing views of how circular economy should be implemented. It further results in a lack of focus of intervention points. Nevertheless, it also leaves practitioners more room to assess the given context and whether a certain initiative is suited taking every aspect in to consideration. Thus, the concept appears to have a holistic approach.

As the horticulture sector is constantly exposed to various changes and challenges, we argue that it calls for a more holistic and flexible approach. One example is related to the negative and unforeseen impacts of climate changes, which entail that farmers sometimes have to respond in a way that might not be the most optimal environmentally or socially to for example secure food supply. Climate change is one of the factors that have led to an increase in the amount of pest and diseases and reduced soil fertility. When producing organically, you are usually not allowed to use chemicals, which is obviously a gain for the environment, food safety and for the soil fertility long-term, nevertheless, in order to address the pressing issues of food demand, it can be crucial to use inorganic fertilisers and pesticides to combat the reduced soil fertility and the high levels of pests and diseases experienced in some periods. Even though circular economy in the agricultural sector aims at minimising and controlling the use of external inputs, it does not ban it. In a situation like this, an assessment of the trade-off between securing food supply versus increasing the use of chemicals is needed, which, from our understanding, is possible applying a circular economy due to its holistic approach.

Throughout our research, we realised that transforming a theoretical concept into practice is not without challenges. We realised that various factors, often context dependent practicalities, impeded the applicability since these are not taken into consideration when coining the term due to their scale and scope compared to the overall picture. These were often related to the economic and political situation in the country. Other context dependent factors such as poor infrastructure in Kenya were also found to impede the adoption of circular economy. Some farmers, even internally, struggled to keep their resources in a loop due to the difficulties of transporting their wastes from one place to another. Nevertheless, this does not mean that circular economy cannot be achieved, instead, it implies that it is important that the given context is taken into account to ensure a successful implementation.

Yet, examples of farmers closing loops with own resources were also present. Some of the examples underpinned that larger systems of circular economy were possible as the farmers would exchange resources if one had surplus of something that someone else needed. This enlargement of the loop clearly had benefits not only for the environment and food supply, by reducing the use of inorganic fertiliser and securing a long-term health of the soil, but it additionally contributed to increased food safety and economic benefits. Despite the challenges of infrastructure, our findings showed that wider loops are possible and should be considered in the development of the concept in the horticultural sector. This will improve its capability to work as a development tool.

The above-mentioned examples illustrate both drivers and barriers of applying circular economy in the horticulture sector. Based on the mentioned barriers, developing an extensive circular economy may require a redesign of production systems, the development of infrastructure and social systems. However, it can be discussed whether this is possible in rural areas mainly characterised by small-scale farmers. This does not mean that circular economy in areas with smallholder farmers should be neglected. Instead, as argued earlier, it needs to be adjusted to the given context. Furthermore, the various benefits that a circular economy might entail when implemented is another reason why it is important not to neglect it.

Ward et al. (2016) and Preston & Lehne (2017) argue that the 'circular' thinking is not necessarily always optimal from an environmental or societal perspective. Therefore, it is important to analyse whether the circularisation can cause negative impacts. Ward et al. (2016) further point out that in some situations it might be better to utilise the agricultural by-products outside the agricultural production to achieve greater environmental benefit. One way to approach this is by using e.g. the LCA which is a tool that can be used to test impacts of the circular business models, validate their assumptions and get feedback for improvement. Moreover, it can help define targets and indicators that can measure and foster circularity over time (Contreras, n.d.). Ward et al. (2016) however argue that in order to get a more holistic approach that takes both environmental and social aspects into account, a social LCA should be applied. We deem these considerations important to develop the concept as

several trade-offs are often involved when working with development that need to be thoroughly analysed before implementing certain practices.

In conclusion, it can be argued that circular economy in the horticulture sector needs further research and clearer guidelines, however, it has also proved that it can be used as a development tool to address some of the challenges raised. As with any other concept and approach, the importance of taking the context into consideration is key in order to ensure a proper adoption. Due to the scope of this project, we have not been able to extensively evaluate on whether other approaches would have been more applicable as this investigation would have demanded more resources and time. However, we still hold the conviction that circular economy is an important approach within the horticultural sector and that the principles behind circulation is very important for future development strategies. Nonetheless, as mentioned, it needs to be adjusted to the given context since all practices cannot be implemented equally in every given place. Concluding, we believe that our findings and conceptual considerations can add to the development of the concept.

7 Conclusion

Increasing awareness of the urgent challenges of increased food demand, resource scarcity, food safety and climate change have called for changes in the horticultural sector in Kenya. To combat these, several sustainable agriculture approaches have been emphasised. Recently, circular economy has received increased attention due to its promising potential to address the mentioned challenges. However, in relation to the horticultural sector specifically, it has yet to be investigated extensively. Consequently, this study set out to explore the research gap. The purpose of the study has been to identify the main determinants and analyse how they impact the adoption of circular economy among the smallholder horticultural farmers in Kenya. To answer the research question, interviews with six farmers and four informants within the field in Kenya were conducted and supported by relevant secondary sources.

As there is no clear definition of circular economy within the agricultural sector, we came up with a unified understanding from reviewing existing literature in order to have a clear guideline throughout the research process. Due to the twofoldness of our research question, we first had to derive the main determinants affecting the adoption of circular economy practices and second analyse how these impacted an adoption. Doing this enabled us to more precisely infer whether the determinants primarily worked as a barrier, driver or both. Our findings revealed seven determinants that significantly affected the adoption of circular economy namely: existing knowledge and awareness; social capital, norms and traditions; infrastructure; market conditions and information; institutions and knowledge transfer; financial access and incentives; and climate change.

Our findings showed that the farmers were generally aware of how their practices impacted their production and the environment. They expressed concerns about the negative impacts on the environment induced by some of their practices and a desire to change to more sustainable solutions. However, existing knowledge impeded their ability to change and the lack of knowledge in one area often impeded them from using existing knowledge in another. Taken together, it was clear that an existing level of knowledge and awareness both have to be present in order to drive change. Social capital was mainly found to be a driver. Even though the adoption of circular economy was sometimes impeded by the impact of traditional

practices and norms, social relations enabled them to share and exchange knowledge and resources, which seemed to pave the way for a more circular economy. Some agricultural traditions, such as reusing resources, diversifying crops and crop rotation, were similarly found to be a driver. Nonetheless, a determinant quite literally blocking the way was the poor infrastructure. This restricted the farmers in reusing resources and complicated the process of getting their produce to the markets. Further, it was also argued to be one of the main reasons for the lack of waste management services. Related to markets, the access, consumer demand and information were found to be impeding determinants. Nevertheless, this was highly determined by whether the farmers were primarily engaged in the export or the domestic market as the export market pushed for increased circular implementation, among other things, due to the enforcement of standards. On the domestic market, however, the coordination and enforcement of green policies lacked even though they were in place. Further, there was no significant demand for more sustainable products discouraging the farmers to produce more sustainable. The lack of resources among government parastatals and extension services were found to impede the circular transition, whereas other institutions, such as export companies and NGOs, played a huge role in terms of knowledge transfer and, ultimately, acted as drivers. One of the most significant barrier was found to be access to finance as it acted as a hindrance to many of the other determinants as well. In particular, it impeded the farmers' possibilities of investing in more circular practices and often made them settle for short-term solutions even if they were aware of the negative environmental consequences and long-term financial benefits. Finally, the issues of climate change and unpredictable weather were found to have a negative influence in terms of increased use of external inputs and reduced soil fertility, contrary, it also encouraged the farmers to prevent further negative outcomes by implementing circular practices to improve the conditions long-term.

Taken together, it can be concluded that various barriers and drivers exist in relation to the implementation of circular economy. From analysing and discussing the findings, required actions to facilitate the adoption among the smallholder farmers emerged. Not surprisingly, the barriers were found to outweigh the drivers. Even though we chose to analyse each determinant separately, it was clear that most of them are connected. A barrier in one area results in a barrier in another area. Thus, it is arguable that an intervention in one area will

have positive spill-over effects in others. However, it was also clear that a successful transition demands an enabling environment where the vast majority of the determinants act as drivers. A broad set of interventions would therefore be the most efficient strategy to lead the transition. This calls for cooperation among the various stakeholders engaged in the sector to create an enabling environment and come up with the right solutions. Nonetheless, we are aware of the fact that some barriers will be more difficult to convert into a driver compared to others due to their deep underlying structural roots. A more realistic approach, which could start to move the transition in the right direction, would be to focus on the factors that already drive the change and thus encourage and reinforce these with the resources available.

7.1 Reflections on Methodological Approach and Further Research

Our methodological approach has allowed us to investigate and thoroughly analyse an issue that has not received adequate attention from academia considering its real-life implications. We have deemed the amount and quality of data collected throughout the research process as adequate to accomplish the aim of our research. Furthermore, the qualitative approach has enabled us to uncover problems that would not have been possible to identify through quantitative methods. Nevertheless, our chosen methodology also has its limitations and other methodological choices could have led to other results. Thus, further research is needed to extent knowledge within the topic.

One limitation is related to the diversity of our interview sample. We interviewed farmers from different counties in Kenya as well as both conventional and organic farmers. Further, some were part of a cooperative connected to the export market and some were not. We did this first of all because these were the farmers that were accessible for the short amount of time we had in Kenya but we also deemed the differences among the farmers as a strength in order to get a broader and more nuanced view of the adoption of circular economy. Thus, we chose to include them all in our study. Having the diversity of the informants also allowed us to look at the differences between them and whether these differences affected their adoption of circular economy practices in a positive or negative way. The inclusion of the organic farmer for example allowed us to uncover some of the difficulties he had experienced by converting his practices and the difficulties related to sustaining his production. Oppositely, it

also enlightened the factors that were driving the change, which could be relevant for regulators to look into and possibly strengthen. However, we are aware of the fact that the diversity of our farmers and the limited sample size make generalisation difficult and our results might have looked different had we interviewed other farmers. This is also due to the fact that the horticulture sector is diverse and include the production of different crops that require different levels of inputs. This entails that the farmers do not necessarily experience the same drivers and barriers. Further, differences exist between the counties in various areas in terms of policies, regulations and climate. Nevertheless, by applying data from secondary sources and the key informant interviews, we seek to validate our findings. Thus, we believe our results reflect trends that can be used for future interventions in the horticulture sector.

Another limitation is related to the fact that our knowledge and awareness have been constantly evolving during the research process. This meant that we became aware of certain conditions, practices and determinants potentially affecting the adoption of circular economy among the smallholders that were not revealed or adequately covered from our interviews. Due to several restrictions, we were not able to go back and follow up on our shortcomings. However, in order to compensate for the limitations, we have subsequently contacted some of our informants and reached out to other experts within the field in Kenya to follow up on our findings. This has enabled us to come up with useful data in the areas where we lacked sufficient information.

Due to the scope of the paper, we chose to leave out certain determinants in our research. We are aware that these might also have an effect on the adoption of circular economy practices. The determinants we intentionally left out include differences between urban and rural setting, location and size of farm, and demographics such as household size, level of earnings, age and gender of farmers and level of education. Further, important determinants might have been unconsciously left out as it is possible that we might not have encountered all relevant aspects or areas and thus not been able to cover these thoroughly. Nonetheless, it would be relevant for future research to include all known determinants as it might provide new insights to the adoption of circular economy.

Finally, we cannot comment on whether the insights provided by our research are solely applicable to the horticultural sector in Kenya or if they can be applied within other agricultural sectors or even in other countries. Some of the impeding determinants found in our study are conditions that commonly occur in developing countries such as financial barriers and lacking governance. Similarly, we deem some of the driving forces to also be present in other similar settings such as the influence of social capital and the awareness of reusing resources. However, we also found some of the determinants to be highly related to the horticultural sector and Kenya as a context. Thus, our findings can be used as a starting point for further research that can shed new light on the topic.

References

Abdulla, A., Owes, V., & Baking, J. A. (2011). Adoption of safer irrigation technologies and cropping patterns: Evidence from Southern Ghana. *Ecological Economics, 70*(7), 1415–1423.

Agricultural Sector Coordination Unit, ASCU (2012). *National Agricultural Sector Extension Policy (NASEP)*. Government of Kenya. June 2012. Retrieved 1 September 2018 from: http://www.kenyamarkets.org/wp-content/uploads/2016/06/National-Agricultural-Sector-Extension-2012.pdf

Ajayi, O. C., Akinnifesi, F. K., Sileshi, G., & Chakeredza, S. (2007). Adoption of renewable soil fertility replenishment technologies in the Southern African region: Lessons learnt and the way forward. *Natural Resources Forum*, *31*, 306–317.

Allen, P., Van Dusen, D., Lundy, J., & Gliessman, S. (1991). Integrating social, environmental, and economic issues in sustainable. *American Journal of Alternative Agriculture, 6*(1), 34-39.

Amekawa, Y. (2010). *Towards sustainable agriculture in the developing world: Theoretical perspectives and empirical insights.* Iowa: Iowa State University. Graduate Theses and Dissertations. 11294.

Andersen, M. S. (2007). An introductory note on the environmental economics of the circular economy. *Sustainability Science*, *2*(1), 133–140.

Ariga, J., & Jayne, T. S (2011). Fertilizer in Kenya: Factors driving the increase in usage by smallholder farmers. In Chuhan-Pole, P. & Angwafo, M. (2011). *Yes Africa Can: Success Stories from a Dynamic Continent.* 269-288. World Bank: Washington, DC.

Ashurst, M., & Mbithi, S. (2010). *Why Africa can make it big in agriculture.* Africa Research Institute. Retrieved 2 September 2018 from: https://www.africaresearchinstitute.org/newsite/publications/counterpoints/why-africa-can-make-it-big-in-agriculture/

Banson, K. E., Nguyen, N. C., & Bosch, O. J. H. (2016). Using System Archetypes to Identify Drivers and Barriers for Sustainable Agriculture in Africa: A Case Study in Ghana. *System Research and Behavioural Science.* Syst. Res. 33, 79-99.

Bechara, J. P. and Van de Ven, A. H. (2007). Philosophy of Science Underlying Engaged Scholarship. In: Van de Ven, A. H. *Engaged Scholarship: A guide for organizational and social research*. 36-70. Oxford University Press.

Bocken, N. M. P., de Pauw, I., Bakker, C., & van der Grinten, B. (2016). Product design and business model strategies for a circular economy. *Journal of Industrial and Production Engineering*, *33*(5), 308–320.

Bouri, A., Mudhaliar, A., Schiff, H., Roberts, A., Loew, D., Desai, N., & Gustafson, L. (2015). *The landscape for impact investment in East Africa - Kenya.* Produced by the GIIN and Open Capital Partners. August 2015.

Burton, M., Rigby, D. and Young, T. (2003). Modelling the adoption of organic horticultural technology in the UK using Duration Analysis. *Australian Journal of Agricultural and Resource Economics, 47*, 29–54.

Byanyima, M. (2010, 20 July 2010). *Ground Control: making the grade in agriculture*. Policy Voices Series. Africa Research Institute. Retrieved 3 September 2018 from: https://www.africaresearchinstitute.org/newsite/press-room/press-releases/ground-control-making-the-grade-in-agriculture-2/

Contreras, S. (n.d.). *Complementing the Circular Economy With LCA.* Sustainability News. PRé Consultants. Retrieved 11 September 2018 from: https://www.pre-sustainability.com/news/complementing-the-circular-economy-with-lca

Corbeels, M., de Graaff, J., Ndah, T. H., Penot, E., Baudron, F., Naudin, K., Andrieu, N., Chirat, G., Schuler, J., Nyagumbo, I., Rusinamhodzi, L., Traore, K., Mzoba, H. D., & Adolwa, I. S. (2014). Understanding the impact and adoption of conservation agriculture in Africa: A multi-scale analysis. *Agriculture, Ecosystems & Environment, 187,* 155-170.

Council of Governors & Ministry of Devolution and Planning (2018). *Devolution at a Glance: Appreciating and Strengthening Devolved Governance; Working Together to Realize the Objectives of Devolution.* Retrieved 13 September 2018 from: http://cog.go.ke/phocadownload/reports/Devolutionataglance.pdf

Dalberg (2015). *Assessment of Financial Services Landscape for Smallholder Farmers in Ghana, Kenya, and Tanzania.* Financial Inclusion for Smallholder Farmers in Africa Programme (FISFAP) of Alliance for a Green Revolution in Africa (AGRA). Final Report. July 2015. Retrieved 13 September 2018 from: https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&cad=rja&uact=8&ved=2ahUKEwj259Hy_bjdAhVDdCwKHYqXA9UQFjAAegQIARAC&url=https%3A%2F%2Fwww.raflearning.org%2Ffile%2F1077%2Fdownload%3Ftoken%3Dw7b-My8u&usg=AOvVaw0B5VdGkoedWifAzbvt1qZ2

de Buck, A.J., van Rijn, I., Roling, N.G., & Wossink, G.A.A. (2001). Farmer's reasons for changing or not changing to sustainable practices: an exploratory study of arable farming in the Netherlands. *The Journal of Agriculture and Extension*, *7*(3), 153-166.

De Jesus, A., & Mendonça, S. (2017). *Lost in Transition? Drivers and Barriers in the Eco-Innovation Road to the Circular Economy.* SPRU Working Paper Series. Brighton, UK: University of Sussex.

Dubois, A., & Gadde, L. E. (2002). Systematic combining: An abductive approach to case research. *Journal of Business Research*, *55*(7), 553–560.

Ecker, S., Kancans, R., & Thompson, L. (2011). Drivers of practice change in land management in Australian agriculture: preliminary national survey results. *Australian Bureau of Agricultural and Resource Economics and Sciences*: Commonwealth of Australia, Canberra.

Ellen MacArthur Foundation (2013). *Towards the Circular Economy. Economic and business rationale for an accelerated transition.* Retrieved 2 September 2018 from: https://www.ellenmacarthurfoundation.org/assets/downloads/publications/Ellen-MacArthur-Foundation-Towards-the-Circular-Economy-vol.1.pdf

Ellen MacArthur Foundation (2015). *Delivering the Circular Economy. A toolkit for policymakers*. Report V1.1. June 2015. Retrieved 2 September 2018 from: https://www.ellenmacarthurfoundation.org/assets/downloads/publications/EllenMacArthurFoundation_PolicymakerToolkit.pdf

Ellen MacArthur Foundation (n.d.A). *Circular Economy Overview.* Retrieved 2 September 2018 from: https://www.ellenmacarthurfoundation.org/circular-economy/overview/concept

Ellen MacArthur Foundation (n.d.B). *Schools of Thought: Cradle to Cradle.* Retrieved 2 September 2018 from: https://www.ellenmacarthurfoundation.org/circular-economy/schools-of-thought/cradle2cradle

Embassy of the Kingdom of the Netherlands, EKN (2017). *Horticulture Study: Phase 1: Mapping of production of fruits and Vegetables in Kenya.* Final Report. March 2017. Retrieved 4 September 2018 from: https://www.agroberichtenbuitenland.nl/binaries/agroberichtenbuitenland/documenten/rapporten/2017/03/01/sourcing-of-fruits-and-vegetables-in-kenya-and-tanzania/Scoping-horticultural-study-Kenya-2017.pdf

Export.gov (2017, 22 November 2017). *Kenya – Agriculture.* Kenya Country Commercial Guide. Retrieved 15 September 2018 from: https://www.export.gov/article?id=Kenya-Agriculture

FAO (2017). *Conservation Agriculture Community of Practice (CA-CoP).* Policy Support and Governance. Retrieved 13 September 2018 from: http://www.fao.org/policy-support/resources/resources-details/en/c/1042015/

FAO (n.d.). *Kenya at a glance: The agricultural sector in Kenya.* FAO in Kenya. Retrieved 7 September 2018 from: http://www.fao.org/kenya/fao-in-kenya/kenya-at-a-glance/en/

FAO, CGIAR & CCAFS (2015). Knowledge on Climate-Smart Agriculture. Retrieved 29 August 2018 from: http://www.fao.org/3/a-i4064e.pdf

Farmer Trend (2016, 31 October 2016). *Major Challenges facing Agricultural sector*. Retrieved 3 September 2018 from: https://www.farmerstrend.co.ke/major-challenges-facing-agricultural-sector-kenya/

FinAccess (2016). *The 2016 FinAccess Household Survey.* February 2016. Retrieved 3 September 2018 from: http://s3-eu-central-1.amazonaws.com/fsd-circle/wp-content/uploads/2016/02/30093031/The-2016-FinAccess-household-survey-report4.pdf

Geissdoerfer, M., Savaget, P., Bocken, N. M. P., & Hultink, E. J. (2017). The Circular Economy – A new sustainability paradigm? *Journal of Cleaner Production*, *143*, 757–768.

Glover, J.L., Champion, D., Daniels, K.J., & Dainty, A.J.D. (2014). An Institutional Theory perspective on sustainable practices across the dairy supply chain. *International Journal of Production Economics, 152*, 102-111.

Govindan, K., & Hasanagic M. (2018). A systematic review on drivers, barriers, and practices towards circular economy: A supply chain perspective. *International Journal of Production Research, 56(1-2)*, 278-311.

HCD (n.d.). *Background Information.* Horticultural Crops Directorate. Agriculture and Food Authority (AFA). Retrieved 14 September 2018 from: http://horticulture.agricultureauthority.go.ke/?page_id=14

Hvass, K. K. (2016). *Weaving a Path from Waste to Value: Exploring fashion industry business models and the circular economy*. *Exploring Fashion Industry Business Models and the Circular Economy*. Frederiksberg: Copenhagen Business School [Phd]. PhD Series, No. 06-2016.

Information Cradle (n.d.). *Horticulture in Kenya: Horticulture Farming in Kenya*. Retrieved 3 September 2018 from: https://informationcradle.com/kenya/horticulture-in-kenya/

Jeffries, N. (2018, 8 February 2018). *A circular economy for food: 5 case studies.* Medium. Retrieved 2 September 2018 from: https://medium.com/circulatenews/a-circular-economy-for-food-5-case-studies-5722728c9f1e

Jun, H., & Xiang, H. (2011). Development of Circular Economy Is A Fundamental Way to Achieve Agriculture Sustainable Development in China. *Energy Procedia, 5(2011),*1530-1534.

Jurgilevich, A., Birge, T., Kentala-Lehtonen, J., Korhonen-Kurki, K., Pietikäinen, J., Saikku, L., & Schösler, H. (2016) Transition towards Circular Economy in the Food System. *Sustainability, 8(1),* 69.

Kabubo-Mariara, J., & Karanja, F. K. (2007). The economic impact of climate change on Kenyan crop agriculture: A Ricardian approach. *Global and Planetary Change 57(2007),* 319–330.

Kamwendwa, N. (2013, 16 May 2013). *Challenges in agriculture sector surmountable.* The Standard. Retrieved 1 September 2018 from: https://www.standardmedia.co.ke/article/2000083754/challenges-in-agriculture-sector-surmountable

Kangai, E., & Gwademba, G. (2017). *Creating Employment in Horticulture Sector in Kenya: Productivity, Contracting and Marketing Policies*. Utafiti Sera Policy Brief 002. Retrieved 3 September 2018 from: http://includeplatform.net/wp-content/uploads/2017/10/Final-Horticulture-Policy-Brief-11-7-17.pdf

Kassie, M., Jaleta, M., Shiferaw, B., Mmbando, F., & Mekuria, M. (2013). Adoption of interrelated sustainable agricultural practices in smallholder systems: Evidence from rural Tanzania. *Technological Forecasting and Social Change, 80(3)*, 525–540.

KEPHIS (n.d.). *About KEPHIS.* Kenya Plant Health Inspectorate Service. Retrieved 13 September 2018 from: http://www.kephis.org/index.php/about-us/about-kephis

Kiprono, P., & Matsumoto, T. (2014). *Roads and farming: The effect of infrastructure improvement on agricultural input use, farm productivity and market participation in Kenya.* A Paper presented at CSAE Conference, Economic Development in Africa, March 23-25. England: The University of Oxford.

Kirchherr, J., Reike, D., & Hekkert, M. (2017). Conceptualizing the circular economy: An analysis of 114 definitions. *Resources, Conservation and Recycling, 127(2017),* 221-232.

Kopnina, H., & Blewitt, J. (2015). *Sustainable Business: Key Issues.* London: Routledge.

Korhonen, J., Nuur, C., Feldmann, A., & Birkie, S. E. (2018). Circular economy as an essentially contested concept. *Journal of Cleaner Production*, *175*, 544–552.

Kristensen, D. K., Kjeldsen, C., & Thorsøe, M. H. (2016). Enabling Sustainable Agro-Food Futures: Exploring Fault Lines and Synergies Between the Integrated Territorial Paradigm, Rural Eco-Economy and Circular Economy. *Journal of Agricultural and Environmental Ethics, 29(5),* 749-765.

Kuo, L. (2017, 1 February 2017). *Kenya's mobile phone ownership is lower than we thought.* Quartz Africa. Retrieved 10 September 2018 from: https://qz.com/africa/900099/kenyas-mobile-phone-ownership-is-lower-than-we-thought/

Kurgat, B. K., Ngenoh, E., Bett, H. K., Stöber, S., Mwonga, S., Lotze-Campen, H., & Rosenstock, T. S. (2018). Drivers of sustainable intensification in Kenyan rural and peri-urban vegetable production. *International Journal of Agricultural Sustainability.*

Levidow, L. et al. (2012). The Bio-Economy concept and knowledge base in a public goods and farmer perspective *Bio-based and Applied Economics 1(1),* 47-63.

Marenya, P. P., & Barrett, C. B. (2007). Household-level determinants of adoption of improved natural resources management practices among smallholder farmers in western Kenya. *Food Policy, 32(4),* 515–536.

McCarthy, Breda, and Schurmann, Andrea (2014) *Sustainable horticulture: understanding barriers to the adoption of innovation.* In: Proceedings of the Australian and New Zealand

Marketing Academy Conference, pp. 1446-1452. From: ANZMAC 2014: Australian and New Zealand Marketing Academy Conference: agents of change, 1-3 December 2014, Brisbane, QLD, Australia.

McDonough, W., & Braungart, M. (2002). *Cradle to Cradle: Remaking the Way We Make Things.* New York: North Point Press.

Mertz, O., Mbow, C., Reenberg, A., & Diouf, A. (2008). Farmers' Perception of Climate Change an Agricultural Adaption Strategies in Rural Sahel. *Environmental Management (2009), 43,* 804-816.

Montpellier Panel. (2013). *Sustainable intensification: A new paradigm for African agriculture*. London: Imperial College.

Mottram, N. (2018, 9 April 2018). *Sensing and analytics in agriculture: Turning an art into science.* White paper. Cambridge Consultants. Retrieved 3 September 2018 from: https://www.cambridgeconsultants.com/insights/sensing-and-analytics-agriculture-turning-art-science

Mugai, P. N. (2018). *Which way forward for State's subsidized fertilizer programme?* The Standard. Retrieved 2 September 2018 from: https://www.standardmedia.co.ke/business/article/2001280105/which-way-forward-for-state-s-subsidised-fertilizer-programme

Muuru, J. G. (2009). *Kenya's Flying Vegetables: Small farmers and the 'food miles' debate*. Policy Voices Series. Africa Research Institute. Retrieved 2 September 2018 from: http://africaresearchinstitute.org/newsite/wp-content/uploads/2013/03/PV-Kenyas-Flying-Vegetables-Ed.2.pdf

Naab, J. B., Mahama, G. Y., Yahaca, I., & Prasad, P. V. V. (2017). Conservation Agriculture Imrpoves Soil Quality, Crop Yield and Incomes of Smallholder Farmers in North Western Ghana. *Front Plant Sci. 2017; 8(996).*

Ndungu, J., De Groote, H., & Danda, K. (2005). Non-Governmental Organizations and Agricultural Development in the Coastal Region of Kenya. *Eastern Africa Journal of Rural Development, 21.* 174-191.

Nordea Trade (2018, June). *Country Profile Kenya: The economic context of Kenya.* Retrieved 31 August 2018 from: https://www.nordeatrade.com/en/explore-new-market/kenya/economical-context

Ochieng, J., Kirimi, L, & Mathenge, M. (2016). Effects of climate variability and change on agricultural production: The case of small scale farmers in Kenya. *NJAS – Wageningen Journal of Life Sciences, 77,* 77-78.

Pauwels, P., & Matthyssens, P. (2004). The Architecture of Multiple Case Study Research in International Business, in: Marschan-Piekkari, R: & C. Welch (eds.)

PCPB (n.d.). *Get to know about PCPB.* Pest Control Products Board. Retrieved 13 September 2018 from: http://www.pcpb.or.ke/about.html

Pearce, D. W., & Turner, R. K. (1990). *Economics of natural resources and the environment*. Johns Hopkins University Press.

Preston, F., & Lehne, J. (2017). *A Wider Circle? The Circular Economy in Developing Countries.* Chatham House Briefing. Energy, Environment and Resources Department. Chatham House. Retrieved from: https://reader.chathamhouse.org/wider-circle-circular-economy-developing-countries#key-questions-and-challenges

Prieto-Sandoval, V., Jaca, C., & Ormazabal, M. (2018). Towards a consensus on the circular economy. *Journal of Cleaner Production*.

sProGrOV (2017). *Productivity and Growth in Organic Value Chains.* Project conducted by University of Nairobi, Makere University, Sokoine University of Agriculture, Aarhus University, University of Copenhagen and International Centre for Research in Organic Food Systems (ICROFS).

Qi, J., Zhao, J., Li, W., Peng, X., Wu, B., & Wang, H. (2016). Circular Economy-Oriented Agricultural Practice. In: *Development of Circular Economy in China. Research Series on the Chinese Dream and China's Development Path.* 223-245. Singapore: Springer.

Rading, B. (2018, 9 August 2018). *15 percent of pesticide products in Kenya are fake, says AAK.* The Standard. Retrieved 1 September 2018 from: https://www.standardmedia.co.ke/business/article/2001291189/15-percent-of-pesticide-products-in-kenya-are-fake

Ranta, V., Aarikka-Stenroos, L., Ritala, P., & Mäkinen, S. J. (2018). Exploring institutional drivers and barriers of the circular economy: A cross-regional comparison of China, the US and Europe. *Resources, Conservation & Recycling 135 (2018)*, 70-82.

Rizos, V., Behrens, A., Kafyeke, T., Hirschnitz-Garbers, M., & Ioannou, A. (2015). *The Circular Economy: Barriers and Opportunities for SMEs.* CEPS Working Document. September 2015. No. 412. Retrieved 2 September 2018 from: https://www.researchgate.net/publication/283121970_The_Circular_Economy_Barriers_and_Opportunities_for_SMEs

Robson, C. (2002). *Real World Research* (Second Edition). Oxford: Blackwell.

Rogers, E. M. (1999). *Diffusion of Innovations* (Fourth Edition). Free Press, New York.

Royal Tropical Institute (2016, 31 August 2016). *New programme of water for agriculture in Kenya.* Sustainable Economic Development. Retrieved 14 September 2018 from: https://www.kit.nl/sed/news/new-programme-water-resources-agricultural-development-kenya/

Saunders, M., Lewis, P. and Thornhill, A. (2009). *Research Methods for Business Students* (Fifth Edition). Pearson, New York.

Schram, S. F., Flyvbjerg, B., and Landman, T. (2013). Political Political Science: A Phronetic Approach. *New Political Science*, *35(3),* 359- 372.

Shady, A. M. (2013). Is irrigation sustainable? An Approach to Sustainable International Irrigation Development. *Canadian Water Resource Journal, 16/4),* 361-366.

Sikinyi, E. O. (2010). *Baseline Study/Survey Report on the Seed Sector in Kenya.* Nairobi, Kenya: The African Seed Trade Association. Retrieved 13 September 2018 from: http://afsta.org/wp-content/uploads/documents/KENYA%20SEED%20SECTOR%20BASELINE%20STUDY.pdf

SNV World (2018). *Agriculture*. SNV Netherlands Development Organisation. Retrieved 6 September from: http://www.snv.org/sector/agriculture

Soezer, A. (2016). *A Circular Economy Waste Management Approach For Urban Areas in Kenya*. Low Emission Capacity-Building Programme. Nairobi, Kenya: Ministry of Environment and Natural Resources.

Stahel, W. R. (2010). *The Performance Economy*. London: Palgrave Macmillan UK.

Stahel, W. R. (1982). *The Product-Life Factor.* An Inquiry into the Nature of Sustainable Societies: The Role of the Private Sector. Houston Area Research Center.

Stahel, W. R., & Reday, G. (1976). *The potential for substituting manpower for energy: Final report to the Commission of the European Communities*. Geneva.

Su, B., Heshmati, A., Geng, Y., & Yu, X. (2013). A review of the circular economy in China: Moving from rhetoric to implementation. *Journal of Cleaner Production*, *42*, 215–227.

Suddaby, R. (2006). From the editors: what grounded theory is not. *Academy of Management Journal, 49(4),* 633–642.

Sutherland, L. (2011). Effectively organic: environmental gains on conventional farms through the market? *Land Use Policy*, *28*, 815-824.

Transparency International (2018). *Kenya.* Retrieved 2 September 2018 from: https://www.transparency.org/country/KEN

Urbinati, A., Chiaroni, D., & Chiesa, V. (2017). Towards a new taxonomy of circular economy business models. *Journal of Cleaner Production*, *168*, 487–498.

USAID (2012). *Global Competitiveness Study: Benchmarking Kenya's Horticulture Sector for Enhanced Export Competitiveness.* Kenya Horticulture Competiveness Project (KHCP). Nairobi, Kenya: Fintrac Inc. Retrieved 3 September 2018 from:

http://www.unionfleurs.org/docs/Keynotes/August_2015/USAID-KHCP_Global_Competitiveness_Study_0.pdf

van den Berg, M. R., & Bakker, C. A. (2015). A product design framework for a circular economy. *PLATE (Product Lifetimes And The Environment) Conference Proceedings*, (June), 365–379. Retrieved 4 September 2018 from: https://www.researchgate.net/profile/Giuseppe_Salvia/publication/303476076_Product_%20Lifetimes_And_The_Environment_Conference_Proceedings/links/57447ba808aea45ee8%205306ca.pdf#page=373

van Houten, F. (2014, 23 January). *Why we need a circular economy.* World Economic Forum. Retrieved 2 September 2018 from: https://www.weforum.org/agenda/2014/01/need-circular-economy-revolution/

Verhagen, J., Blom, G., van Beek, C., & Verzandvoort, S. (2017). *Approaches aiming at sustainable agricultural production.* Wageningen Research, Report WPR-677. Retrieved 2 September 2018 from: http://edepot.wur.nl/416937

Ward, S. M., Holden, N. M., White, E. P., & Oldfield, T. L. (2016). *The 'circular economy' applied to the agriculture (livestock production) sector – discussion paper*. Workshop on the Sustainability of EU's livestock Production Systems. European Commission, DG Agriculture and Rural Development. Brussels. Retrieved 3 September 2018 from: http://ec.europa.eu/information_society/newsroom/image/document/2016-48/ward_-_circular_economy_applied_to_the_livestock_production_sector___brussels__2_40231.pdf

Were, A. (2016, 25 August 2016). *Iron out key land issues to unlock growth potential in Kenya*. Africa Research Institute. Retrieved 3 September 2018 from: https://www.africaresearchinstitute.org/newsite/blog/iron-out-key-land-issues-to-unlock-growth-potential-in-kenya/

Wheeler, S. (2008). The barriers to further adoption of organic farming and genetic engineering in Australia: views of agricultural professionals and their information sources. *Renewable Agriculture and Food Systems*, *23 (2),* 161-170.

Wijkman, A., & Skånberg, K. (2015). The circular economy and benefits for society. Club of Rome. Retrieved 3 September 2018 from: https://www.clubofrome.org/wp-content/uploads/2016/03/The-Circular-Economy-and-Benefits-for-Society.pdf

World Bank (2018, 19 April 2018). *Context: Overview*. The World Bank in Kenya. Retrieved 13 September 2018: https://www.worldbank.org/en/country/kenya/overview

World Bank (2014). *Accountable Devolution Program: Insights from the Governance Partnership Facility in Kenya.* Lessons Learned. The International Bank for Reconstruction and Development, Washington. Retrieved 13 September 2018 from: http://siteresources.worldbank.org/PUBLICSECTORANDGOVERNANCE/Resources/285741-1343934891414/9059_GPFLearningSeries_Kenya_Web.pdf

World Economic Forum (2014). *Towards the Circular Economy: Accelerating the scale-up across global supply chains.* Retrieved 2 September 2018 from: http://www3.weforum.org/docs/WEF_ENV_TowardsCircularEconomy_Report_2014.pdf

Yin, R. K. (2003). *Case study research: Design and methods* (Third edition). Applied Social Research Methods Series Vol 5. Sage Publications, London.

Yuan, Z., Bi, J., & Moriguichi, Y. (2006). The Circular Economy - A New Development Strategy in China. *Journal of Industrial Ecology*, *10*(1).

Appendices

Appendix 1: Farmer 1

M: So, the two companies doing the export are Kenyan companies?

J: Yes, they are Kenyan companies doing export.

M: But that is quite new, right? Because when I was doing the internship last semester with the SSC program, at that time you did not export or what?

J: We were exporting with the companies at that time, we were doing some things. So when the SSC program came on their hygiene training, even the companies were doing some training through the PMO. With them, we did the training on hygiene and safety. Safety of food. They did a training for 4 or 5 days on all the farmers. So, when the SSC program came, we formed a task force to enable the AFPC to be able to be more efficient. The aim of the AFPC is to be able to export with the export companies. And we have gone several milestones towards that. Although we have not achieved it completely yet, the export companies help us to attain the requirements because they have the experience of producing export produce. Because when we come to sell our produce directly, we say we know the quality, the requirements directly, the safety of the food. So that is what we have been doing. We have several trainings for the spray by the spray providers SSP. We have those trainings. The training was done by the AAK [some chemical association of Kenya]. We have a collaboration with PCPB. We have learned to do uniform spray coverage and apply the recommended spray rates with adjusted equipment

M: They are the ones setting the standards for the chemicals, right?

J: Yes, both for the chemicals and then AAK does the training. The you have the FPIK, we have done training of horticulture export. Management on how to do export and the requirement of the export market. Then we have done the soil sampling by the KEPHIS as well as water and produce. They did the produce sampling to know the level of MRL of the produce, which are going for the export. And the result came so they are doing more training because some had high levels of the chemicals so they are doing the test on the same farmer to know if the training has made any improvement. Moreover, the soil sampling informed me about the fertility of my soil and afterwards I actually saved money as I could by less and the right fertilisers. Then we have the county, which is helping us to facilitate some training on the good agricultural practices. So, through all of this, we have achieved the level of production in this area. However, this may still not be enough for the export, so we have decided to cooperate with other areas within the county. There are some other areas, where there are farmers and the weather is almost similar. So, we collaborate. We said that they can join us on export. So now they are receiving training. There is another area, Karuka, where we have Thomas doing the export. They are selling through the export companies. Other export companies. They have three export companies there. We have one called Frigoken, we have Kenya Fresh, and then Okakaju. We are doing export through those companies. So, we have informed them that we are trying to do our own export. Farmers exporting themselves direct.

So, with the training we have received so far, we should be able to deliver our products continuously.

M: So that is the aim?

J: Yes, we shall have a contract with the customer. So, if we have an agreement on the contract of the supply, we know the quantity to deliver per week. So that is what we have done. On our part, as the AFPC, we started the journey towards the export, when we went to the HCD, we start the requirements for us to be able to do the export. They said you cannot export as a cooperative. We have to register as a company. The requirements of the HCD is to have a company. So, we had to have another name not a cooperative but a company.

E: So, it has to be a registered company?

M: Aberdare Fresh Produce Company?

J: Yeah that one we requested for that. But at the register you have to do the search of the name. And when we searched for the name, it was okay. But before we came to register, after research you have to wait. Your name is preserved for one month. I you come after one month, you are late. We came after one month and 15 days. So, when we came, we researched the name again and the name did not come up. So, you have to give three names, if the first one fails, it goes to the second. So, it went to the second, which was Aberdare Practo Horticulture Company, so we registered as that. Now after deciding on that name, we went to the HCD and we were given the export license. So now we have the license and a registered company, so what we are missing to be able to do the export, is a global crops certificate. If we get the certificate, then we are ready to do export. Then we can connect to the buyers in the other countries. In able to get the global crops certificate, we must be trained and audited and then we will be given a certificate. So, for us to be able to be done with training, it requires a lot of cash. So, we have written a proposal to the Embassy to help us with the further training and auditing. So, we have forwarded all the requirements to them, so we are awaiting their response. So, if we get all of that, we will be able to do the export.

M: So, we can tell a bit about why we are here and what we are doing. I am Mathilde and I was doing the internship last semester at the Danish Embassy with Henning so I have been here before one or two times maybe.

E: My name is Emilie. I did an internship with the Danish Embassy as well but in Indonesia so very difficult however it was along the same lines. Now we are writing our thesis or doing a project on circular economy within the agricultural sector in Kenya. So, circular is about reusing all the resources and making sure that there is no waste. All waste, residues and whatever you have to put back into the system in a way so everything stays within the circle and nothing goes to waste. So, you can recycle stuff, you can reuse it in different ways to minimize waste as much as possible.

M: So, what we want to investigate is what are the practices of the farmers here. So, we hope you have time to show us around here to see what do you do with your waste, like leaves and peels. Just to hear about your experiences and your practices and then we want to understand how are the institutions impacting you. Are they encouraging you to do circular practices or are they a barrier? So, in general we want to know a bit about your practices and what you do. So, if you have time we would like to do an interview with you and hopefully you would be able to show us

around on your fields? And you have talking to some other farmers who would be willing to talk to us as well? But let's start with you. So, your farm is like 5 acres? Yeah. And what do you grow? What are your crops?

J: Here we grow several crops. I do the peas, which are for export. We have several varieties. There are snow peas, sugar snaps, [carrot] peas. Also, we have potatoes, we have kales, we have cabbages, then we have carrots. And we have oat for cows.

M: So, you also have some livestock? How much? How many?

J: We have two cows.

M: So, two cows, around 5 acres and you have different types of crops. And are you the only the employed here or do you have people that work for you? Are you the only one working on your farm?

J: Ah no I have three people working here.

M: And then could we have a look around. Do you often have waste? I guess you have different types of waste from when you harvest?

J: Yes.

M: Which kind of wastes do you have?

J: We have plant crops. We have the rejected crops. The papers.

M: So, you reject the ones that are not good enough?

J: Yeah, the ones that are not good quality. Maybe they are damaged, maybe they have been diseased. You have to select.

M: So, for all the crops, all the rejected waste you put in this waste disposal pit?

J: Yeah you can put it here, the ones you reject, then you recycle to be raw manure.

M: Okay, so you use this as manure? And how often do you use it? How are the practicalities?

J: For the purpose about one week, and then for five months before you will empty the pit.

M: So, you have also been trained in how to use compost? Cause I know that there are different ways to do it?

J: Yes

M: And what about the manure from the cows, you also use that?

J: Yes, we use the manure from the cow. You gather the manure, then after covering it, you cover it with the polythene paper, and then wait for it to dry. After it has dried, you go into the process of the composting. After the composting, you turn them for about three months. After the first month then you turn it, another month you turn it, and another month. At that time, all the bacteria, all microbe have been dead. So, then the manure will be ready to use on the farm.

M: And then you spread it on your fields?

J: You can put it in the field, where you are planting, you can put it on your plantings. If you are planting in holes, you can put it in there. The amount you wish to use, you can spread it.

M: So, do you have any waste that you don't use for example by-products like the manure? Or do you sometimes have too much or can you use all of your wastes? Do you always feed it back to the system here?

J: We put them back in there. It is only the chemicals containers we cannot use. With the chemical containers, we put them in the storage there. Those ones are then collected by the AAK. The export companies hire a person who comes and collect them to be taken to be destroyed.

M: So, actually the only waste you don't recycle are the containers for chemicals?

J: Yes, because they cannot be recycled.

M: Do you sometimes have so much manure that you can sell it to your neighbours or?

J: No, we don't have that much. Even what we have is not enough for us so we add manure that we get from grazing people.

M: So, as fertiliser you have your own organic and then you also get fertiliser from other people. The fertiliser you get is that also organic or is it chemical?

J: We also use the chemical and the organic fertiliser.

M: But the one you get externally that is the chemical one?

J: Yes

M: And then I guess you also use pesticides?

J: Yes, we use pesticides. We use the insect-side and fact-side. So, we are using those chemicals.

M: Have your practices changed the last years? Are you using less or more pesticides? Are you using less or more fertiliser? Have that changed?

E: If we compare back in time, because you took over this farm from your father and grandfather, right?

J: You can say as the years goes, the fertility of the land is going down. So, you have to put more manure.

M: You have to put the nutrients back?

J: If you don't have manure, you have to use more fertiliser. So, it depends on whether you are applying manure. If you are not applying manure, you will be required to put more fertiliser.

M: So maybe because they used too little manure, then you have been forced to use more fertilisers?

J: Yes

M: And what about the pesticides? When did you start to use pesticides?

J: When did I start? Hmm.

M: Or have you always used pesticides?

J: Yeah with the weather here, you have to use the pesticides. When it is dry, insects are the most affecting crops, so you have to spray for insect-side. Like this season, you have to use more fact-side. So, you are using more fact-side all around. It is applied all around. But we are trying to minimize by keeping the field clean, so if you put the field clean, it means it will reduce the pesticides. If you feed the crop to be healthier, you put manure, you put fertiliser, it means the crop will be healthy, it will be tolerant towards diseases. It will control the usage of pesticides.

M: So, you are always trying to control or lower the level?

J: Yes. If it is raining, you make the crop to be clean to reduce the pest or the insect-side. So that you do not have to spray more.

M: So, the pesticides you buy, where do you buy them from? Is it easy for you to get it? And also, the fertilisers? Are there a lot of people on the market selling it? Or is it difficult? Or expensive?

J: It is not difficult. The export companies issue the chemicals that are allowed to be sprayed for their crops.

M: So, the export companies, you can buy from them?

J: Yes, they supply on credit. To be used on the produce. So, if you are not getting from them, you have them in the shop. So, it is easy to get. Then for the fertiliser, it is also available in the agro dealers. Then the county is doing a bit of effort to buy fertiliser for the farmers on subsidiary costs. So, at the shop we are getting it at KSH 3,000 per bag but we are getting the same quantity from the county government with KSH 1,500. So, it is half the price. So, the farmers are moving in that direction to get the fertiliser from the county. But also, the fertiliser from the county is not reliable because it not continuous. It comes once per year so if you don't have cash on that time that means that you won't get the fertiliser. So, then you would have to go to the shop.

E: Is it because there is a limited supply of the fertiliser?

J: They purchase once and that is issued within a period of one month. So, within one month, the fertiliser is over until the next year.

M: So, if you don't have cash enough you cannot buy enough?

J: Yes, you cannot buy enough. Maybe you can even not get it because it is not given credit. You have to buy it cash. So, if you don't have cash then no fertiliser. So maybe when you get cash, maybe when you are planting, you will need it to go to the shop to buy at the higher price. Because the one from the shop, that person is getting the profit. You see that person already have several channels. It is that person who does the export, he bought the fertiliser. Then you

have the distributor, the wholesale and the retail. Every person is doing something to get his profit. So, it adds up to the 3,000 per bag.

M: It seems like you are engaging with a lot of different institutions like KEPHIS, PCBP, SSC project, PMO, county government, etc. Are they also teaching you sustainable practices? For example, do you think they teach you how to reuse your resources or what you are doing with your waste or is it something you have learned from your father or yourself or is it something you have been trained in?

J: On good agricultural practices? The extension officers have tried to teach farmers on the recycling of the plant crop, how they can recycle them to be farm manure. So that one they have done.

M: And that is the extension services? Is that part of the county government of who leads the extension services?

J: It is from the county government.

M: So, they kind of encourage farmers to produce more sustainable. And what in general do you think the farmers think about, of course the financial part is important because you need to be able to feed your family right? But do you think in general that people here think about the environment or are aware about climate change?

J: Come a bit, come a bit again.

E: Is the only aim of the farmers, what they are thinking about with their farming, is that to be able to make a living so that they have enough money to be able to feed their family? Or do they also think of the environment and about the resources of the environment? Because the resources are decreasing so they have to take of the environment also. Do think about that in the sense that they would like to produce more sustainable? Or do they only think of the profit because they have to survive.

J: Some. Some think about the conservation and producing for the conservation of the environment. Others don't. So, with those who are thinking that it is better to farm and protect the environment because of how the climate change is going. Because, as I told you, of the water resources. We have to protect that mountain [Aberdare Mountain] for us to be able to get continuous supply of water. If you destroy it, it means water will stop.

M: Yeah it will hurt you.

J: Yes, it will affect us. Some farmers are doing some agro-foresting in their farms. So, they are doing it may be commercially and others are doing it commercially and for the environment like myself. There are several NGOs who are here to support the farmers to practice against the climate change. We have an NGO called WWF, it is doing a lot and helping farmers with the conservation of soil not only to farm but to farm and conserve the soil. The conservation of soil, they strip the soil and protect it not to go in the rivers and to avoid erosion. For the rivers to have clean water. Some have also planted grass strips for this purpose. So that organization is helping farmers. So those who are part of and practicing that, they are getting more benefits from that. So, others are doing it commercially just for food and as a cash crop. So, you can't

say that all are doing some. But some are. I would say the bigger percentage is protecting the environment and farming for it.

M: Your own practices, who do you think have affected your knowledge the most or your practices? Is it country government, some of the institutions or is it your family, or everybody? How did you learn what you have learned? Who affected you the most? Or extension services or what it might be?

J: Affected on which area?

M: Like what to do with your crops? For example, reusing?

E: Is it something someone told you that this could be a good idea or something you came up with or something your father learned you like the reuse of resources to make manure?

M: Because it seems that you know a lot and is quite aware and know about it. So, who gave you that knowledge?

J: We have the country government, we have the extension officer, the agricultural officer, which is within the area and we are having several education programs with the farmers and informing them to use the crop materials and compost materials. Also, we have these export companies, who are training farmers on waste management. Even we have a file for the waste management. It says what do I have, what can I do with it, if it is a fertiliser bag what do I have to do with it, waste products, etc. We have a file for that.

M: Is that only in this area Geta or where is this waste management going on?

J: It is only for the AFPC farmers. So, it is in the office. We are educated and farmers are asked by the export companies what do you do with this waste product. So, you make an agreement with them and you inform them. And then they advise you on how to use the waste product, on which way it can be used, etc.

M: So, they actually encourage you to reuse the waste? And that is the export companies?

J: Yes, they do. They also help us on which seeds to buy. Sometimes we can buy them directly but not always and then we go to the agro-vet. But in general, it is a problem that the seeds are bad.

M: Are there any things that make it difficult for you to reuse resources or minimize external inputs? Is there anything that makes it difficult for you to do that?

J: Yes. For example, now it is rainy, you know this paper cannot, you have to burn them to be able to reuse them. Like the polythene bags, if you put them in the field, they do not decompose so you have to burn them. But these polythene bags are now minimised by the national government by law, so there is no use of the polythene bags. But however, when it is rainy, you cannot burn. So, it goes up in heaps and heaps. During the burning, some polythene bags do not burn because they are wet. So that is a problem for doing that. But also water we know little about. Most of the farmers here use sprinkler. But otherwise, we have little information and it is difficult to know how much each crop needs.

M: What about the manure from the cow? Do you keep that in another place?

J: Yes, the manure from the cow you have to put in another place and cover it with the polythene for it to dry. For it to decompose, it must dry. If it is wet, it will not decompose. You have to cover it with the polythene, then after covering it, you wait for it to dry. So, if you don't have a polythene bag to cover it, then that manure it will be difficult for it to dry because of this raining.

M: But is it also expensive?

J: The polythene? Yes, it is expensive. Because for it to cover maybe 20 feet square, you need to have about 3K maybe 5K to buy that big of a polythene for it cover.

M: So, it is the financial part that is difficult?

J: You have to buy an old one. Because a new one used to cover the green houses is more expensive. So, farmers have to buy used one. The ones that green houses are removing, you buy that one. And then you cover your manure for it to dry.

M: But you don't have the polythene now? Or what do you do now yourself?

J: For the manure, here I don't have. It is at another farm where we can go and see.

M: Ah I see. So, do you pay anything for using it?

J: What?

M: Do you pay your neighbour to use his manure thing?

J: You just use it in your farm. You don't have to sell it to the neighbour because even it is not enough for you yes.

M: So, you can just go and put it there so it can dry properly?

J: Yes. The one I have is at another farm where the cows are.

M: Ah so the cows are there as well.

J: Then you have another farmer, where you can go and see his manure, where he has put it then.

M: Is it far? Or is it difficult for you to transport it back here, when you need to spread it here? Or is it not that far?

J: Okay I am using it on that farm. So, for this farm, I just purchase for it to use here. So that one for that farm, and this one for this farm.

M: So, it would be expensive to have your own? Or you have too little manure for it to make sense to buy your own?

J: Yes yeah.

M: Okay. Maybe just to sum up. The institutions you are involved with. So that is KEPHIS. And KEPHIS also does some training, right? Yeah and you are involved with PCBD? Are you are

involved with the county government? And SSC project but that is kind of yeah. So just KEPHIS is training on – which kind of training do they offer?

J: MRL.

M: And PCPB that more – they also do training?

J: Yes, on SSP.

M: And county government? That is more extension services?

J: Yes, the extension services.

M: And KEPHIS how often do they come here? Do they test sometimes your products as well?

J: Yes, KEPHIS are the ones that do the crop test. Yes, KEPHIS does this test of the produce.

E: And how often do they come here?

J: They come after 6 months. So, every 6 months. And then we have the HCD. Those are the ones who regulate the export market and issue the export licenses.

M: So, they help you with the requirements?

J: Yes, governing of exports.

M: So, a lot of institutions are involved. Or you are close to or collaborate with a lot of different institutions?

J: Yes, we collaborate. Because for us to do this, we have to organize the farmers to participate in the training. Then as I told you we are working towards our reach of export. So, there is part of us on productions, AFPC have to do the production. Because what we are producing is on the [free shop] we shall sell. So that is how we have been doing it.

M: So, last question, how many farmers are in the AFPC? In the cooperative?

J: We are 106 farmers.

M: Great. That was a lot of useful information and interesting to see.

Appendix 2: Farmer 2

E: We are students from Denmark, Copenhagen Business School, doing a project on circular economy practices in the agricultural sector in Kenya. Circular economy means reusing and recycling waste, minimising external inputs and keeping nutrient in a closed loop. Mathilde has been working with The Danish Embassy in Nairobi on an environment and an agricultural programme and therefore knows the country, but for me it is the first time. We would like to ask you some questions about your practices in your farm. If you have any questions to us during the interview, feel free to ask.

M: Which kind of crops do you grow?

J: Green peace, snow peace, garden, potatoes

M: How many acres is your farm?

J: It is only 1 acres. We inherit it from our family. If we are more siblings, we have to split it.

M: Do you have any waste from growing the crops? E.g. after harvesting?

J: Yes, after harvesting, I collect the waste and put it in the compost hole. I have three different holes.

M: Have you always been doing that?

J: Yes, for several years.

M: Have you been taught by any how to reuse the compost?

J: Yes, I went to a seminar. I don't remember who did it. But there were several seminars. We were taught not just to put the waste back on the fields right after collecting is as they might have diseases after harvesting. So, it is good to bring it all together and ban it for some time. And then you can use it as compost. And you can avoid using pesticides.

M: Do you have any livestock and wastes from them?

J: Yes, I have two cows. They produce manure, which I cover with a polythene bag and dry it. On the third month, I take it to the shamba (field). I also have rabbits and use the manure from them. And some few hens.

M: Which kind of wastes do you have on the farm?

J: I have compost and manure. The manure I cover with a polythene bag and dry it. On the third month, I take it to the shamba (field)

M: Do you have any surplus of waste?

J: No, I have been using it on my own fields. But sometimes I give some to my neighbour. She is old and cannot afford buying fertilisers.

M: Have you considered to get more livestock?

J: If I could afford it, but I cannot. If I could get 5, the crops could change because there would be more manure and would not have to use fertilisers.

M: Have you considered to obtain a loan?

J: There is a bank that we usually deal with, equity bank, because I am a customer, but the interest is high for the farmers.

M: So right now, you just buy fertiliser instead.

J: Yes, even though that is also expensive. But to invest in livestock is more expensive but in the long run it is advantageous if I could afford it. If I could buy three cows, I could for example use them for 10 years, but the fertiliser I have to buy all the time.

M: Do you also buy fertilisers and pesticides?

J: Yes, I do.

E: Is it easy accessible?

J: Yes, it is. At times, we go to the council and buy the pesticides and chemicals that are about to expire at a lower price. But sometimes they are also sold at a high price due to transportation costs.

M: Do you use more or less pesticides today than some years ago?

J: We use more know because we are getting more pests than before because of the weather. But if I knew my soil better and get the right information, then maybe I wouldn't even use one drop of pesticides.

M: All the practices you apply at your farm, from who have you learned it?

J: Long time ago, I attended a training from an export company. But that is back in 2011. Here we learned about pesticide use. We learned how much to apply and when.

M: Do you help you neighbours or give each other advice?

J: Yes, for several years. We used to have a small group to help each other. I introduced some of the other farmers to a new crop and how to spray and use water for it.

M: What is the general environment awareness?

J: Some of the farmers are aware and many are reusing resourcing.

E: The ones who don't do it, why do you think so?

J: Because they did not receive any training in how to reuse it and dry it properly. They need to be trained.

M: When did you last engage with KEPHIS?

J: KEPHIS was here in 2012 to give advice on the crops and good practices. They told about the process of how the crops are tested and verified in terms of pesticides level.

M: What about PCPB?

J: The group I was a part of, we came up with an idea, whether the PCPB and county government could support us with DAP. Some farmers were able to buy one or two bags, but now I don't know what the situation is. Instead we have to go to Ol Kalou and buy it.

M: Are the fertilisers affordable?

J: They are expensive. Therefore, I try to use my own resources. In fact, at some point I considered to change to organic farming, but I needed someone that could train me. It is better, because the chemicals are affecting the people and the environment. It is only that we had no one to sponsor and lacked information. There was a person visiting us from Thika at some point, who was doing organic farming. The way he explained to us, I found it easy and economically beneficial. But I need more information about the market also. If one or two changed practices in the community, then everybody in the village would change if they saw it worked well.

M: Who was the guy from Thika?

J: It was a research project and groups called Karikas that go around the country and show people how to invest and make groups. And this guy was doing organic farming and earned a lot of money. So, he was the inspiration. I even went a step further and talked to another group about it.

M: The polythene bag you have for the manure, was it easy to get and affordable?

J: I had to go to Nairobi, because the ones around here I could not use. So, some of the other farmers use my bag to ban their manure. I think I am the only one in this area that has one. It is too expensive.

M: What make you buy it?

J: I heard it was a good investment. After getting the polythene bag, the I banned the manure and covered it with the polythene bag, I almost got the double amount from my crops. It was not difficult to see the benefits by drying the manure this way. And as I told, I let some of the other farmers us it as well as they have seen the benefits. It also means that we use less fertilisers.

M: Who told you about the polythene bag?

J: It was a seminar we attended, who told us. Supported from the county government. Also, an export company exporting snow peace has come and told us that it is a good way to do it. We have some plastic containers after using the chemicals. And we don't know exactly what to do with them. We have always either buried or burn it, because we don't know what to do with it. There is no place to take them. But we know it is very risky to the livestock and the groundwater. So that we don't recycle.

M: To sum up, you need some solutions to recycle your plastic and there is a financial barrier in order to invest in more livestock.

J: Yes. The current county government that was elected recently, they came with a new way to do samples. But they have not been here. That is why we use the manure. They should come and take samples from our soil, so we know which fertiliser to use. They took some samples of a few farms in Nyandarua to advice on which fertilisers to use, but all the areas are very diverse and a sample taken one place even though it is close to you, you cannot necessarily use that result for your own soil. So, I need a separate sample from my own soil to know how to grow the crops the best way. If we get the right information we could use less pesticides.

Appendix 3: Farmer 3

The size of his farm is ½ acre.

The crops on the farm are garden peas, potatoes, fruits.

His wastes are remains of peas and crops residues.

He has two farms. He has his two cows on the other farms along with two goats and some hens.

He uses the manure of the livestock for his shamba [fields]. But only for his own use (not that much).

He uses both fertiliser and pesticides.

With the livestock manure, he puts it in a hole and let is dry with the sun for approximately 3 months and then he takes it back to the shamba [fields].

The information about reusing of the manure was something he learned through agricultural training offered by the county government.

In general, he does not really talk to other farmers and exchange knowledge. He does not find that useful. He can figure out for himself.

The only type of waste that he cannot reuse is plastic and does not know how to dispose. However, he does not always use his waste or manure. He sometimes just let it compost in the field.

The reason why he doesn't always the manure is because of the distance between his farms as they are 3 km apart, which makes it difficult to transport the manure from one farm to the other.

He think there is easy access to fertilisers. But that they are expensive, which makes it difficult to get.

Compared to earlier, he uses a lot of pesticides. He has some knowledge on the usage of pesticides but he would like more training on the problems of pesticides. He has already attended some training but he would like some more.

He would like to get more livestock as he believes the manure from the livestock is doing very well. However, it is too expensive of an investment and he cannot get a loan. Thus, he uses the pesticides instead even though he knows that manure would be cheaper in the long run.

KEPHIS comes and takes tests of the soil. This is used for them to give the farmers advice on chemical use, on what fertiliser to use to get the nutrients lacking in the soil, and on how to be able to produce more. He explained that he got a sample taken years ago but had not been able to do it again.

Samples have shown that the soil in the area is very acidic. So even though they have been advised on what fertiliser to use, manure would be better.

He is aware of the environment and thinks about it. He has received agricultural training on how to use and dispose in the best manner to protect the environment. But again, he would like some more training.

He has heard about organic farming and also thought about switching to it. However, he lacks knowledge on the processing of manure for organic farming. So, if he could more training and had the financial means, he would consider it.

He had heard about biogas and that it was possible to convert manure into biogas, which then could be used for cooking, etc. However, he did not have any knowledge about how and what you would need to be able to do the conversion. Thus, he asked if we knew and could explain the process for him.

In terms of water management, he had sprinklers. However, he said that he and other farmers in general do not know the right amount of water to use. By knowing their crops better, they would know where to use their water most efficient.

In terms of financing, he explained that there was easy access to loans, however, they came at a high interest and with a very short payback period. Also, you would need to be able to come up with some sort of guarantee, which farmers usually don't have. He explained that it would be possible for them to get a loan as a group, but then would come the issue of where should the digester [use for the conversion of biogas] be placed for it to be fair for all.

He believed that it would be an idea to incorporate education on the financial aspect (how to reuse and put all money into farm) into training as well.

Appendix 4: Farmer 4

E: We are coming from Denmark and are studying at Copenhagen Business School. At the moment, we are doing out master thesis project on circular economy practices in the agricultural sector in Kenya. Circular economy means reusing and recycling waste, minimising external inputs and keeping nutrient in a closed loop. So, it is a lot about sustainable practices. Mathilde has been to Kenya before as she was doing an internship for the Danish Embassy, and for me it is the first time. We are in Aberdares to talk to some of you farmers and would like to hear about your practices. Therefore, we have some questions that we hope you will answer. If you have any questions to us during the interview, feel free to ask.

M: Can you tell us a bit about your farm?

J: It is 0,5 acres. I have mine here, and then my dad has a bigger farm a bit further away. I grow different vegetables such as various types of peace and potatoes.

M: Do you also have any livestock?

J: Yes, I have three cows as well.

M: Which kinds of wastes do you have on your farm?

J: I have wastes from when I harvest and use it as compost and then I have the manure from my cows.

M: What do you do with your wastes?

J: I use some of it, for example the manure, and spread it on the field, but I don't have a lot of knowledge in how to use it the best way.

M: So do you sometimes have waste from the crops that you don't reuse?

J: Yes, instead I buy fertilisers.

M: Do you have a polythene bag for your manure?

J: No, I have heard that it should be better to dry the manure with that, however, I am not able to invest in one and I need some knowledge, so I know how to use it.

M: Where do you keep your compost?

J: I have a hole here, where I keep some of it and dry it.

M: Do you also use pesticides?

J: Yes

M: The practice you apply now, who did you learn it from?

J: I do what I have learned from my father and then an exporting company has been teaching us in how to use pesticides. I have also been visiting other farms.

M: How is your use of fertilisers and pesticides today compared to some years ago?

J: I use more now than I did some years ago. It is easy to get. However, I am still trying to take care of the environment. I know it is not good if the pesticides residues get into the spring, because it will affect the people here and our children in a bad way. I try to avoid the use by applying practices learned from the export company. For example, my planting times have now been adjusted to avoid some pests. But I would like more information on what is needed for my soil to produce in a way that hurts the environment the least.

M: Beside the training from the export company, have you received any other training or support from other?

J: When KEPHIS is here, they come with good advice on better practices and also give information about what is required from the export company. Many years ago, I took part in a training from the county government, but I don't remember exactly what we learned.

M: Do you know of or have considered organic farming?

J: I know it and know some farmers are doing it, but I don't have any knowledge of the practices and what the change involves, if its economically beneficial, so I have never considered to change. What I am doing is what I always have learned and what most of the farmers in the area do. My dad has more livestock than I have but his farm is too far away from mine so it does not make sense to transport his manure. It takes too much time. He also uses most of it himself but I know that he sometimes has surplus.

M: What does he do with it?

J: He either gives it to neighbours or just leave it. You see, the problem here is that the distances sometime are too big or the roads are too bad to transport it. Then it is easier just to use the fertilisers you have bought, even though that is also expensive. I hope that we could get more training in better practices. I know that the county government has taken samples of some farmers soil. If I knew which kind of fertiliser my soil needed and how much, I would be able to grow my crops better and maybe use less fertilisers. The exporting company is the one that gives me most knowledge.

Appendix 5: Farmer 5

M: Can you tell us a bit about your farm?

W: My farm is in Bungoma in West Kenya. But I am in Nairobi for a period to earn some extra money. I have family that takes care of my farm. My farm is 2,5 acres. I grow different crops but I have mainly maize and beans.

M: Do you any livestock?

W: I have 8 livestock. I used to have 12, but I needed cash so I had to sell some of them. For a cow, you get approximately 25.000 shillings. Many farmers often need to sell some of their livestock if they need money. The livestock is very important for them, but they cannot get any loans so this is the only way for them to get cash if they need it.

M: Do you use the manure from the livestock in your production?

W: I use all the manure I have and mix it with remains from the maize.

M: Do you do anything else with the manure before you spread it?

W: I keep it for one year and let it dry. It's the same procedure every year.

M: How do you dry it? Do you have anything to cover it?

W: I just put it somewhere on my farm where I always keep the manure. I don't cover it. I just do what my father has been doing. And also in school we learn about agricultural practices.

M: Have you been able to use what you have been taught in school and what did they more specifically teach you?

W: Yes, I have used it a lot. In general, good agricultural practices. How do we get most out of our crops. We have also been taught in how to take care of the environment.

M: Can you specify that? Did you learn about how to get more out of your own resources?

W: They learned us that if we don't use pesticides properly, it will spread to the ground water and will make our family and society sick. It is a big problem in Kenya. We did not learn how to reuse our resources better, but of course we know that we can use manure and other remains. All farmers are doing that.

M: Do you have other wastes or by-products from your production?

W: I have remains from the crops, and as I said, I mix the maize remain with the manure. I also have a separate place for the compost which I spread back on the fields. But usually I mix it with the manure.

M: Do you buy any fertilisers or pesticides?

W: Yes, I buy both. Mostly at markets through the middle man. I would like not to because it's more stable not to be dependent on it. The fertiliser prices are changing a lot. The county

government is in charge of it, but they often sell it to middleman who mixes different kind of fertiliser and other stuff, so you don't get what you need. I have tried many times to use fertiliser where nothing happened even though I used a lot. You don't know what you get and it might be bad for the crops. The middle men earn a lot of money.

M: Do you think county government know this?

W: Of course, they do. The middle men have some contacts in the county government and get the license to sell it and can sell it for an over price. The county government also earns money that way by being paid by the middle men. That is way I would like to produce more organic, but I cannot afford to change.

M: What about pesticides?

W: Pesticides you don't buy through the county government but just at private stores. It is also very expensive but often needed.

M: Are you using more fertilisers and pesticides than before?

W: Fertilisers used to be more expensive and got cheaper because the government started to subsidise it. Therefore, more farmers have been able to afford it. However, now the market it's getting more unstable due to corruption. Also, when the fertilisers don't work as they should because you don't know what you get, you automatically use more because you think more is needed or you try another fertiliser. Often the middle men come by your form to sell it, so it is not difficult to get.

E: Have you ever got sample of your soil?

W: No that is another problem. It would be more efficient if I knew exactly which fertiliser to use and when. But I have never got a sample of my soil. It is expensive even though it might pay off. But I have never made the investment. This would also be better for the environment. And I could maybe even avoid to buy fertilisers or pesticides.

M: What about the pesticides?

W: Pesticides prices I guess are the same. But because the climate has changed and is more unreliable, I have used more the last years. However, many farmers cannot afford pesticides and use fertilisers instead.

M: You mention that both fertilisers and pesticides are expensive and that you have used more of it the recent years. What stops you from converting to more organic practices?

W: It is too expensive and I need more knowledge. I would need more livestock and I cannot afford to buy more. Therefore, I continue to buy fertilisers instead because the investment is not as big. I would like to get more informed about more sustainable practices. I think it is better and that you will save a lot of money. And it is better for our children.

M: Have you received any other forms of training besides what you have learned in school? For example, from KEPHIS or extension services?

W: No, I have never attended any training and I have never engaged with KEPHIS. I know them but I have not talked to them. They have not tested my crops.

M: What about the other farmers in the area. Do you exchange your practices - what works and what do not work? How

W: No not really. Everybody just does what they usually do. But of course, we talk.

M: Who do you sell your produce to?

W: I sell it to the national city portal. But the prices are not good right now. So sometimes I keep the maize and use at compost if the prices are too low. You also need to calculate the transportation cost and therefore it is better sometimes just to reuse it on your farm.

Appendix 6: Farmer 6

M: For how long have you been an organic farmer?

MR: I have been farming organic for 10 years.

M: How big is your farm?

MR: It is 2.5 acres.

M: Ah okay. So, it is like a semi-big farm. Which crops are you growing?

MR: Hmm, I am just growing maize, beans, bananas. And then some fruits like mango, avocado, and some greens like vegetables such as spinach.

M: So, you have a lot of different crops?

MR: Yes, the diversity is quite big.

M: Have you always been growing the same crops?

MR: I do change from season to season and grow some other plants.

E: So, you rotate the crops?

MR: Yes, I rotate

M: Do you have any livestock?

MR: I did have some. But now I don't have.

M: So not at all?

MR: No not at the fields. Cows and goats, I used to have some but today I don't have.

M: Okay. How come? Was it too expensive or?

MR: My wife was sick for a long time so I had to sell them for her treatment. And after that she left me. So now I don't have any. But I am hoping to get some again.

M: Do you have any wastes when you harvest and stuff that you reuse?

MR: Yes of course waste is there but I do also sell to those who have the cows. I just sell to them. And if not I just slice them and put them back to the farm.

M: So, what you don't sell, you reuse it then. Do you have somewhere, where you compost it or dry it?

MR: Of course. Yes, that is normally what we do. Organic farmers compost their manure. It is obvious. It is a must to make a compost manure. But compost manure you usually make when plants are green.

M: Okay, do you have somewhere that you put them or?

MR: You see that one over there? I am just now slicing them to come down and then they are ready to dry. And when they are dry I put them in the soil again. That is what I do.

M: And do you have enough or do you sometimes have to buy more?

MR: No, what I do, I exchange sometimes with my waste and some manure from my neighbour. He needs my leaves for example for his cows and then we exchange for some manure. They give me manure and I give them some waste.

M: Yes, I was wondering about your processes because I think the use of manure is quite common for organic farmers. So how often do you exchange?

MR: Actually, we change during the [dry season] cause that is the time we need it, the manure. But for me, I don't depend on seasons because I just carry on, I have water. So, the problem is water but I have enough water. I can even farm during the dry periods. But even in dry seasons I need compost, I need manure.

M: What made you change from conventional to organic farming?

MR: Well, before when I was doing conventional farming, I came to realize that the benefits of organic farming are many. You get healthy food. First thing is someone's life is health. Then after that, you compare yourself and your neighbours, so you find that it is also good to assist other people from those products adding chemicals to free chemical products.

M: But who – did someone inspire you? Or was it just yourself?

MR: Yes, there was somebody. It was an organization actually who were supporting us all getting into organic farming. The organization is called SACDEP. First, they came and pitched the idea. They told us about the kitchen garden. They told us don't put any chemicals in that. And from the kitchen garden, we just moved on to the farm. That is what we did. And from there, we also joined another organization called KOAN. You know KOAN? This is also another organization who is also assisting organic farmers in Kenya. And from there, when it was a small organization, to now it has become a big organization, people like Leah from University of Nairobi are now starting to work with organic farming. And they are also supporting us in the organic farming actually. They do call us to their meetings and they tell us about organic farming. So, it is now a big organization. Because the people interested in organic farming are now very many. Now again Leah here, she is doing a PhD in organic farming, which is good. So, there is a very strong pillar of organic farming for the future. That is what we want.

M: So SACDEP is that an NGO or?

MR: It is an NGO.

M: So, did they just come here randomly or? Or how did they find you?

MR: Yeah, they just came here and told us about organic farming. They told us about organic manure and composting manure. They also told us to use our indigenous pesticides during farming.

E: So, they told you about sustainable farming and then recruited farmers and trained them in the practices.

M: They wanted to recruit people to convert to organic farming?

MR: Exactly! We were recruited in groups yeah.

M: So, you said that one of the drivers for you were that you would produce more healthy food? And also, what about the financial part? Did they say that you would earn more money or?

MR: Of course! That is also one of the benefits of organic farming. The costs are less than with conventional farming because you don't need to buy pesticide, fertiliser. You use only compost and manure from cows. Thus, the expenses are less than with conventional. You have larger gains than with conventional. So since, I started to farm organically I have never needed help. I am suiting myself. I am okay. Because I produce products that I can sell to hotels. And I also sell to individual customers who need my product. I supply them with baskets delivered to them in Nairobi.

E: And how often do you do this?

MR: I do this at least two times a month. I bring them out to at least 6 persons, customers. They are not taking my product for less than 2,500 KSH per basket. They will tell me what they want and I just combine them so they get what they asked for. It goes for 1,500 to 2,500, not less.

M: So, do you go to Nairobi yourself?

MR: Yes, I go to Nairobi.

M: So, you sell you produce to those 6 customers and then to the hotels. So, you don't have any middlemen?

MR: Some hotels yeah. I also supply them with some cases if they need my product. They come and say they want this and this and this.

M: You do not have any middlemen then or?

MR: The middlemen are buying here. They are the people who are buying in the farm, who are with me. I sell to them.

E: You sell to them often or?

MR: Sometimes they just come.

M: But it is not like they come every week on Fridays?

MR: No, it is random.

M: So, your market or who you supply to that is the 6 customers, sometimes hotels, and then middlemen if there are any. But did SACDEP help you, or did they give a market to you, or tell you how find a market to sell to?

MR: KOAN told us very much about looking for a organic market. We had one at Karen, which were selling at Saturdays. Every Saturday at Karen. And there was also another one at the American Embassy, which was also there every Thursdays, every week. So those two. Then

we started another one at Thika but the county government charged us a lot and we were unable to continue.

M: So SACDEP also convinced you that there is a market? Have you always been able to sell all of your products? Or do you sometimes have surplus that you can sell at a market or?

MR: Yeah sometimes. But markets actually yes. If I don't take them there to the organic markets, there is an open market here, a local market, where I do sell my products like for example tomatoes. This is two days a week. There is also another one close, which is open different days. But they are not on the same days. One is open on Wednesdays and Saturdays and the other Mondays, Tuesdays and Fridays. You see they are different. So, you can go one day there and come back and go to the other. So, the markets are always there. But then you don't sell it as organic. Then you just sell it as normal. Cause you cannot go there and say mine is organic, people will not pay because it is too expensive. So, you just sell it as conventional. But for a good price still.

M: But when you sell to your customers or the hotels, then you get more money than the conventional farmers right?

MR: Of course. Because of all of the expenses you have.

M: And are someone coming and testing you? Like KEPHIS sometimes? Or are there any other organisations here that test products?

MR: Hmm, we do not have any other organizations who come here to assist. It is more people like Leah. KOAN sometimes they call us about seminars. SACDEP also about seminars. They do assist us with that, seminars.

E: What about organic inspections?

MR: You pay yourself.

E: To who? Or who comes?

MR: ENCERT.

E: ENCERT are the ones with the certificates.

M: Is that a governmental certificate or?

MR: It is private one. But I think they are connected to KOAN. They come every year. They come and audit.

M: So, when you sell to the hotels, then they can see that you have the certificate. Then they know that you have been certified.

E: And how much do you pay them per year?

MR: Every year at least 1,600 KSH.

E: You pay that amount alone or as a group or?

MR: Yeah, we pay that amount alone. As a person. So, you see it is very expensive and not every farmer can afford it.

M: So, you have received training from SACDEP, and the ProGrOV programme, extension services…

MR: And KOAN.

M: Any others? Or what about when you went to school? Did you learn anything about agricultural practices there? Or how did you learn how to grow your crops? Did you learn something in school when you were younger?

MR: You want to know my educational background? Me, I am learner even today. I am learning all the time. I did not go to school during my young age time. I just started going to school when I got old. I am now in form 3. Class 8.

M: So, you can still attend school now even though you are older?

MR: Yes, I can. You just have to pay for it.

E: Where do you, how do you study?

MR: I study in a primary school close to here, where they have secondary teachers. We go every day. Every day from 6 pm to 9 pm at night. We don't go during the day. Cause we are busy during the day. So, we have only three hours a day.

E: And how many are you?

MR: We were at least 15. Some did already finish last year. Me I did not because of the fee. Because it is 8,600 KSH, and then I couldn't reach it. So, I could not finish.

E: So, it is through the adult classes that you have learned English? Mathematics?

MR: Yes yes. I even have some books here. I learn about biology, chemistry, agriculture.

M: So, they also teach you a bit about agriculture?

MR: Yes, we do learn about agriculture. Because me, I like agriculture.

M: Before did you have any knowledge of organic farming?

MR: No, I had no knowledge. I just followed what I knew. I took over the farm from my parents so I learned from them.

M: So, you just continued doing what they taught you? And the with your neighbours do you help each other or copy each other? If something is working well, do you tell each other about it or?

MR: I have a group even now today. They are also doing organic. The certificate is there for them. I can show you.

[Looking for certificate…]

M: So, you are actually registered? Can we take a picture? Is it okay? It is just funny to see how it looks when you get a certificate.

E: Is this the organic certificate?

MR: Yes, it is. This is from the county. From social services.

M: Have there ever been a time while you have been an organic farmer that you have thought about stopping because there has been too much pest or? Where you have thought this is too difficult I need to go back to conventional farming?

MR: Yeah, I have come to think about it. But I couldn't go back to conventional, no.

M: But some years have you had a lot of pests or? Or where you have not been able to produce things?

MR: Like now, even today we are also having some problems with pests like calibrates. You know calibrates? It is a disease for tomatoes. Even right now in my farm, I have not been able harvest any tomatoes because of that. And because the weather was too bad. Also, I have been sick since the 18th of last month. So, I could not do anything. But today, I did do some things today. That is the only problem I have. But about pesticides, this organisation sometimes tell us what to use in this organic magazine. So, if you get some pest in your farm, they can tell you what to do. They do also have some special "chemicals" that are intended for organic farmers.

M: But do you need some kind of permission to use those?

MR: Of course. They come with a description on how to use it.

M: But when you for example have pest, do you just read in the paper or do you call anybody to get advice? Do you always get all your information from the paper? Or do you go to get county government?

MR: No when you buy chemicals it is there. When you open it, there will be an instruction of how to use it. You need that. For me I read it. I understand it.

M: Have you ever gone to your neighbour or someone else if you had had any diseases and asked if they had maybe had the same?

MR: Ah yes yes. But we are not all from the same area. However, we do visit each other. If I have a problem, like this one for example, they just come 6 of them. So, if there are any problems, they just come.

M: Why do you think there are not any more organic farmers in Kenya? What do you think the main barriers are to become an organic farmer?

MR: The reason why. First, I think as I told you we have been doing what our fathers have done as well. That is one reason. Secondly, we need some organisations to come and support organic farming in Kenya. Because in Kenya, from the highest officer in the national government to the ground officer, they are not supporting organic farming. Why? The reason is that these are the people who are supplying these chemicals.

M: That is a good point. So, they have their own economic incentives?

MR: They are even the ones who are allowing GMO to the country for them to sell it. Even the officers, they are determined to come to the field. They will come. Leah and county officers are now getting this info about organic farming. So, it should be now easier to spread the prosperity.

M: Do you think this is the reason that farmers are using more pesticides and fertiliser now? Cause we have been talking to other farmers as well who have mentioned that the government gets more money because they sell it now.

MR: No, the government does not make any money. But because they have chosen to subsidize the fertiliser, this has created more awareness.

M: And pesticides that is not through the government? That is just private or?

MR: Yes.

M: I see. So, knowledge is a big barrier for people to become organic farmers because they simply do not know about it? So, culture – what your family/father has been doing has a big effect on you practices as well? But for example, now in school, do they also teach you about sustainable practices? Or is it only about normal practices? Or do they also teach you how to be environmentally friendly?

MR: If you ask me, I am trying very much to. I am trying to bring people together in order to continue with organic farming. Like now, I have an organization, which is bigger than this one [pointing to certificate]. We call it COFCO that means: Central Organic Farmers and Consumers Organisation. We were many small groups that decided to go together and have one big group to be able to help even more people learn about organic farming. The organisation now has 5,000 members, all organic. And they are from different counties. We have Kiambu County, Muranga County, Machakos County, Nairobi County and also Nyeri County. So, it covers a lot of different counties. And we are looking at how we can have financial tools in order to assist more people to learn about organic production and the benefits. We meet every month.

M: But you said that you have been making more money or getting more benefits from switching to organic farming? You have been earning since you changed to organic farming?

MR: Although not more, it is not the same. It is a bit higher.

M: So, I guess that is also a way that you can advertise organic agriculture. You earn the same at least or sometimes even more. But have you had any years where you did not earn anything because there was too much pest? Or have you always been able to earn an income from your crops? Or have some years been really bad become of pest and you couldn't do anything about it? Or has your income been quite stable?

MR: At that time [as a conventional farmer] we were not even recording our earnings. So, we do not know what position we were in. But today we have to do that.

M: So now you know. I see. But that might actually be quite common for small farmers? As we discussed previously, it might more be a way of living than an actual business.

E: Any other challenges?

MR: Yes yes, there are. The most challenging factor is weather. Climate you know. And sometimes it is not good. Sometimes the rain is too much and I cannot use chemicals.

E: Sometimes it is the lack of water. But you, you don't have a problem with when it is dry?

MR: No for me, I do not have a problem with that. I have a bowl. I did buy a bowl. But for many, rain and water are the most common problem. For every farmer. What else, what else. And again, for organic farmers or an organic organization, we do not have our own organic seeds. That is one problem. I don't know where we can get our own seeds. Because we are using and buying the conventional seeds and converting them to organic ones. But I am hoping that we can just have organic seeds from starting. We need organic seeds. So, I don't think we can say that we are actually doing purely organic farming.

E: No because you don't have the right seeds.

M: No and you can't really do anything about it if it is not on the market.

MR: But we should have. We should have at least a seed bank somewhere. That is what make it an organic product. From every seed from the smallest to the biggest, it is very very important if we can do that. But I don't know how. How should we do that? When you say you are organic and you are not having your seeds, it is a problem. I don't know whether you have many organic farmers in Denmark?

M: Yeah quite many are farming organic.

MR: And where do they get their seeds?

E: I think in Denmark there must be a seed bank or something and it must be quite easy to get. Because there is quite a big demand for organic products among consumers, which have increased in the past few years. So, more are farming organic, so it must be easily accessible. But we don't know specifically about that.

MR: So, it is easier. So, if we can just try to find people, like Leah for example, who is in university, who can help us on how to develop organic seeds. It can be done like that. And then we can produce. So, if you could start a branch at University of Nairobi to help with the development, it could be done just like that.

M: So that is also a challenge. Do you think if you had your own livestock that you would produce more? Is that also you think a barrier for many organic farmers that they are not able to afford livestock?

MR: Livestock is good actually if you have it. I used to have 8 cows. And at that time, I was doing very well. The milk was helping. And the manure as well. And now you see that I exchange my waste to my friend or my neighbour so I can get manure. But if I did have the money to buy, I would have at least two cows right now. That would be enough.

M: Have you ever considered to get a loan to invest in livestock?

MR: No not a loan. As a small-scale farmer that is very difficult. Because the interest is incredible. It is just too much. Otherwise they will come and sell your land. So, loans are too expensive. It is not an option.

M: And you don't have any saving groups here? Or have ever gone together in group and talked about investing together?

MR: That is why we have started the group I told you about. The certificate I showed you. We wanted to start the table banking. So, we will all contribute a little. And then we will see how we can just move.

M: Because then I guess it is easier, as a group than as an individual to obtain a loan. Cause then you will just guarantee for each other?

MR: Do you know actually that when we started, SACDEP did help us a lot. Cause they told us and gave us materials to build cages and supplied us with rabbits. SACDEP supported us a lot. It is only the SACDEP organization who did a lot to farmers. They changed some farmers from conventional to organic. They did very good work. They are very good.

E: Do you have any challenges for marketing?

MR: Challenges for marketing? Not really because we have to. You know when you have products or goods, you have to go out to look for the market before your products mature. You just walk out. You talk to the people and tell them what you have and ask if they want to buy.

M: So, you have never had big problems with the market?

MR: No, the market is not a problem.

M: And now some in Nairobi is starting to know that you are selling organic? So, I think we are almost through. Do you have any questions for us?

MR: This is not a question but maybe a comment or a proposal. My request as you are now coming from a developing country like Denmark and not like Kenya, and I am sure that you come here to learn more about organic farming, so you have an idea why you come here. So how can you just think to assist people like us? Assist organizations like COFCO, which is a big organization, a cooperation between people that come together, who are not really well off? How can you support such organizations?

M: I mean we are just students and we are not really involved in an organisation as such so for us it is difficult to say.

E: But from the Embassy's side and the national government, they are supporting some of these groups. Like the cooperative we visited in Aberdare a few days ago, that is supported by the Embassy, which is doing a project with them. It is a cooperative made up of 106 farmers, who want to export, so they are helping projects with small-scale farmers. And I could imagine, it could be an interesting project for them as well to help more people get into organic farming. So. they are doing a lot to support small-scale farmers and trying to help them. So, you probably need to come up with a proposal? The COFCO – who many members again?

MR: We are 5,0000.

E: And how many are actively farming?

MR: We are almost at least 4,000 members that are active. We have members from different counties.

M: So yeah, I think it is about coming up with a proposal.

MR: It is a combination of groups. A combination of 28 groups and if you multiply that by 8 to 40, you get how many members. And when I go to seminars, I always write COFCO. I always go with COFCO. I never go alone.

E: So, the last meeting you had when was that? You said you meet every month?

MR: Last month. We met at least 15 members from the different counties. Every month we meet.

Appendix 7: Raphael Wahome

According to Wahome, there has been a transition among the farmers the last 15 years, which has led to an increase in the use of agro chemicals and external inputs. This might be due to the fact that government and county governments now subsidize fertilisers. Furthermore, the farmers believe that they can make more money by using more external inputs. On the other hand, the number of organic farmers has not increased even though some counties have started to advocate organic production.

Due to the devolution initiated in 2010 in Kenya, responsibilities in agricultural area have now been allocated to the county governments. According to Wahome, this has led to slow policy processes. This is also due to the fact that the county government changes every 5th(?) year and processes initiated might be stopped as an outcome hereof. At the moment, policies are not enforcing. Hence, when the farmers do not have any monetary incentives to change behaviour, they will not change. The extension service in the country have moreover been weakened in the last years.

In terms of NGOs, Wahome is under the impression that they have a big influence on the farmers in Kenya. He explains that they often come with many incentives and inputs that can lead to long term impacts. Furthermore, he argues that they have a bigger impact than the policies that are in place as the NGOs have direct contact with the farmers. Wahome mentions the Kenyan Organic Agriculture Network (KOAN) and that it appears as a consistent player that has existed for a long time. The organisation provides knowledge and training and organises markets for the producers.

A lot of the farmers' knowledge in terms of farming practices stems from extension services. Moreover, the farmers learn from neighbours and often copy practices that they can see generate more income. If practices are effective, they spread quickly. Finally, Wahome mentions that it is common practice that crop residues and crop manure go back into the system. He explains that if the farmers have surplus then they will sell it to each other instead of just discarding it. Thus, recycling is deemed as a common practice in the agricultural sector.

Appendix 8: Josphat Njenga

According to Njenga, a barrier to increased organic production is found at the consumer level. The majority of the consumers are yet not willing to pay more in order to buy organic products. Moreover, they cannot be sure that what they actually buy is organic. Therefore, the organic production is supply-driven rather than demand-driven. More focus has been directed toward food safety in Kenya in recent years as many people are getting sick from the food they eat. However, more information to the consumers regarding organic products is vital in order to make them change behaviour.

At farmer level, it is a problem that there often is no follow up on pesticide level from the regulating institutions. This means that there are no incentives for the farmers to live up to certain standards unless their produce is meant for export. The national government only regulates for the bare minimum of pesticide levels and food safety. However, some counties have gone a step further and started to regulate more strictly and put more focus on cleaner production. General lack of knowledge of sustainable practices and how to reuse by-products are also mentioned as barriers. In relation to this, a barrier for some farmers is the distance between their fields and farm where the livestock is. Sometimes, it is simply too difficult or takes too long to transport e.g. manure from the livestock to the fields. Hence, their by-products are instead wasted and replaced with either external fertilisers or nothing at all, which means that the soil does not get the needed nutrients. This also supports the fact that he mentions attitudes towards practices as another barrier. Furthermore, one barrier that can immensely hinder the ones that actually want to produce more sustainable is that access to inputs and financing is difficult.

In terms of drivers toward more circular practices, the farmers experience more unstable production outputs due to the changing weather conditions. This makes them more aware of their own practices.

Appendix 9: Leah Murimi

Murimi is working as an extension officer for Kiambu County. The extension service is offered for all farmers and the aim for them is also to reach every farmer in the county. The idea is that farmers can contact the officers when they face issues that require outside guidance such as pests. In addition, they offer trainings and demonstrations for groups of farmers. She mentions that circular economy practices are not a specific focus for the county government and its extension service officers. Even though, the focus for them is more on basic training as the farmers need to learn the basics before they can get knowledge on more specific practices, they do offer training on soil conservation. Another service they offer is soil sampling. The extension officers facilitate getting the samples and analysing them. The analysis offers insights into what nutrients the soil is lacking or containing too much of. On the basis of that, they can advise on which fertilisers and pesticides to use and when as well as which type of crops would grow better given the condition and composition of the soil. However, this is not a free service they offer farmers and therefore many are also not able to afford the investment even though it could potentially make a huge difference for them.

According to Murimi, there have been a general increase in the use of pesticides among smallholder farmers. This is primarily due to climate changes, which leads to more pests among the farmers. Further, she argues that there is an increasing awareness of fertilisers, which has also increased the usage. She mentions that awareness has increased due to the fact that the government have initiated a programme where they subsidise fertilisers. This has made fertilisers more affordable for smallholder farmers. Even though the subsidised fertilisers are sold at specific stores that are run by the National Cereal Produce Board through the county governments, the accessibility of it depends on each county and their agricultural minister. Murimi mentions that the county government also works with KEPHIS and PCPB but again the collaboration differs in the counties and usually depends on which type of crops are most commonly grown there. She explains that KEPHIS usually does not control the small-scale farmers. Instead, for the once exporting, the export company will teach the farmers how to comply with the standards. Moreover, she tells that a lot of NGOs are involved in the county where she works offering different services to the farmers. She argues that if the farmers were more educated, many would not have to use as many external inputs as is the case now. Hence, national government has also started to focus more on improving agricultural practices as they have become aware of population growth, climate changes and food security issues.

The farmers are highly influenced by culture and neighbours in terms of how they grow their land. They often do what they have been taught by their parents or what are the common practices in the area. Murimi explains that in Kiambu County, it is her impression that the farmers do not care about money. Their biggest concern is that they need to be able to feed their family, pay rent, etc. They perceive farming more of a hobby they have always had instead of viewing it as an actual business and thus something that can be improved. Therefore, it can be quite challenging to train the farmers and change their mind-set. The older generation were taught about agriculture in school, however, today not all schools offer agricultural education as less people get employed in the sector compared to earlier. Nevertheless, Murimi experiences that farmers have become more environmentally aware. They know how certain practices can affect the climate and the environment negatively. She

believes that the increasing awareness is due to climate changes that the farmers have experienced first-hand. Moreover, they have seen how the water is getting more polluted and friends and family are getting sick.

Appendix 10: Leah Mwaura

M: Can you maybe tell us what you have experienced as the main drivers and barriers for sustainable implementation?

L: Alright, maybe I can introduce myself first. My name is Leah Mwaura. I work as a business case advisor for HortIMPACT, which is a five-year programme. We are in our fourth year. We are involved in the horticulture sector, which includes fruits, vegetables and potatoes. We are concentrating on three themes: improving food safety, reducing food losses and improving the income level of the farmers. We work in 16 counties in Kenya. We work with business cases. We work with Dutch and Kenyan SMEs. Basically, we work with businesses to help improve any of the three objectives. They have to also be working with farmers and impacting them. Our goal is to reach and impact about 50,000 farmers in the five years. We are about 37,000 at the moment. So, we have a long way to go. Basically, we work with business cases and innovation cases. With business cases, we give grants to companies, so we co-invest in them. Depending on their project, we ask them to fund 50 percent or over themselves and then we fund the remaining up to maximum 50 percent. We also have innovation cases, where we fund innovative ideas that would otherwise probably not be funded by banks or micro-finance institutes. We think that it is ideas that will catalyse the horticulture sector with such innovation. The maximum funding here is about 30,000 euros. Here, we also ask companies to co-invest. So, that is basically what I do.

M: Very interesting. Are you in the field as well or are you mainly a programme officer?

L: We have a programme manager, which is the one you reached out to. I am an advisor. So basically, I am both in the field and here. The way we work, we led the market work for itself. We work with existing companies, who take lead on the projects, and we go in to facilitate and see if there are any gaps. We look to see if we are impacting as many farmers as possible. So, I am both in the field and in the office.

M: So, you have both experiences. We can see that you work a lot on the policy level, both at the national level and with county regulations from your webpage. In general, do you think that regulation is a big barrier for the farmers to produce more sustainable?

L: We do work with regulators. In particular, we work with government regulator. We work on food safety, and with food safety there is a lot of regulation around it, especially domestic food safety. For the export market, that is ideally taken care of, but the existing domestic market, there is not a lot of procedures and regulations around that. So, we work with the regulators, the government regulators, that could be KEPHIS. In the potato sector, we work with regulators to regulate quality. For example, the bags, storage, etc. Mainly it has been about the bags. There has been an issue in Kenya on how to package potatoes. We have worked with the National Potato Council on that and whether to ideally regulate the bags or market them in kilograms instead of in bags. We also work with Ministry of Agriculture and KEPHIS to regulate and come up with policies around domestic production, which has been a problem. We are strong in advocating for a policy called KS1856, which is a policy around food safety, domestic food safety, and it that we are very keen to work with businesses on traceability, reducing food losses, increasing awareness on food safety especially on the

domestic level. We also work with regulators to regulate inputs. Because one of the issues with production in Kenya is that farmers are using a lot of counterfeit inputs. So, we are also working with a business case that is helping agro-dealers and input companies to look at issues of counterfeiting and being able to capture the products and sending it through a verification system that can tell whether a product is fake or not. So, we are trying to capture many levels.

M: As far as I understood, in the horticulture sector it is KEPHIS, who is controlling the pesticides level, PSPB set the standards and HCD helps the farmers to export or are they more advisors?

L: The HCD is a body that helps the farmers to know the standards, especially for export. For example, there was a ban from the EU on the maximum residue level, which was really driving the conversation around producing safely and adhering the PHI level. They also provide counselling for everyone who is exporting, exporting through the horticulture crop directorate. So, they are a bit of a regulator also.

M: Our impression was, when we went to Kenya, we interviewed some farmers who were part of a cooperative, which was exporting, and then we interviewed some conventional farmers that were producing for the domestic market, and our impression was that the export farmers we highly related to KEPHIS, PCPB and HCD and got support from them, whereas the domestic farmers were not in touch with the different regulators and some had never received control. So, is it a common thing that KEPHIS focus on the export farmers and domestic farmers do not get that support and check, which is why you see the high level of pesticides and experience the problems with food safety?

L: Yes, there has been a lot of focus on the export market. A few years ago, we only exported around five percent of our produce and 95 percent was consumed on the domestic market, and then there was no focus on food safety and food security. Food security had been there but food safety was not common or something that was being taken seriously. But recently, we have had a lot of issues with our health and different bodies, such as AAK, have started coming and they have been starting to ask consumers to advocate for food safety, safe products., adhering to food safety and standards like they adhere to the export market. So, really it is not something that has been addressed and heated off like the export market. So, we are working with the different regulators around it and we do engage with them at stakeholder level and tell them, you do need to start paying attention to the domestic market and they do need to know the standards and the different levels. Because now, the agricultural sector is really devolved, most of the conversation are happening at county level and even people like KEPHIS has offices at county level, so it is dripping down to the farmers.

M: Would you say that the regulations are there but it is the enforcement that is needed? Or would you say that the regulation could be improved?

L: Yeah, the regulation is there and as I said, there is the KS1856 regulation around the domestic market, so the regulation is there but the enforcement is what is a challenge and one of the key drivers for enforcement would be at the consumer level. For the consumers to demand food safety because that would automatically generate the farmers to adhere to the food safety, just like the EU demand food safety and here the farmers are very keen and aware of the products they are exporting. So one of the things that HortIMPACT does around that is

that we work with AAK to come with spray providers that are really trained on maximum residue level, how to spray, when to spray, how much to spray. We also work with IPM instead of working with the inorganic pesticides to change the way the farmers work.

M: Is every farmer allowed to spray himself or does he need a certificate to say that he received training? Or can anyone just go out there and spray their crops?

L: Yeah, anyone can spray. I can go buy pesticides and spray them on my farm any time. No, they are not certified.

M: So, it is about the knowledge then that they need the knowledge to know how to operate, and know that they can save money and that it is better for the environment if they the exact amount and how to spray.

L: Basically, they use the agro-dealers and agro-vets in their areas to sort of tell what they need to spray according to which kind of crops they are growing, they correct usage for spraying. But you don't need a certificate to spray and you don't need to have someone to come and spray for you if you don't want it. Most farmers actually spray for themselves.

M: We read that there has been this subsiding programme for the fertiliser. But the chemicals, they are sold privately, right? Or is this also through the government? Is it connected or?

L: Yeah, there is the subsidise fertilizer programme. But actually, a lot of fertiliser and pesticides are sold through the private sector. And the government only supply around three percent in terms of subsidy and the remaining fertiliser consumed locally is sold by the private sector. In terms of pesticides, there is no subsidy around that, so everyone does want they want. So, it is private sector.

M: But can the smallholder farmers, can all of them afford fertiliser? Because we have seen that the level has gone up in recent years due to climate change, and there is more pests and diseases, and also because it has gotten cheaper. But is it a common thing now among the farmers and a thing that everyone can afford more or less? From your experience, does every farmer use it nowadays in Kenya?

L: No no no. Not all farmers can afford and not all farmers can afford the correct fertiliser or pesticides for the crops they are spraying. So, you will find that the farmers that cannot afford the right fertiliser would probably use manure from their cows or compost manure from anything that they might have. But most farmers would really want to use fertiliser and pesticides. In terms of pesticides, one of the key challenges, even around food safety, is that the farmers who cannot afford a particular pesticide would go for an alternative one for different pest and spray it, so it could be an insecticide that they spray as a pesticide. So, that is really dangerous and it happens a lot.

E: We also read that they use fake chemicals and that there is a big market for fake chemicals as well.

L: Yeah, there is a big issue of counterfeit products. So, a farmer would probably go an agro-dealer and buy a particular pesticide but it is counterfeit so it is not working but they keep on spraying and spraying and spraying. But most of the farmers that are into commercial farming

would squeeze themselves to go and buy fertiliser and pesticides. For example, there are crops that you can buy, one of them are local greens that would not really require pesticides, and even fertiliser is not a must, you can grow without, it does not really need it. Those ones are mainly organic the local greens. But high value crops like, tomatoes, cucumbers, you really need to spray because of the appearance of pests.

M: But it sounds like, as you say, that one of the problems are that they are not knowledgeable on how to spray and when and also the financial part as they cannot afford the right stuff and maybe they are not aware how to do.

L: Yeah, and especially for fertiliser. They have been using the same fertiliser for years so one of the things they are also not doing is ground testing, all though there is a very big drive around soil testing asking farmers to test their soil. Because there was a lot of leaking going around to the rivers, to the lake, from the fertiliser they are using that is really not needed. So, if farmers are taking the time to test their soil, they may find out that they really don't need a particular fertiliser.

M: The farmers we talked to, it was a big problem for them that they could not afford this soil test. But do you know if any counties considered to subsidy or support soil testing? If that is on the policy agenda?

L: There are two counties that are subsidising soil sampling. One of them is Bungoma county. They have a lab box that they bought from Soilcares and they are subsiding soil testing. People can also go to KALRO and test their soil. It is a bit subsidised but it takes a while for the results to come out because there are so many tests. They can also test their soils at KEPHIS. But there are also private companies like Soilcares, there are a lot of private companies around where people can test their soil. We also in particular have a business case around soil testing, where they use a technique from Soilcares and then it is instant. The farmers get the results instantly and they don't need to wait.

M: What is the price for a soil test?

L: It depends on the level of the test you want. A particular test for just testing the soil would be around 2,000 – 2,500 KSH but if you want a more intensive test that looks even at the organisms, the biological, if you have any bacteria, these costs about 4,000 KSH.

M: Of course, that is a big investment for a smallholder farmer who has nothing right.

L: It is but it is actually the mind-set for them. Most of them to do have the 4,000 KSH but the problem is that they cannot see the economics of doing it, which is what we are trying to get them to see. If you test your soil for 4,000 KSH, you have probably bought fertiliser for 4,000 KSH, but this tells you not to buy the fertiliser, then you are actually saving money. And they have seen that. But one of the challenges around soil testing is that it is taking a lot of time.

E: Yeah, I guess you need to inform them about the benefits they can get out of this investment. If they invest in this one time, this will save them from a lot of investments in the future, and it will help them to increase their production and be more efficient but I guess you have to educate them about the benefits before they understand it.

L: Yes, that has been one of the key things to educate the farmers about the benefits of soil testing. Because it saves them a lot.

M: In terms of climate changes, have you seen a big change in the last years in terms of are the farmers trying to be proactive, are they changing, are they using more pesticides and fertilisers? Or have you seen changes in their practices due to climate changes?

L: Well in the last couple of years, we have had a lot of changes especially in terms of pests and diseases. One of the pests that has been a problem is one for tomatoes. Initially, it was not a pest that was in Kenya, it came from the north. So, pests for tomatoes has been one of the biggest issues. Companies have really tried to innovate around this pest, which really have helped the farmers to reduce the spraying too much but it is true that in the last couple of years, we have a lot of problems with pests and diseases. Even diseases have been changing. The weather has really changed and it is becoming different. When it is cold, it is very cold and there is a lot of frosting around our crops. So, some farmers have gone into greenhouse farming. So, they are also trying to be more resilient around it. The weather patterns have also really changed. For example, last year we had drought and this year we have had too much rain so there is a lot of flooding. So, we are really not sure what to do. But the metrological department are really trying to keep focus and the farmers are keen on it as the majority rely on it for income. So, everyone is doing the best they can. But apart from that, they are trying to be resilient the best they can. They are storing water in water ponds or tanks intercropping with different crops. They are also going back to the local vegetables instead of the hybrid ones because they are more resilient to crops or diseases.

M: We also talking to a county extension officer from Kiambu county and she also said that her impression was that many of the smallholder farmers say they are farming to earn money but for many it is also a hobby so they often do not see the business case or do not think that it might be good to get their soil sampled. Is it also your impression that many of the farmers do not think of it as a business and that is just something they do? Traditional?

E: It is more so that they can afford the basics but when they are able to afford that, they do not really think further and think that maybe they could get more out of their production or be more efficient? Is this also something you see?

L: Yeah, that is basically how it is. Most farmers also have different sources of income. So, for example, they are a teacher who has a farm and the farm has a few goats, cows and chickens and there is a place where they plant. So, most of them are not doing it as a business. But that is why we are here to really show the business side of it. And there are some that are business-oriented. Most small-scale farmers are not but large-scale farmers are. But in terms of small-scale farmers, one of the key issues is that they don't keep records so they do not know if they are making a loss or a gain. So, when you tell them that they could probably reduce their cows from 7 to 2 and explain why, they really don't see the incentives and they are not seeing the business. But there are some that are, especially the ones that are in horticulture. Because horticulture are very high value crops, so they are really keen on it but there is still the problem of records.

M: Do you collaborate closely with the county extension services in your project?

L: Yeah, we work with the counties and therefore also the county extension officers. They do have a bit of a different mandate from us. Also, there are not many in the county, so they are really stretched and do not reach as many farmers in their county as they would like. So, we also work with agro-vets. The agro-vets in these areas are sort of a one-stop-shop as they have the products but hey also give advice to the farmers and spread their information to the farmers. They are one of our key stakeholders. They are very important to us.

M: Would you say that the county extension officers do not reach a lot of farmers?

L: They don't reach all farmers. They are very few and we have a huge population. There are not enough.

M: But is this something the government want to put more money into then? Is that on the agenda?

L: It is per county because it is devolved and every county would have their own agenda around it. Not all counties are agricultural, some are, and therefore some would have more emphasis on agriculture than others. You find a county like Trans-Nzoia, they have a lot county extension officers because they are very big in maize so they put a lot of emphasis in that because of the issues around maize production. So, it goes county by county. And also, the focus is very different for each extension officer. For example, in Kiambu, there focus is on milk so they would really be more interested in the milk production in the area and how the cows are feeding etc.

M: What about seeds? We heard that seeds were a big problem. A that depending on the quality, this could lead to an increased use of fertiliser and use of more pesticides. But we were told that they actually buy the seeds from certified shops but even then, the quality is not good and this leads to a lot of problems and diseases?

L: It depends on the crops. There are for example people who plant grains, they have access to certified seeds because the seeds are not very expensive like for horticulture or potatoes. Issues for seeds are mainly around potatoes because that is where getting certified seeds is a problem. It is true that farmers have a problem getting certified seeds that means that the seeds are probably contaminated or when they plant they get a lot of pests and diseases, which eventually will lead them to use a lot of pesticides. For horticulture, they really try to use certified seeds because you cannot reuse the seeds. So, it also depends on the crops. For the crops, where you can reuse the seeds, most farmers would probably reuse them. But for crops that you cannot, you really have to buy certified seeds. If you use certified seeds compared to normal seeds that will really increase your production.

M: We also look, in terms of circular economy, in general, they can reduce external inputs, maintain quality of soil and water, and in terms of, for example, irrigation, how does it in general work for the smallholder farmers? Is the water clean? Do they overwater? Or what is the general practice?

L: It depends on the area. In areas where there is very little water, like Kisumu, you find farmers maybe harvesting water but they are not really looking at the potential for using the water. They want to irrigate five acres with water that can probably only last for half an acre.

So, they end up squeezing the water level for a particular crop. But for most of them, irrigation is not really common because it is very expensive, the equipment itself. Therefore, the agriculture here is mainly rain-fed. But there are areas where people irrigate, especially the ones doing high-value crops. But with the changing climatic condition, there is very little rain coming so they cannot really store and the ones that can store are really squeezing the water that they have to irrigate a very big portion of land. So, one of the key things that we are also doing is to the economics around it. You don't necessarily have to irrigate the whole piece of land.

M: So, they have to learn which crop need the water they most?

L: Horticultural crops actually need a lot of water. It depends on the crop. But if they don't have water, it just dries out.

M: Do they do it by hand sometimes or is it also sprinklers?

L: Yes. They are not using a lot of technologies. The ones that use greenhouses are the ones that mainly use drips. But there are also some that even use drips outside of the greenhouse. Some also use sprinklers. Some flood the land. There are also different technologies around it. There are some sprinklers that make a mist out the rain. But that is a very small portion.

M: But are there ways for them to better be able to collect the water?

L: Yes, the farmers have tanks. Plastic tanks. Some have water ponds that they have dug. Some have underground tanks. It depends on the farmer and the type of space they have. Sone have big space so they would probably do a water pond.

M: Is the water usually clean or is it contaminated? Do you know in general?

L: Yes, a water pond has a lot of contaminants because it is not covered so it is not water that can be diverted to other uses such as in the house or to feed animals. But water that is in a tank can be used in a variety of ways. So, for example, if they have the water tank below ground, they also have to invest in a pump because they have to pump they water and probably have to use electricity to pump the water.

M: What do you find as the mail barriers for farmers to be able to grow their crops more sustainable? Or produce more sustainable in general?

E: Is it terms of knowledge or access to finance?

L: Access to finance is a very big issue for farmers at the moment. Because at the moment the cabinet has a cap rate on the interest rate that banks can lend to. So, they have classified farmers as very risky clients. Also, because banks have taken a risk and it is their strategy and they shy away from lending to farmers. And farmers also do not make it easy because they do not keep records so they cannot show that they have a sustainable business. A lot of farmers need money for working capital, basically to buy inputs and for labour, so they end up not buying enough pesticides or fertiliser or don't have enough labour. So, it really hinders their production and they are not able to be as efficient as they could. Another thing is access to market, farmers do not have a ready market waiting for them. So, you find there are a lot of

production losses. They will produce a product a specific time but there is no market so the crop will just go bad. So, staple markets have also been an issue. So, those are the two things that are happening. There are a lot of pesticides and fertilisers. Inputs are available, locally available, but what is also lacking is for farmers to do their due diligence before planting such as testing their soil. They should check the weather patterns so see if this particular crop should be planted at this particular time. Researching on the different pests and diseases to actually know what to look out for. Because some just come a tell that, for example, planting cucumber is very profitable and then will just okay and go ahead. So, they just jump to the next big thing.

M: So, they need more knowledge overall? Training is key?

L: They need more economic training. Not only training around production but also the business side of it for them to see the business case of it. That is what is most lacking and that is probably what will be our focus for the next year. Not only to make farmers more aware but when you think of it as a business then you have to check your risks before you do something. Just like a normal business.

M: One of your focuses was also on the post-harvest losses. How do work with that? What do you train them in?

L: In terms of post-harvest losses, we work with companies that are big in value addition. For example, we have a business case where we work with companies who do drying for mangoes. We are working with a company that does ketchup so they are drying the tomatoes. We are also working with farmers to teach them about storage beforehand. We have companies that for potatoes are investing in huge storage for them to be able to store the potatoes at optimal level so they can keep them fresh. This is also good because then they can wait for times when prices are not so low and then they can sell them. So, storage is very important. Handling at harvesting level is also another thing that is very keen. Because a lot of post-harvest loss occur at farm level and transportation. So, we also try to work with logistic companies that are involved in transporting produce. Especially, in coming up with trucks with cooling.

M: But do the farmers also know how to reuse it? As compost for example? Is that also a focus?

L: Yeah, some of the crops like macadamia and coffee are some of the things that are really reused. The focus is that most of the farmer should not have any surplus of produce. But a lot of reuse is done from livestock. They have the bio digesters for the livestock manure so they can also use the energy from the biogas to cook or serve as electricity in their houses.

M: But how many have the bio-digesters?

E: Is it common? Do you think?

L: They are fairly common. There has been a lot of push towards climate change and the reuse of manure from livestock. So, you see a digester in maybe one out of four homes depending on if they have livestock. But the ones that does not have livestock, it does not make sense. They do something else. But you will find a lot of farmers who use manure from livestock as an alternative to fertiliser. Because fertiliser is expensive.

M: That is also what we experience. But many of the farmers said that it was a problem that they could not afford to invest in more livestock? To invest in one more cow was too expensive so instead they had to invest in fertiliser. Again, the financial part impeded them.

L: Also, investing in one more cow is expensive not only in terms of buying but maintaining it. So, it is actually easier just to buy fertiliser.

M: But I guess all the farmers who have livestock are aware of how they can reuse it? Or do you see some farmers who don't know?

L: Yes.

M: So, that is common practice?

L: It is common practice to reuse. It is done in every home, every household. If they have the bio-digester, they use that. Otherwise, they will just let it dry on their farms that is common.

M: So, it is only when they have used all of their own resources that they will start to buy fertiliser?

L: Yeah, and mainly because they don't know what their farms are lacking. Then it is just common practice to take the manure and put it in the soil, let it plant. But maybe, if they knew, it would be much easier.

M: You think one of the keys is to educate the consumer to ask for more sustainable products? That is one of the key things in order to change practices for the farmers?

L: Yeah, I think consumers really need to come out and demand to know where is this product from, when was it harvested, has it been tested as food safe. So, I think if we want a change, it has to come from consumer level. Because the farmers can only work with what is being demanded. If there is no demand for food safety, then they will not get it. So, I think that is one of the biggest things. Because if they will produce food that no one will buy, then that will make them conscious about it and they will start to change.

M: But do you also think that it is something at governmental level? That they have to start to advertise healthy food? I know it is a focus but do you think that they could do even more?

L: I think the government and the Ministry of Agriculture and the Ministry of Health they need to try this and they need to ask consumers to demand for it by advertising it. That is the only way they will get the farmers to adhere. They could also have bans around the local markets or things like that to make sure that the farmers adhere to that and that the traders also adhere to that so that they are not selling food that is not safe.

M: If KEPHIS is coming and controlling, do they actually sometimes give fines to the smallholders if their pesticides levels are too high?

L: No no no. Only for the export market they do. They ban an area or a particular product from a certain place. But for domestic, there are no fines. There is no penalty for producing food that is not safe. There are no incentives for the farmers. Also, a lot of product that has been rejected for export end up coming to the domestic market because it has to be sold somewhere.

Appendix 11: Interview Guide

Introduction

Background

- Two students from Copenhagen Business School in Denmark
- In Kenya on a field trip to collect data for our master thesis regarding smallholder farmers in Kenya and their circular economy practices.
- Our link to Kenya

Elaborate on CE and why we have chosen to investigate this and why we want to interview the farmer.

Research question: What are the main determinants for the smallholder farmers in the horticulture sector in Kenya to adopt circular economy practices and how do these impact the implementation?

Framework of the interview

- Length of interview
- Which kind of information do we want
- Inform about anonymity and confidentiality
- Clarify that the farmer can stop the interview at any time, ask questions, get points clarified etc.

Themes

Background knowledge

- Information about the farmer, the farm, crops, size, employees, neighbourhood, etc.
- Explanation about their practices and if possible get shown around on the field
- Changes of practices over the years
- Prope on practice related to our CE understanding:
    - Reduce, reuse and recycle in general
    - Minimising and controlling external inputs
    - Closing nutrient loops
    - Maintaining the quality of soil and water
- Relate all their practices to our framework with proposed determinants. Why have they undertaken the given practices/why haven't they

Knowledge of concept/practices: Knowledge about own practices, CE, sustainable agriculture, what a does change take etc.

Social/cultural: Environmental awareness, own values and beliefs, norms, habits, neighbours, farming groups, family.

Institutions/governmental: Regulative (national laws/regulations + county laws/regulation), NGOs, export company, other institutions - how do they impact their knowledge, practices and environment.

Financial/economic: Access to finance. Encouragement/discouragement.

Technical: Availability of solutions/inappropriate technical solutions.

Market: Access to market, demand, information etc.

Environmental constraint: Any changes in climate affecting their practices?

Other areas we have not covered important to them?

Debriefing

- Summarise points
- Contact information

Appendix 12: Interview Coding

Theme	ID	Quote
Existing Knowledge and Awareness	1	"We have learned to do uniform spray coverage and apply the recommended spray rates with adjusted equipment."
Existing Knowledge and Awareness	1	"The soil sampling informed me about the fertility of my soil and afterwards I actually saved money as I could by less and the right fertilisers."
Existing Knowledge and Awareness	1	"the ones [produce] you reject, then you recycle to be raw manure."
Existing Knowledge and Awareness	1	"We use the manure from the cow. You gather the manure, then after covering it, you cover it with the polythene paper, and then wait for it to dry. After it has dried, you go into the process of the composting. After the composting, you turn them for about three months. After the first month then you turn it, another month you turn it, and another month. At that time, all the bacteria, all microbe have been dead. So, then the manure will be ready to use on the farm."
Existing Knowledge and Awareness	1	"But we are trying to minimize by keeping the field clean, so if you put the field clean, it means it will reduce the pesticides. If you feed the crop to be healthier, you put manure, you put fertiliser, it means the crop will be healthy, it will be tolerant towards diseases. It will control the usage of pesticides. "
Existing Knowledge and Awareness	1	"Some think about the conservation and producing for the conservation of the environment. Others don't. So, with those who are thinking that it is better to farm and protect the environment because of how the climate change is going. Because, as I told you, of the water resources. We have to protect that mountain [Aberdare Mountain] for us to be able to get continuous supply of water. If you destroy it, it means water will stop."
Existing Knowledge and Awareness	1	"Some farmers are doing some agro-foresting in their farms. So, they are doing it may be commercially and others are doing it commercially and for the environment like myself."
Existing Knowledge and Awareness	2	"I have compost and manure. The manure I cover with a polythene bag and dry it. On the third month, I take it to the shamba (field)."
Existing Knowledge and Awareness	2	"But if I knew my soil better and get the right information, then maybe I wouldn't even use one drop of pesticides."
Existing Knowledge and Awareness	2	"Some of the farmers are aware and many are reusing resourcing."
Existing Knowledge and Awareness	2	"I considered to change to organic farming, but I needed someone that could train me. It is better, because the chemicals are affecting the people and the environment. It is only that we had no one to sponsor and lacked information."
Existing Knowledge and Awareness	2	"I need a separate sample from my own soil to know how to grow the crops the best way. If we get the right information we could use less pesticides."
Existing Knowledge and Awareness	3	He uses the manure of the livestock for his shamba [fields].
Existing Knowledge and Awareness	3	With the livestock manure, he puts it in a hole and let is dry with the sun for approximately 3 months and then he takes it back to the shamba [fields].
Existing Knowledge and Awareness	3	He has some knowledge on the usage of pesticides but he would like more training on the problems of pesticides. He has already attended some training but he would like some more.
Existing Knowledge and Awareness	3	He has received agricultural training on how to use and dispose in the best manner to protect the environment. But again, he would

		like some more training.
Existing Knowledge and Awareness	3	(…) he lacks knowledge on the processing of manure for organic farming. So, if he could more training and had the financial means, he would consider it.
Existing Knowledge and Awareness	3	(…) he had sprinklers. However, he said that he and other farmers in general do not know the right amount of water to use. By knowing their crops better, they would know where to use their water most efficient.
Existing Knowledge and Awareness	4	"I use some of it, for example the manure, and spread it on the field, but I don't have a lot of knowledge in how to use it the best way."
Existing Knowledge and Awareness	4	"I have heard that it should be better to dry the manure with that [polythene bag], however, I am not able to invest in one and I need some knowledge, so I know how to use it."
Existing Knowledge and Awareness	4	"I use more now than I did some years ago. It is easy to get. However, I am still trying to take care of the environment. I know it is not good if the pesticides residues get into the spring, because it will affect the people here and our children in a bad way."
Existing Knowledge and Awareness	4	"I don't have any knowledge of the practices [of organic farming] and what the change involves, if its economically beneficial, so I have never considered to change."
Existing Knowledge and Awareness	4	"I hope that we could get more training in better practices. I know that the county government has taken samples of some farmers soil. If I knew which kind of fertiliser my soil needed and how much, I would be able to grow my crops better and maybe use less fertilisers."
Existing Knowledge and Awareness	5	"I use all the manure I have and mix it with remains from the maize."
Existing Knowledge and Awareness	5	"I keep [the manure] it for one year and let it dry. It's the same procedure every year."
Existing Knowledge and Awareness	5	"They learned us that if we don't use pesticides properly, it will spread to the ground water and will make our family and society sick. It is a big problem in Kenya."
Existing Knowledge and Awareness	5	"I have remains from the crops, and as I said, I mix the maize remain with the manure. I also have a separate place for the compost which I spread back on the fields. But usually I mix it with the manure."
Existing Knowledge and Awareness	5	"No that is another problem. It would be more efficient if I knew exactly which fertiliser to use and when. But I have never got a sample of my soil. It is expensive even though it might pay off. But I have never made the investment. This would also be better for the environment. And I could maybe even avoid to buy fertilisers or pesticides."
Existing Knowledge and Awareness	5	"It is too expensive [to convert to organic farming] and I need more knowledge. I would need more livestock and I cannot afford to buy more. Therefore, I continue to buy fertilisers instead because the investment is not as big. I would like to get more informed about more sustainable practices. I think it is better and that you will save a lot of money. And it is better for our children
Existing Knowledge and Awareness	6	"I came to realize that the benefits of organic farming are many. You get healthy food."
Social Capital, Norms and Traditions	1	"For the manure, here I don't have [a polythene bag]. It is at another farm where we can go and see."
Social Capital, Norms and Traditions	1	"The aim of the AFPC is to be able to export with the export

		companies."
Social Capital, Norms and Traditions	1	"So, we have decided to cooperate with other areas within the county. There are some other areas, where there are farmers and the weather is almost similar. So, we collaborate. We said that they can join us on export. So now they are receiving training."
Social Capital, Norms and Traditions	2	"But sometimes I give some to my neighbour. She is old and cannot afford buying fertilisers."
Social Capital, Norms and Traditions	2	"We used to have a small group to help each other. I introduced some of the other farmers to a new crop and how to spray and use water for it."
Social Capital, Norms and Traditions	2	"If one or two changed practices in the community, then everybody in the village would change if they saw it worked well."
Social Capital, Norms and Traditions	2	"So, some of the other farmers use my bag to ban their manure. I think I am the only one in this area that has one."
Social Capital, Norms and Traditions	2	"And as I told, I let some of the other farmers us it as well as they have seen the benefits."
Social Capital, Norms and Traditions	3	In general, he does not really talk to other farmers and exchange knowledge. He does not find that useful. He can figure out for himself.
Social Capital, Norms and Traditions	3	(…) it would be possible for them to get a loan as a group, but then would come the issue of where should the digester [use for the conversion of biogas] be placed for it to be fair for all.
Social Capital, Norms and Traditions	4	"I do what I have learned from my father (…) I have also been visiting other farms."
Social Capital, Norms and Traditions	4	"What I am doing is what I always have learned and what most of the farmers in the area do."
Social Capital, Norms and Traditions	5	"I just put it somewhere on my farm where I always keep the manure. I don't cover it. I just do what my father has been doing."
Social Capital, Norms and Traditions	6	"I do also sell [wastes] to those who have the cows. I just sell to them."
Social Capital, Norms and Traditions	6	"…what I do, I exchange sometimes with my waste and some manure from my neighbour. He needs my leaves for example for his cows and then we exchange for some manure. They give me manure and I give them some waste."
Social Capital, Norms and Traditions	6	"…you find that it is also good to assist other people from those products adding chemicals to free chemical products."
Social Capital, Norms and Traditions	6	"I took over the farm from my parents so I learned from them."
Social Capital, Norms and Traditions	6	"I have a group even now today. They are also doing organic."
Social Capital, Norms and Traditions	6	"…we are not all from the same area [group members]. However, we do visit each other. If I have a problem, like this one for example, they just come 6 of them.
Social Capital, Norms and Traditions	6	"I am trying to bring people together in order to continue with organic farming. Like now, I have an organization (…) Central Organic Farmers and Consumers Organisation. We were many small groups that decided to go together and have one big group to be able to help even more people learn about organic farming."
Social Capital, Norms and Traditions	6	"now you see that I exchange my waste to my friend or my neighbour so I can get manure."
Social Capital, Norms and Traditions	6	"That is why we have started the group I told you about. The certificate I showed you. We wanted to start the table banking. So, we will all contribute a little."
Infrastructure	2	"We have some plastic containers after using the chemicals. And we don't know exactly what to do with them. We have always

		either buried or burn it, because we don't know what to do with it."
Infrastructure	3	The only type of waste that he cannot reuse is plastic and does not know how to dispose.
Infrastructure	3	The reason why he doesn't always the manure is because of the distance between his farms as they are 3 km apart, which makes it difficult to transport the manure from one farm to the other.
Infrastructure	3	"My dad has more livestock than I have but his farm is too far away from mine so it does not make sense to transport his manure. It takes too much time."
Infrastructure	3	"…the problem here is that the distances sometime are too big or the roads are too bad to transport it."
Infrastructure	5	"You also need to calculate the transportation cost and therefore it is better sometimes just to reuse it [produce] on your farm."
Market Conditions and Information	2	"But I need more information about the market also."
Market Conditions and Information	6	"I produce products that I can sell to hotels. And I also sell to individual customers who need my product. I supply them with baskets delivered to them in Nairobi."
Market Conditions and Information	6	"KOAN told us very much about looking for a organic market."
Market Conditions and Information	6	"If I don't take them there to the organic markets, there is an open market here, a local market, where I do sell my products (…) So, the markets are always there. But then you don't sell it as organic. Then you just sell it as normal. Cause you cannot go there and say mine is organic, people will not pay because it is too expensive. So, you just sell it as conventional."
Market Conditions and Information	6	"You know when you have products or goods, you have to go out to look for the market before your products mature. You just walk out. You talk to the people and tell them what you have and ask if they want to buy."
Market Conditions and Information	6	"…the market is not a problem."
Institutions and Knowledge Transfer	1	"With them [export companies], we did the training on hygiene and safety."
Institutions and Knowledge Transfer	1	"The export companies help us to attain the requirements because they have the experience of producing export produce."
Institutions and Knowledge Transfer	1	"We have several trainings for the spray by the spray providers SSP. We have those trainings. The training was done by the AAK."
Institutions and Knowledge Transfer	1	"We have a collaboration with PCPB."
Institutions and Knowledge Transfer	1	"We have done training of horticulture export. Management on how to do export and the requirement of the export market."
Institutions and Knowledge Transfer	1	"We have done the soil sampling by the KEPHIS as well as water and produce."
Institutions and Knowledge Transfer	1	"It is only the chemicals containers we cannot use. With the chemical containers, we put them in the storage there. Those ones are then collected by the AAK. The export companies hire a person who comes and collect them to be taken to be destroyed."
Institutions and Knowledge Transfer	1	"The export companies issue the chemicals that are allowed to be sprayed for their crops. "
Institutions and Knowledge Transfer	1	"Then we have the county, which is helping us to facilitate some training on the good agricultural practices."
Institutions and Knowledge Transfer	1	"Then the county is doing a bit of effort to buy fertiliser for the farmers on subsidiary costs (…) But also, the fertiliser from the county is not reliable because it not continuous. It comes once per year so if you don't have cash on that time that means that you

		won't get the fertiliser."
Institutions and Knowledge Transfer	1	"The extension officers have tried to teach farmers on the recycling of the plant crop, how they can recycle them to be farm manure."
Institutions and Knowledge Transfer	1	"We have an NGO called WWF, it is doing a lot and helping farmers with the conservation of soil not only to farm but to farm and conserve the soil. The conservation of soil, they strip the soil and protect it not to go in the rivers and to avoid erosion. For the rivers to have clean water. Some have also planted grass strips for this purpose. So that organization is helping farmers."
Institutions and Knowledge Transfer	1	Also, we have these export companies, who are training farmers on waste management. Even we have a file for the waste management. It says what do I have, what can I do with it, if it is a fertiliser bag what do I have to do with it, waste products, etc."
Institutions and Knowledge Transfer	1	"They [export companies] also help us on which seeds to buy. Sometimes we can buy them directly but not always and then we go to the agro-vet. But in general, it is a problem that the seeds are bad. "
Institutions and Knowledge Transfer	1	"In order to get the global crops certificate, we must be trained and audited and then we will be given a certificate."
Institutions and Knowledge Transfer	2	"Yes, I went to a seminar. I don't remember who did it. But there were several seminars. We were taught not just to put the waste back on the fields right after collecting is as they might have diseases after harvesting. So, it is good to bring it all together and ban it for some time. And then you can use it as compost. And you can avoid using pesticides."
Institutions and Knowledge Transfer	2	"Long time ago, I attended a training from an export company. But that is back in 2011. Here we learned about pesticide use. We learned how much to apply and when."
Institutions and Knowledge Transfer	2	"KEPHIS was here in 2012 to give advice on the crops and good practices. They told about the process of how the crops are tested and verified in terms of pesticides level."
Institutions and Knowledge Transfer	2	It was a seminar we attended, who told us [about the polythene bag]. Supported from the county government. Also, an export company exporting snow peace has come and told us that it is a good way to do it."
Institutions and Knowledge Transfer	2	"The current county government that was elected recently, they came with a new way to do samples. But they have not been here (…) They should come and take samples from our soil, so we know which fertiliser to use.
Institutions and Knowledge Transfer	3	The information about reusing of the manure was something he learned through agricultural training offered by the county government.
Institutions and Knowledge Transfer	3	KEPHIS comes and takes tests of the soil (…) He explained that he got a sample taken years ago but had not been able to do it again.
Institutions and Knowledge Transfer	4	"…an exporting company has been teaching us in how to use pesticides."
Institutions and Knowledge Transfer	4	"I try to avoid the use by applying practices learned from the export company. For example, my planting times have now been adjusted to avoid some pests. But I would like more information on what is needed for my soil to produce in a way that hurts the environment the least."
Institutions and Knowledge Transfer	4	"KEPHIS is here, they come with good advice on better practices and also give information about what is required from the export

		company. Many years ago, I took part in a training from the county government, but I don't remember exactly what we learned."
Institutions and Knowledge Transfer	4	"The exporting company is the one that gives me most knowledge."
Institutions and Knowledge Transfer	5	"The fertiliser prices are changing a lot. The county government is in charge of it, but they often sell it to middleman who mixes different kind of fertiliser and other stuff, so you don't get what you need. I have tried many times to use fertiliser where nothing happened even though I used a lot. You don't know what you get and it might be bad for the crops. The middle men earn a lot of money (…) The middle men have some contacts in the county government and get the license to sell it and can sell it for an over price. The county government also earns money that way by being paid by the middle men."
Institutions and Knowledge Transfer	5	"Fertilisers used to be more expensive and got cheaper because the government started to subsidise it. Therefore, more farmers have been able to afford it. However, now the market it's getting more unstable due to corruption. Also, when the fertilisers don't work as they should because you don't know what you get, you automatically use more because you think more is needed or you try another fertiliser. Often the middle men come by your form to sell it, so it is not difficult to get. "
Institutions and Knowledge Transfer	5	"I have never attended any training and I have never engaged with KEPHIS. I know them but I have not talked to them. They have not tested my crops."
Institutions and Knowledge Transfer	6	"It was an organization actually who were supporting us all getting into organic farming. The organization is called SACDEP. First, they came and pitched the idea. They told us about the kitchen garden. They told us don't put any chemicals in that. And from the kitchen garden, we just moved on to the farm."
Institutions and Knowledge Transfer	6	"…they [SACDEP] just came here and told us about organic farming. They told us about organic manure and composting manure. They also told us to use our indigenous pesticides during farming."
Institutions and Knowledge Transfer	6	"KOAN sometimes they call us about seminars. SACDEP also about seminars. They do assist us with that, seminars."
Institutions and Knowledge Transfer	6	"…in Kenya, from the highest officer in the national government to the ground officer, they are not supporting organic farming."
Institutions and Knowledge Transfer	6	"…the government does not make any money. But because they have chosen to subsidize the fertiliser, this has created more awareness."
Institutions and Knowledge Transfer	6	"when we started, SACDEP did help us a lot. Cause they told us and gave us materials to build cages and supplied us with rabbits. SACDEP supported us a lot. It is only the SACDEP organization who did a lot to farmers. They changed some farmers from conventional to organic. They did very good work."
Financial Access and incentives	2	"…to invest in livestock is more expensive but in the long run it is advantageous if I could afford it. If I could buy three cows, I could for example use them for 10 years, but the fertiliser I have to buy all the time."
Financial Access and incentives	2	"There is a bank that we usually deal with, equity bank, because I am a customer, but the interest is high for the farmers."
Financial Access and incentives	2	"They are expensive. Therefore, I try to use my own resources."
Financial Access and incentives	2	"I had to go to Nairobi, because the ones around here [polythene

		bags] I could not use. (…) It is too expensive."
Financial Access and incentives	2	"I heard it was a good investment. After getting the polythene bag, the I banned the manure and covered it with the polythene bag, I almost got the double amount from my crops (…) It also means that we use less fertilisers."
Financial Access and incentives	3	He thinks there is easy access to fertilisers. But that they are expensive, which makes it difficult to get.
Financial Access and incentives	3	He would like to get more livestock as he believes the manure from the livestock is doing very well. However, it is too expensive of an investment and he cannot get a loan. Thus, he uses the pesticides instead even though he knows that manure would be cheaper in the long run.
Financial Access and incentives	3	In terms of financing, he explained that there was easy access to loans, however, they came at a high interest and with a very short payback period. Also, you would need to be able to come up with some sort of guarantee, which farmers usually don't have.
Financial Access and incentives	3	(…) it would be an idea to incorporate education on the financial aspect (how to reuse and put all money into farm) into training as well.
Financial Access and incentives	4	"I have heard that it should be better to dry the manure with that [polythene bag], however, I am not able to invest in one and I need some knowledge, so I know how to use it."
Financial Access and incentives	5	"I have 8 livestock. I used to have 12, but I needed cash so I had to sell some of them. For a cow, you get approximately 25.000 shillings. Many farmers often need to sell some of their livestock if they need money. The livestock is very important for them, but they cannot get any loans so this is the only way for them to get cash if they need it."
Financial Access and incentives	5	"That is way I would like to produce more organic, but I cannot afford to change. "
Financial Access and incentives	5	"No that is another problem. It would be more efficient if I knew exactly which fertiliser to use and when. But I have never got a sample of my soil. It is expensive even though it might pay off. But I have never made the investment. This would also be better for the environment. And I could maybe even avoid to buy fertilisers or pesticides."
Financial Access and incentives	5	"It is too expensive [to convert to organic farming] and I need more knowledge. I would need more livestock and I cannot afford to buy more. Therefore, I continue to buy fertilisers instead because the investment is not as big. I would like to get more informed about more sustainable practices. I think it is better and that you will save a lot of money. And it is better for our children."
Financial Access and incentives	6	"My wife was sick for a long time so I had to sell them [livestock] for her treatment."
Financial Access and incentives	6	"That is also one of the benefits of organic farming. The costs are less than with conventional farming because you don't need to buy pesticide, fertiliser. You use only compost and manure from cows. Thus, the expenses are less than with conventional. You have larger gains than with conventional. So since, I started to farm organically I have never needed help. I am suiting myself."
Financial Access and incentives	6	"we pay that amount alone [for the organic certificate]. As a person. So, you see it is very expensive and not every farmer can afford it."
Financial Access and incentives	6	"…if I did have the money to buy, I would have at least two cows

		right now. That would be enough."
Financial Access and incentives	6	"…not a loan. As a small-scale farmer that is very difficult. Because the interest is incredible. It is just too much. Otherwise they will come and sell your land. So, loans are too expensive. It is not an option."
Social Capital, Norms and Traditions	6	"That is why we have started the group I told you about. The certificate I showed you. We wanted to start the table banking. So, we will all contribute a little."
Climate Change	1	"Yeah with the weather here, you have to use the pesticides."
Climate Change	2	"We use more know because we are getting more pests than before because of the weather."
Climate Change	5	"…because the climate has changed and is more unreliable, I have used more [pesticides] the last years."
Climate Change	6	"The most challenging factor is weather. Climate you know. And sometimes it is not good. Sometimes the rain is too much and I cannot use chemicals."

Appendix 13: Overview of Policies and Regulations in the Horticulture Sector

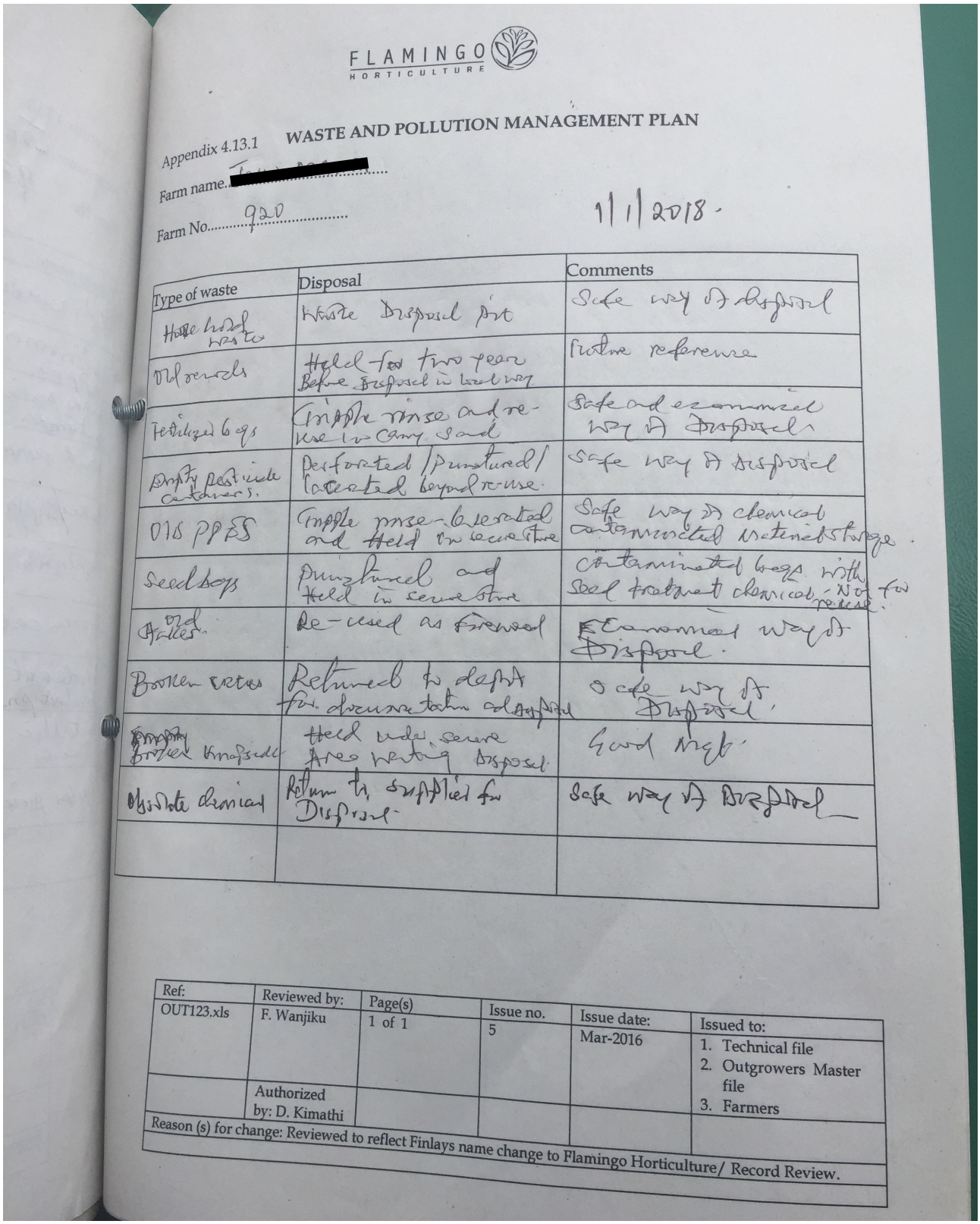
Table 7: Policies and regulatory frameworks

1. Policies	
	Main thrust
National Food and Nutrition Security policy	• The policy thrust is to achieve good nutrition for optimum health of all Kenyans; to increase the quantity and quality of food available, accessible and affordable to all Kenyans at all times; to protect vulnerable populations using innovative and cost effective safety nets linked to long term development.
National Agricultural Sector Extension Policy (2012)	• The main objective is to empower a pluralistic extension clientele through sharing information, imparting knowledge and skills and changing attitudes to enhance technology and innovation adoption. In this regards linkages and partnerships with extension agents are crucial for deployment of comprehensive outreach strategies for the purpose of creating value.
National Agricultural Research System Policy (2008)	• The Policy aims at facilitating the prompt application of agricultural research results and services to enhance productivity and economic growth; and promoting private sector and non-state institutions engagement in research and technology transfer
National Land Policy (2007)	• The policy aims to guide the country towards efficient, sustainable and equitable use of land for prosperity and posterity. Key issues the policy addresses are constitutional, land tenure, land use management, land administration, and land issues requiring special intervention. The Land Act (GOK, 2012c) mandates the National Land Commission to reorient the use of land as a productive asset, rather than a prestige title. This could increase access to land through renting for productive purposes and innovations.
National Horticulture Policy (2012)	• The broad objective of the policy is to accelerate and sustain growth and development of the horticultural industry in order to enhance its contribution towards food security, poverty reduction as well as employment and wealth creation. Specific policy objectives are to: facilitate increased production of high-quality horticultural produce; enhance provision of the sub-sector's support services like finances, insurance and technical advisory services; promote value addition and increase domestic and external trade; develop and improve
	infrastructure to support the horticultural industry particularly in major production areas; and promote horticultural investment in the ASALS.
The National Seed Policy (2010)	• Outlines the intervention measures to be implemented by the seed sub sector to provide guidance to the industry to sustainability avail adequate high quality seed and planting material to the users and harmonizing all seed related activities.
Agricultural Sector Development Strategy (ASDS) (2010 – 2020)	• The overall national strategy document for the agricultural sector ministries and other stakeholders in Kenya. The main objectives include: increasing productivity; commercialization and competitiveness of agricultural commodities and enterprises; and developing and managing key factors of production.

National Agri-business Strategy (2012)	• The objective is to bring about a highly productive and efficient agribusiness sector, competitive both locally and internationally. The strategy emphasises the need to encouraged private sector organizations in development of diversified agricultural and food products, which are essential for improving the competiveness of the sector.
Sustainability Strategy for Regional Development Authorities (2010)	• The goals include promoting integrated economic development through sectoral value chains and spatial concentration of infrastructure facilities and stronger linkages between zones; to enhance productivity and skills as well as firm competitiveness and expansion of export markets and diversification of export products.
2. Legislations	
A. Input related legislation	
Seed and Plant Variety Act Cap 326	• Regulate transactions in seeds, including provisions for seed testing and certification; establishment of an index of names of plant varieties; control on introduction of new varieties; seeds importation; to authorize measures to prevent injurious cross-pollination; management of proprietary rights to breeders or discovering and developing new varieties; and arbitration on seed matters.
Fertilizer and Animal Feedstuff Act Cap 345	• Regulates the importation, manufacture and sale of agricultural fertilizers and animal foodstuffs and substances of animal origin intended for the manufacture of such fertilizers and foodstuffs, and to provide for matters incidental to and connected with the foregoing.
Pest Control Products Act (Cap 346)	• Regulate the importation, exportation, manufacture, distribution and use of pests control products and bio-control products of plant and animal origin.
B: Production and GAP related	
Agricultural Act Cap 318	• Governs agriculture production including conservation of the soil and its fertility and to stimulate the development of agricultural land in accordance with the accepted good land management and agricultural practices.
Crop Production and Livestock Cap 205 (1948), Act No. 47 of 1949	• Provide for the control and improvement of crop production and livestock, and the marketing and processing.
Plant Protection Act Cap 324	• Governs prevention of the introduction and spread of pests and disease destructive to plants.
Crops (No.16 of 2013)	• Developed in 2013 to consolidate and repeal various statutes relating to crops; and to provide for the growth and development of agricultural crops and for connected purposes.
Biosafety Act 2009 (CAP 321 A)	• Regulates activities in genetically modified organisms, to establish the National Biosafety Authority, and for connected purposes
Environmental Management and Coordination Act) (EMCA) (CAP 387No. 8 of 1999	• Constitutes the legal and institutional framework for the management of the environment and for the matters connected therewith and incidental thereto.

Irrigation Bill (2015)	• An Act of Parliament to amend and consolidate the law relating to sustain able development and management of irrigation for the socio-economic development in the country; to align existing irrigation laws to the Constitution of Kenya 2010, to repeal the Irrigation Act, Chapter 347 Laws of Kenya; and for purposes incidental thereto and connected therewith
Kenya Standard 1758: Part II Fruits and Vegetables	• This is the Horticulture Code of Practice that specifies the requirements for legal compliance, the responsible procurement of inputs, safe production, handling and marketing of fresh fruits, vegetables, herbs and spices. It applies to all players in the industry including but not limited to growers, propagators, plant breeders, seed merchants, consolidators, transporters, shippers and cargo handlers.
C: Aggregation & Quality related	
Agricultural Produce Act (Export) Cap 319	• Provides guidance on the grading and inspection of agricultural produce to be exported, and generally for the better regulation of agricultural manufactured products.
Agricultural Produce Marketing Cap 320	• The Act aims to control and regulate the marketing of agricultural produce, establishment of marketing boards.
Food Drugs Chemical Substances Act Cap 254(Rev. 2002)	• An Act of Parliament to make provision for the prevention of adulteration of food, drugs and chemical substances and for matters incidental thereto and connected therewith.
Public Health Act Cap 242(Rev.2002)	• An Act of Parliament to make provision for securing and maintaining health.
D: Marketing and Export related	
Standards Act Cap 496	• Governs the standardisation of the specification of commodities, development of standards for various commodities and codes of practice; and creation of the Kenya Bureau of Standards for the management of the same.
E. Business Support Services	
Science and Technology (Amendment) Act, Cap 256, 1979	• The Act was established to coordinate matters relating to scientific and technological activities as well as the coordination of research and experimental development. The Act establishes the National Commission for Science, Technology and Innovation (NACOSTI) charged with the responsibility of advising the government on a national science policy, the scientific and technological requirements for the conservation of the natural and social environment and the transfer of technology into agriculture and industry.
The Export Processing Zone (EPZ) Act, Cap 517, 1990, revised 2012 and 2015	• The Act created the Export Processing Zones Authority (EPZA) as the regulatory body. Investors in EPZs benefit from a range of fiscal incentives. These include a 10 years tax holiday followed by a 25 percent at tax for the next 10 years; exemption from all withholding taxes during the first 10 years; exemption from import duties on
	machinery, raw materials, and inputs; no restrictions on management or technical arrangements; and exemption from stamp duty and from the VAT on raw materials, machinery and other inputs.

Appendix 14: Waste Management Plan (Example from farmer 1)



FLAMINGO HORTICULTURE

Appendix 4.13.1 **WASTE AND POLLUTION MANAGEMENT PLAN**

Farm name. [redacted]

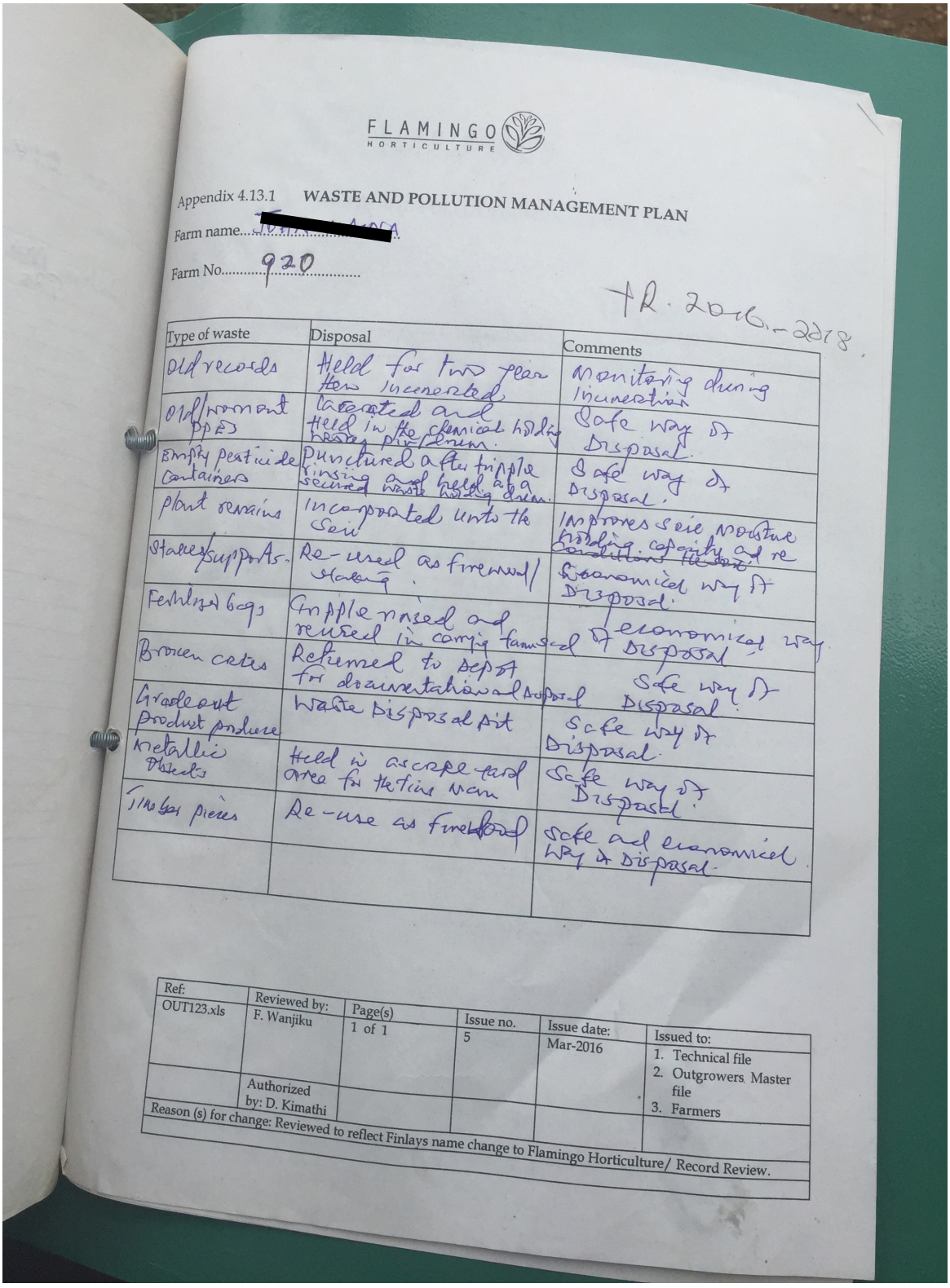
Farm No. 920

1/1/2018.

Type of waste	Disposal	Comments
House hold waste	Waste Disposal pit	Safe way of disposal
Old records	Held for two years Before Disposal in best way	Future reference
Fertilizer bags	Triple rinse and re-use in carry sand	Safe and economical way of Disposal.
Empty Pesticide containers.	Perforated / punctured / Incerated beyond re-use.	Safe way of Disposal
Old PPES	Triple rinse - Incerated and Held in secure store	Safe way of chemical contaminated materials storage.
Seed bags	Punctured and Held in secure store	Contaminated bags with seed treated chemical - Not for reuse.
Old Files.	Re-used as Firewood	Economical way of Disposal.
Broken vetes	Returned to depot for documentation and Disposal	Safe way of Disposal.
Empty Broken Knapsack	Held under secure Area waiting Disposal	Good Mgt.
Obsolete chemical	Return to supplier for Disposal.	Safe way of Disposal

Ref:	Reviewed by:	Page(s)	Issue no.	Issue date:	Issued to:
OUT123.xls	F. Wanjiku	1 of 1	5	Mar-2016	1. Technical file 2. Outgrowers Master file 3. Farmers
	Authorized by: D. Kimathi				

Reason (s) for change: Reviewed to reflect Finlays name change to Flamingo Horticulture/ Record Review.



FLAMINGO HORTICULTURE

Appendix 4.13.1 **WASTE AND POLLUTION MANAGEMENT PLAN**

Farm name..... [redacted]

Farm No.....920

TR. 2016-2018.

Type of waste	Disposal	Comments
Old records	Held for two years then incinerated	Monitoring during incineration
Old/worn out PPE	Incinerated and Held in the chemical holding pit/room.	Safe way of Disposal.
Empty pesticide containers	Punctured after triple rinsing and held a a secured waste holding area.	Safe way of Disposal.
plant remains	Incorporated unto the Soil	Improves soil moisture holding capacity and re [illegible]
Stakes/supports.	Re-used as firewood/ Making.	Economical way of Disposal.
Fertilizer bags	Crushed and reused in carrying farmyard	economical way of Disposal
Broken crates	Returned to depot for documentation and disposal	Safe way of Disposal
Grade out product produce	Waste Disposal pit	Safe way of Disposal.
Metallic Objects	Held in scrap yard area for the time	Safe way of Disposal.
Wooden pieces	Re-use as firewood	Safe and economical way of Disposal.

Ref:	Reviewed by:	Page(s)	Issue no.	Issue date:	Issued to:
OUT123.xls	F. Wanjiku	1 of 1	5	Mar-2016	1. Technical file 2. Outgrowers Master file 3. Farmers
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