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Urban agriculture: outsmarting climate change?

The occurrence, perceptions and potential of climate-smart urban agriculture
in the eThekwini Municipality, South Africa

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Abstract

South Africa has stumbled upon a new obstacle before reaching the golden end of Nelson Mandela's rainbow. On a global scale, climate change is hitting Africa the hardest, South Africa being no exception. With limited space, scarce supplies and poor infrastructure, livelihood development becomes a inventive challenge in the poor areas of eThekwini. Urban agriculture, seen in this research as 'agricultural activity within the 'intra-urban' environment', is a strategy deployed by the urban poor to combat these challenges. With the increasing impact of climate change on the municipality, urban agriculture as a pro-poor developmental tool is forced to overcome the effects of climate change to remain an effective developmental strategy for the many urbanites living in poverty. 'Climate-smart agriculture' serves as an umbrella term for this specific strategy, referring to the agricultural practices which help farmers adapt to or mitigate the effects of climate change, sustainably increasing agricultural productivity and incomes. Although this concept is gaining popularity in rural areas all across the globe, its urban counterpart is severely underexposed in both policy and science, especially in Africa. Precisely climate-smart urban agriculture could prove to be an important tool for Durban's municipality, its relevant stakeholders and its urban farmers to jointly engage in. So, is this joint framework actually visible in Durban?. Could it be an effective strategy for these urban farmers to climate-proof their activities. And if it has potential, how can it be promoted? This research centres around these questions, and looks for the answers by including all relevant climate-smart urban agriculture stakeholders, actors and practitioners into this debate. This is done by using questionnaires, a focus group and key-informant interviews. Also, several frameworks and approaches, such as the Sustainable Livelihoods approach, will be looked at and used in this research.

Acknowledgements

The past year has been a wonderful experience for me, as I progressed in my masters International Development Studies. The primary focus during this programme was my three months stay in Durban, South Africa, where I carried out quantitative and qualitative research for my thesis. The combination of field work, literature studies, interviews, meetings and focus groups made it possible for me to get the full picture of a phenomenon I initially knew quite little about, and it gave me an experience and set of skills that are of paramount importance for my future career and aspirations.

Without the help and support of a lot of people, this wouldn't have been the experience it ended up becoming. First and foremost, I want to thank my supervisors in South Africa. I begin with Prof. Dr. Urmilla Bob, who was the first person I met in Durban, and gave me the most warm welcome possible. She was also the one who initiated this internship, together with Dr. Lawal Marafa, whom I thank as well. Second, I want to thank Dr. Sershen Naidoo and Drs. Suveshnee Munien for their unforgettable support during my research, and their kind hospitality during my three month stay. Next, I want to thank Dr. Roshini Bob, Balan Govender, Nombuso Zama and Hayley Hore from the eThekwini Municipality for their help and support. My focus group, during which I also got remarkable aid from Nombuso Zama, couldn't have been prepared without the great support of Phumzile Ndlovu and Liziwe Bentswana. I also want to thank Walter Coughlan, Dr. Nicola Rodda, Ezio Gori, Errol Douwes and Collin Pillay and for their extraordinary assistance. Apart from the questionnaire and interview respondents, above all, I want to thank all the urban farmers in Cato Manor for their humble and kind assistance and hospitality.

Focusing on back home, of course I want to thank Dr. Femke van Noorloos for supervising me, and giving me essential and valuable feedback and critique during the process. My family, above all my mother, and my friends have also been indispensable during the process with their trust and support, and I would like to thank them as well.

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1. Introduction

A recent economic boom has put South Africa, and thereby Sub-Saharan Africa, on today's map of world trade and international business. Dubbed the 'rise of the South', and accompanied by its recent acceptance into the BRIC club, this positive economic development has kindled hope for many South Africans for the future of their country. This nation is currently 20 years into recovery after the Apartheid regime, abolished in 1994, which has left its marks on society (Viljoen & Sekhampu, 2013; UNDP, 2013). However, the road to sustainable economic growth proves to be more difficult than it seems. Various pressures on this growth become clear when looking at various other statistics about South Africa. It's ranked 121st in the global HDI index, the average life expectancy at birth is 53.4 years (global average is 70.1 years), income inequality is high with an average income GINI coefficient of 63.1 over the last 10 years (global average is 77.2), and 23% of the national population is living under the National Poverty Line (UNDP, 2013).

What is topping these effects on South Africa's economy today is the pressure of climate change. Both natural and human induced climate change have been affecting rural and urban areas for many years now, especially within the context of agricultural systems. Increasingly, farmers are finding it hard to adapt to changing conditions for the production and marketing of agricultural products (Leichenko & O'Brien, 2002). Accompanied by significant urbanization – with 63% of South Africa's 52 million inhabitants now living in cities, compared to 58% in 2001 and 55% in 1996 – pressures on food security will make climate change an even greater threat to South Africa (Statistics South Africa, 2011; FAO, 2013). Moreover, data from the 2007 General Household Survey shows that serious hunger is widespread in South Africa and is found in similar proportions in rural districts and metropolitans. The worst case of hunger was recorded in the Umzinyathi Municipality in KwaZulu-Natal, just north from eThekwini. (Altman et al., 2009). Durban itself is no exception, where shackdwellers' movements, such as Umkumbane and Cato Manor, are grounded on the struggle against exploitation, misery, and hunger (Gibson, 2007). Later on, Altman et al. overlap with the following quote by May and Rogerson about urban food supply, stating that – as Dreze and Sen also observe – urban food supply is a vital, albeit neglected area for policy formulation in the developing world (May & Rogerson, 1995, p. 166; Altman et al., 2009). These authors all stress the vital role local governments, like Durban, currently have to match post-Apartheid decentralized policy with current development objectives and the needs of the urban poor.

The eThekwini Municipality governs the city of Durban, one of South Africa's biggest metropolises. To combat the pressures on food security and income security and to improve poverty alleviation in the city, planning for and promotion of 'urban agriculture' (UA) – farming activity in an urban environment – has been one of the Municipality's strategies. Alongside these interventions, there exists a significant occurrence of informal cultivation in low-income areas within this metropolis, adopted as a pro-poor development strategy (Rogerson, 2003). However, with the above illustrated urban context of climate change in mind,

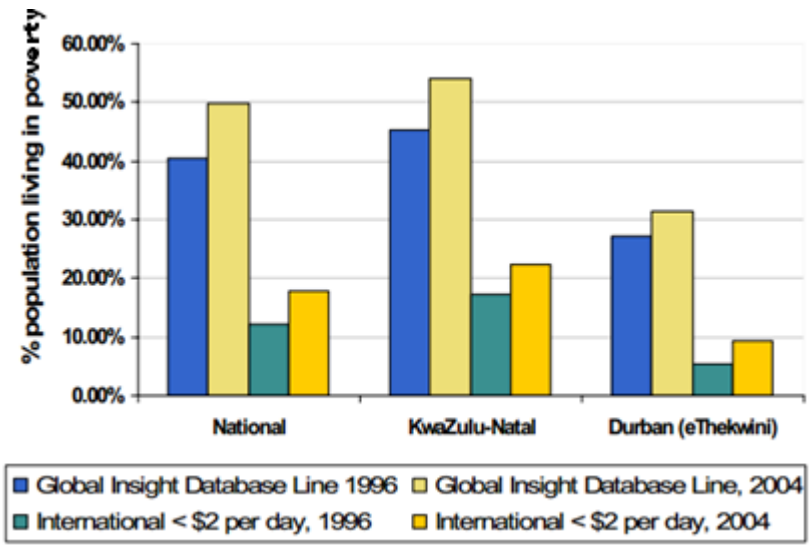


Figure 1: Poverty on three scales in South Africa (eThekwini Muncipality, 2006)

these urban farmers, along with every other of its city's growing population of 3.5 million citizens, will experience the adverse affects of climate change as well these coming decades (eThekwini Municipality, 2007).

Aiming at differences in priorities and capacity, an approach that has received a lot of global attention these past years is 'Climate-Smart Agriculture' (CSA). The term encompasses both adaptation and mitigation strategies within agricultural systems, assures sustainable productivity and enhances achievement of national food security and development goals (FAO, 2013). Applying this strategy to the urban environment could prove to be of paramount importance for the many Durban citizens living in poverty, as illustrated in Figure 1 from calculations by the eThekwini Municipality in its Economic Review of 2006-2007. This raises the question if this activity is already visible in the eThekwini Municipality, and what the potential of climate-smart urban agriculture is for pro-poor sustainable development in a city like Durban.

Within scientific literature, the topic of sustainable agriculture is already quite a well-documented phenomenon (Brocklesby & Fisher, 2003). However, although there has been much written about past and current successes and challenges within this field, there still exists a substantial knowledge gap concerning newer developments (Pearson et al., 2010). One of these developments has its roots in the rise of urban agriculture. Although the activity of farming in an urban environment isn't always promoted or practiced as a sustainable practice, the phenomenon itself is increasingly referred to as a development-inductive platform for urban sustainability, both in a academic literature as by organizations like the FAO (May & Rogerson, 1995)(Shackleton et al., 2010)(FAO, 2013). Their "climate-smart" conceptualizations, amongst others, have contributed to a new hybrid term: *climate-smart urban agriculture*. Currently, its scientific exposure has been in its infancy. This, however is not the only reason it needs to be understood better. As of today, implementing this approach is challenging, mainly due to a lack of tools and experience. Climate-smart interventions are highly location-specific and knowledge-intensive. Considerable efforts are required to develop the knowledge and capacities to make CSA a reality (FAO, 2013), especially within cities where poverty levels are high and the population is rising rapidly.

Looking at the developmental relevance, urban agriculture in academic literature is frequently described as an important tool for safeguarding food and income security (May & Rogerson, 1995). The same can be said about climate-smart agriculture. Not only for climate change effect mitigation, but also for vulnerability and resilience adaptation, diversifying income sources, advancing livelihoods and smallholder capacity building, is this agricultural transformation of value. Encompassed in all of these challenges is the key objective of climate change adaptation. Not only because of the environmental fragility of South African cities, but also because of the importance of urban agriculture for South African livelihoods (Shackleton et al., 2010), solutions for changing climatic shifts need to be researched more. Equally important in this case is the relationship between policy and knowledge institutions and the urban farmers themselves, a vital aspect to get an understanding of. From both a policy and practice perspective, a good relationship between these two groups might be the most important catalyst for climate-smart urban agriculture to become a success in the eThekwini Municipality. Knowledge gaps – as a reference to Pearson et al., illustrated earlier in this introduction – must be eliminated to get most out of both policy and

practice. This refers to both the social, economic and environmental attributes of UA, and secondly to the institutions which govern UA (Pearson et al., 2010).

2. Research aim and objectives

Although the academic world has written a good amount of literature on these barriers in South African cities, a new phenomenon has diversified this subject. Climate change is currently adversely affecting these cities, along with the fragile green spaces which can be found in these metropolises. Not much has been written on the relationship between climate change and urban agriculture in South African cities. Therefore, the research aim of this thesis is to gain a better understanding of the effect climate change has on urban farmers, how 'climate-smart agriculture' contributes to adapting to and mitigation of the impacts of climate change, and how policy on 'climate-smart urban agriculture' can be optimized, thereby safeguarding the development of the urban poor.

The city case in this research is the eThekwini Municipality, which is situated on the east coast of South Africa, and harbors the large metropolis of Durban. Applying my research aim to this area has led to the following main question:

To what extent is urban agriculture within the eThekwini Municipality climate-smart, and according to whom?

By subdividing this question into several objectives, the different questions addressed in this research are becoming clear. To get a solid understanding about the phenomenon of urban agriculture in this municipality, the first objective is to find out who practices urban agriculture. It's also important to know more about the practice itself as a strategy. Therefore, the first sub-question is as follows: *Who is practicing urban agriculture in the eThekwini Municipality, and why do they practice it?*

The second objective consists of looking at the relationship between this practice and its environment. The urban habitat presents farmers with a different set of challenges, compared to its rural counterpart. Whereas rural agriculture in South Africa is well covered in academic literature, it's interesting to find out more about the dynamics regarding these barriers to urban agriculture, especially in a large urban setting within the eThekwini Municipality. Thus, the second sub-question can be written down: *What are the barriers to urban agriculture in the eThekwini Municipality?*

These first two objectives give the research its contextual basis, with the second question serving as a bridge to the next part of this paper. These next two objectives will cover the main thematic matter, which is the human response to the influence of climate change on urban agriculture. To get to grips with these two objectives, it's first required to look at the influence of climate change on urban agriculture, and its farmers, in the eThekwini Municipality, and to what extent this phenomenon is considered nowadays as an influence to urban agriculture. In other words, is climate-smart urban agriculture visible, and if yes, what shape and form does it take in this municipality? The third question therefore is: *To what extent is climate change a consideration in urban agriculture policy and practice in the eThekwini Municipality?*

As mentioned, the above provided third objective needs to paint a picture of the degree of occurrence of climate-smart urban agriculture. This will give this research its status quo on the phenomenon and the contextual characteristics. However, as this phenomenon is new to not only

academic literature, but also the field of practice and policy in cities, it will be of paramount importance to not only scope the degree and desire of promotion of climate-smart urban agriculture by the eThekwini Municipality, but also the wishes of the urban farmers and the role of the other stakeholders in this field of practice. Essential to this last question is the current institutional structure around urban agriculture in the municipality, and what changes need to be made to fit the abovementioned needs and desires. The final question can thus be provided: *According to whom is promotion of climate-smart urban agriculture in the eThekwini Municipality needed, and which institutional changes can to be made to fit these needs?*

Providing an understanding about all of these objectives, and giving answers to these sub-questions, will eventually lead to the answer of the main question. As this research is both evaluating and policy-oriented in its approach, recommendations regarding policy and practice will be central to this study's final part.

3. Theoretical framework

The following chapter will delve into the academic literature, and will form a literature basis for the research chapters that will follow. This theoretical framework is divided into three parts; the general framework, which discusses the conceptual and theoretical fundament of this research, the contextual, which looks into the contextual and thematic topics of this paper, and the eThekwini Community Gardens Statistics, which paints a clearer picture of the contextual situation of communal UA in Durban, as described in the conceptual framework.

3.1. General framework

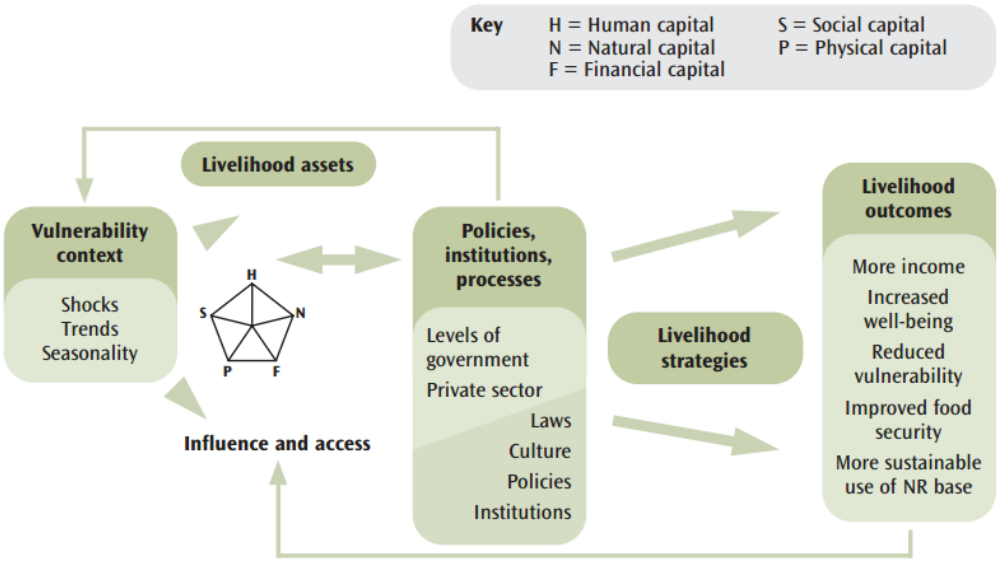
The general framework consists of three theoretical approaches that are vital to understand the forces and decisions behind climate-smart urban agriculture. The first of these is called the Sustainable Livelihoods framework, and gives an understanding about the strategic reasons behind practicing urban agriculture for livelihoods, and introduces the sustainable factor. This thus corresponds with the first and the second sub-questions of this research, while also partly overlapping with the climate-smart dimension of urban agriculture. The second approach is about governance and decentralization. Insights out of this sub-chapter will provide the main question and the policy aspects of the four sub-questions with a well-needed theoretical fundament. The third sub-chapter concerns the Ecosystems Approach, elaborating on the theory and methodology behind the climate-smart aspect of urban agriculture, overlapping thus with sub-question three and four of this research.

3.1.1. Sustainable Livelihoods

One of the more well-known development theories is called Sustainable Livelihoods (SL), serving as an umbrella term for thinking and methods regarding livelihood security and associated topics. It became a popular tool of analysis from 1998 onwards, and spread beyond organizations like Oxfam and UNDP around the 1990s, who each adapted this theory to their own views and standards. Instead of the 'public face' of the DFID, the SL approach increasingly became an SL framework, helpful in linking macro-level trends to the micro-level groundwork of reality. It therefore contributed a lot the academic transformation of the notion of poverty, veering away from the traditional top-down perspective of applying a band aid to bottom-up differentiating root causes of poverty. People's assets, their vulnerability, the policies and institutions imposed on them and the interaction of these three aspects exemplify the root causes of poverty, instead of the other way around. Thus, the general goal of the SL approach is to alleviate poverty, by getting a good understanding of the forces behind this phenomenon. The following principles ground this theory (Carney, 2003, p. 11-15):

- **People-centered**: Sustainable poverty elimination is dependent on external support focusing on what matters to people, understands the differences between groups of people and works with them in a way that is congruent with their current livelihood strategies, social environment and ability to adapt;
- **Empowering**: Livelihoods benefit from an amplified voice, opportunities and well-being for the poor;

- **Responsive and participatory**: Poor people themselves are the best actors to identify and addressing the relevant livelihood priorities;
- **Sustainable**: The four pillars of sustainability – economic, institutional, social and environmental – are the fundament of this theory, and correspond with the relevant capitals addressed in this theory;
- **Multi-level and holistic**: Poverty elimination can only be overcome by working at several levels;
- **Conducted in partnership**: Both the public and the private sector are important actors within this approach;
- **Disaggregated**: The understanding of how assets, vulnerabilities, voice and livelihood strategies differ between disadvantaged groups as well as between men and women in these groups, is an important aspect of this theory;
- **Long-term and flexible**: Poverty reduction requires long-term commitments and a flexible and dynamic approach to providing support.



Source: DFID (1999–2005), *Sustainable Livelihoods Guidance Sheet 2.1.*

Figure 2: DFID's Sustainable Livelihood's Framework (Benson & Twigg, 2007)

Its framework (Figure 2) was designed by the Department for International Development (DFID) in 1999, and has been used ever since in academic literature and development policy worldwide. There doesn't exist a single SL approach, but all of these different approaches can be summarized under this one framework. Its main elements are (Benson & Twigg, 2007):

- **Vulnerability context**: The situational environment in which poor people live and work, which is the source for many elements of their day-to-day struggle (i.e.: climate change);
- **Capital**: The assets and capabilities of the poor, which they have access to and use to gain a livelihood (i.e.: seeds);
- **Policies, institutions and processes**: The institutions, organizations, policies and legislation that influence access to assets and choice of livelihood strategies (i.e.: water policy);
- **Livelihood strategies**: The manner in which the poor organize and use their assets and capabilities to safeguard and improve their livelihoods (i.e.: community farming);

- **Livelihood outcomes**: The possible and desired results of livelihood strategies (i.e.: improved food security);

The figure shows the different relationships between the various factors that limit or enhance opportunities. It doesn't show an exact model of reality, but shows structure within a holistic field of thought. There is also no start, middle or end to this model, and the arrows are not strictly causal, but merely forms of feedback and ideas. The pentagon in the middle represents the different livelihood assets, or capitals.

Applying SLA can form a link between research or policy and people's priorities. The analysis can result in either promoting livelihoods, protecting livelihoods or providing livelihoods with essential needs (Benson & Twigg, 2007). At the grass-roots or community level, the SLA guides research in exploring the types of 'capital' (natural, social, human, financial and physical) that exist for the urban poor to earn a livelihood (Thornton, 2008, p. 248). As this approach focuses on people and on people's strengths, whilst having its roots in community resource management, SLA serves as an important framework for both household and community development (Carney, 1999; Brocklesby & Fisher, 2003).

This is why it is a relevant academic theory for the case of eThekwini. Agricultural practice and interventions are rooted in the capacity and strategies of both households and communities. Before introducing a framework such as climate-smart urban agriculture in a poor neighborhood, the situational environment needs to be examined, the assets and capabilities of the poor need to be researched, just as the institutions, organizations, policies and legislation that influence these assets, how the poor use these assets and the possible and desired results of this framework introduction. Each individual has his own view on the extent to which he or she is poor, and to which extent other people are living in poverty (Viljoen & Sekhampu, 2013). Gharajedghi (1986) accordingly states that urban poverty does not only have to be inherently economic in perspective, but is actually psychological in nature as well. Thus, he subdivides the term into five different components: powerlessness, incompetence, meaningfulness, exploitation and conflicting values. Also, some individuals or communities may adopt strategies to cope with these barriers, while others won't or simply are not able to (Viljoen & Sekhampu, 2013). In short, urban poverty is a diverse and inherently contextual phenomenon, and needs to be approached accordingly.

In the case of climate-smart urban agriculture the starting point is the urban farmer livelihood, comprising of the capabilities, assets and activities requires for a means of living. The capabilities are his or her skills regarding agriculture in the urban environment, and additionally his or her knowledge on climate change adaptation and mitigation. The activities consist of the practice of urban agriculture itself, and all the additional tasks that accompany this activity, such as resource transport and facility maintenance. The assets, as seen in Figure 3, can be divided in (Majale, 2002, p. 3):

- Natural capital: The farmer's natural resources (land, water, biodiversity, environmental resources);
- Physical capital: The farmer's basic infrastructure (water, sanitation, energy, transport, communications), housing and his or her agricultural tools and equipment;

- Human capital: The farmer's health, agricultural/ climate knowledge, agricultural skills, information, ability to farm;
- Social capital: The farmer's social resources (relationships of trust, group membership, farmer networks, access to markets or other institutions);
- Financial capital: The farmer's financial resources (remittances or pensions, savings, supplies of credit).

The aim is to make this farmer's livelihood sustainable, so that he or she – along with his or her household – can cope with and recover from stress and shocks. Making urban agriculture climate-smart then implies that the threat of climate change is taken into account, mainly through adaptation and mitigation. Moreover, the aim is also to uphold or improve its capabilities and assets, and provide sustainable livelihood opportunities for generations to come. Other livelihoods should be able to contribute from these benefits, for example through knowledge transfer, and the whole framework should involve various actors, including local government and relevant organizations and institutions, in decision-making and policy formulation and implementation (Majale, 2002, p. 3-4).

The framework is also subject to some critiques in the context of urban agriculture. For example, the definition of 'natural capital' in the framework largely applies to rural areas, and needs reorientation for it to seamlessly apply to an urban environment, when used here. Also, the emphasis in the model is put on the poor themselves, which introduces the danger of ignoring the importance of policy and governance from the top-down (Carney, 2003).

Also, a number of authors have stated that weak local or municipal governments are often unable to address the needs of the urban poor, in some cases even by exclusion or discrimination. The above described link between the government and people's priorities is therefore a vital element of preventing bad urban governance, thereby contributing to safeguarding sustainable livelihoods and improving community development (Farrington et al., 2002). The farmer's social resources are a vital requisite for this development, hence the theorization behind this playing field will be discussed in the next paragraph.

3.1.2. Governance & decentralization

In developing countries, the relationship between state and community is an important aspect of its political and economic atmosphere; it can make or break development policy. The political economy perspective in a developmental context looks at a broad array of facets of economic development. Different subthemes of the political economy of development are relevant when analyzing agricultural activity in urban environments. First, there is the paradigm of social capital, explaining the forces behind community development. Secondly, the political economy of decentralization is key to analyzing the local relationship between state and community.

The concept of social capital is more diverse than merely trust and collective norms, as discussed with the Sustainable Livelihoods Approach. Within literature, some academics highlight the role of both formal and informal networks, a sphere often called 'structural social capital', which can be found in two forms: 'bonding social capital' and 'bridging social capital' (Putnam, 2000). Bonding social capital refers to horizontal ties by common characteristics, looking for example at relationships among a number of farmers within an urban neighborhood. Bridging social capital, on

the other hand, refers to ties between groups, which are often vertical. An example can be found in the relationship between government or Agricultural Extension Officers – which are intermediaries between research, policy and the farmers, operating as facilitators and communicators – and urban farmers, which requires bridging social capital to be beneficial (Van Rijn et al., 2012).

This bridging social capital, as Woolcock and Narayan mentioned as well, implies that the more the government listens to its communities while acting as a strong state respecting human norms, values and rights, the more likely it is that development cooperation will be successful and sustainable. In other words, under the right circumstances, government decentralization will benefit the acquirement of social capital for individuals and communities, and will strengthen the role of civil society in terms of development.

Jean-Paul Faguet did research on the effect of decentralization on local communities in Bolivia. His definition of decentralization is as follows: *"Decentralization is the devolution by central (i.e., national) government of specific functions, with all of the administrative, political and economic attributes that these entail (i.e., municipal) governments which are independent of the center within a legally delimited geographic and functional domain"* (Faguet, 2004, p. 2). His results in Bolivia backed up the assumption that decentralization brings forth change and national investments, as it confirmed that local preferences and needs are vital to understanding these changes. There has also been a lot of other research done on the political economy of decentralization in developing countries (Woolcock & Narayan, 2000). Tendler (1997) for example concluded that, in Brazil, good government is a vital necessity for the success of local programmes. Cissé et al. concluded in West Africa that despite urban agriculture's high value for local poor communities and proven capacity to add to job creation, income security, food security and environmental conservation, along with a high interest from public authorities, civil society and researchers, it currently suffers from being considered unimportant in urban management. They state: *"The institutional aspects of urban agriculture cannot be considered outside the general context of the transfer of responsibilities from central to local level"* (Cissé et al., 2005, p. 151). The authors then give an example of urban agriculture in Niger, where decentralization has in fact been accomplished, leading to environmental restoration and protection and participatory preparation of local plans and schedules relating to the development of natural resources.

However, various factors provide a barrier for full realization of decentralization in developing countries, serving as the root of the problem as to why gaps between government and people still exist. Four factors can be mentioned that affect the implementation of decentralization in these countries (Rondinelli et al., 1989, pp. 77-78):

1. Research indicates that successful implementation of decentralization policies depends heavily on political factors.
2. Organizational factors conducive to decentralization include the appropriate allocation of planning and administrative functions among levels of government and local organizations with each set of functions suited to the decision-making capabilities of each level of organization.
3. Behavioral and psychological conditions supporting decentralization include appropriate attitudes and behavior of central and lower-level government officials towards the

decentralization of service provision and maintenance, and a willingness on their part to share authority with citizens and accept their participation in public decision-making.

4 Financial and human resource factors required for decentralization include granting sufficient authority for local units of administration or government, cooperative and private organizations to obtain adequate financial resources to acquire the equipment, supplies, personnel and facilities needed to fulfill decentralized responsibilities.

Successful decentralization eventually depends on institutional capacity-building. As mentioned, civil society can play an important role within this context. This translates to strengthening the institutional capacity of local organizations, within all of society's spheres, to fund and direct provision and maintenance, and of governments to realize and support decentralization (Rondinelli et al., 1989, p. 78). However, in the case of eThekwini, if or when government decentralization is conducive to urban agriculture for the poor, the next step will be to look at how climate change adaptation and mitigation can be integrated within this strategy. That's where the Ecosystems Approach comes in.

3.1.3. Ecosystems Approach

According to the CBD (Convention on Biological Diversity) an Ecosystems Approach is *"a strategy for the integrated management of land, water and living resources that promotes conservation and sustainable use in an equitable way"* (CBD, 2000). It can highlight objectives for mitigation of, and adaptation to climate change, while recognizing the importance of long term sustainability (UNEP, 2009). In May 2000, during the Fifth Ordinary Meeting of the Conference of the Parties (COP 5) to the Convention on Biological Diversity in Nairobi, Kenya, this approach was drafted and worked out.

An ecosystem approach builds on the use of appropriate scientific methodologies based on levels of ecological and biological organization, which cover the fundamental structure, processes, functions and interactions among humans and their environment. This ecosystem can be a compost heap, a rainwater dam, a forest, a biome or the entire biosphere. Within the context of a city, a household farming plot qualifies just as well as an ecosystem. Hopkins listed a few ecosystem approach principles that make urban food garden projects truly sustainable, striking at the heart of climate-smart urban agriculture (Hopkins, 2000, pp. 202-203):

- Be environmentally sustainable: Avoid the use of chemicals and work with nature's cycles. Inputs into gardening should be provided by another part of the system, and the outputs of gardening should feed other parts of the system. This way, no pollution is created, and sustainable gardening is achieved;
- Build upon existing community networks: Already existing individual or community projects can be used to further sustainable agriculture in cities, to avoid 'reinventing the wheel';
- Integrate water, waste, employment, recreation, housing, energy generation, wildlife and so on into a whole system: This is where the ecosystem part becomes prominent. Through design and interplay between all of these aspects of urban agriculture, a lot of sustainable solutions can be achieved. For example, the continuous purification of waste water can lead to a sustainable water supply;

- Contribute to an overall move towards sustainable development in the community: the wider the extent of sustainable food gardens in a community, the bigger the impact this sustainability can have within the area and outside of this area.

One of the most important scientific methodologies, which encompasses all of the above principles, is 'permaculture'. Hopkins (2000, p. 203) defines this approach as such:

"Permaculture (from permanent agriculture or permanent culture) takes nature as its model, observing that natural systems (…) require no inputs by sun and rain, create no pollution, have a huge natural biodiversity, are productive on an array of levels or 'niches', are permanent and are massively productive in terms of biomass. It aims to maximize the number of 'cycles', seeing any inputs not provided by another part of the system as unnecessary work created, and any output which do not form the inputs for another part of the system as pollution created."

Permaculture thus, is a design approach that focuses on getting the most out of agricultural garden cycles, for example the cycle of water or the cycle of organic matter. Looking at the above principles listed, this approach extends further than the garden itself. With permaculture as one if its scientific methodologies, climate-smart urban agriculture as an ecosystem approach needs adaptive management to deal with the complex and dynamic nature of ecosystems and the absence of complete knowledge or understanding of their functioning. This especially holds up for the effects of outside forces, such as climate change, that barrier or limit agricultural practice and ecosystem conservation. Management must be adaptive in order to be able to respond to such uncertainties and contain elements of "learning-by-doing" or research feedback. Measures are needed when cause-and-effect processes aren't yet scientifically crystallized, such as is the case with climate-smart urban agriculture (CBD, 2000). Figure 3 shows its adaptive management framework.

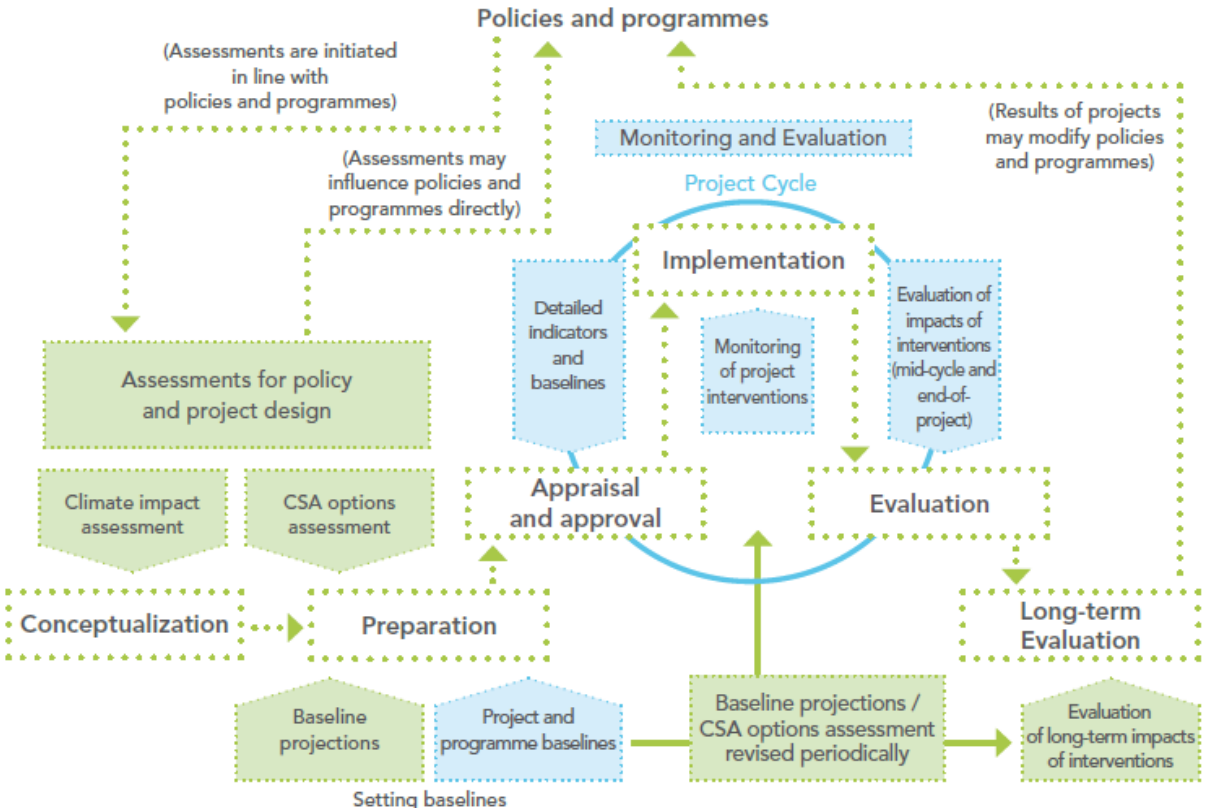


Figure 3: The framework for climate-smart agriculture, used for assessment, monitoring and evaluation (FAO, 2013)

The framework clarifies the processes which structures the approach from the formulation of climate-smart agricultural baselines to the implementation of climate-smart agriculture policies and programmes. One of its most notable features is the project cycle, which incorporates the approval of climate-smart pilots, the actual implementation of climate-smart methods and the evaluation of its outcomes. This project cycle can only be set in motion after a thorough situational and contextual analysis. This feedback loop needs to be constantly monitored, as illustrated in the framework. Only after a successful project cycle can a climate-smart agriculture design or project be mainstreamed into policy and programmes.

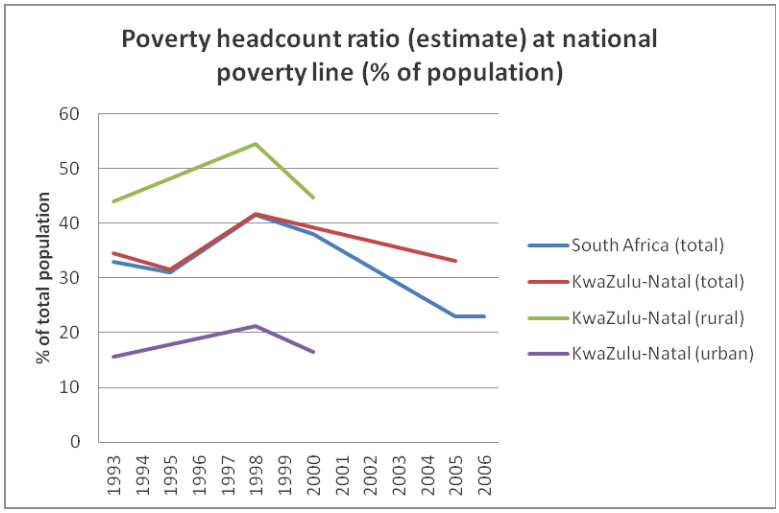
Thornton used the ecosystems approach to link between cross-sectoral concerns and urban and peri-urban agriculture. This approach informed stakeholders on the range of urban and peri-urban agriculture and its impact in the urban environment. By using GIS in conjunction to the eco-systems approach, he revealed the location and spatial pattern of urban and peri-urban agriculture in his research areas. According to him, the integration of agriculture in urban development planning is not a new phenomenon in South Africa and may indicate an emerging trend in ecosystems approaches to urban renewal (Thornton, 2008).

3.2. Contextual framework

3.2.1. Urban poverty

In the sub-chapter about Sustainable Livelihoods, the phenomenon of urban poverty has been touched upon in detail. To then shed a light on current urban poverty existing in South Africa, some background story is needed. Figure 4 shows the percentage of the South African population living below the national poverty line (R174 a month, corrected for inflation) over the last few decades. Additionally, the same trend for the province of KwaZulu-Natal is given, with both the rural and urban numbers shown. What becomes clear about this graph are two things. First, it's obvious to see and conclude that urban poverty is not as high as rural poverty in the province. Secondly, there is a trend visible of increased poverty after 1994, which then fades after 1998. As of today, poverty is still clearly visible in South Africa's cities. Figure 5 shows the percentage of people in urban eThekwini Municipality living below the poverty line in 2006.

Figure 4: National and provincial poverty headcount ratio (May et al., 2000; SSA, 2002; World Bank, 2014)



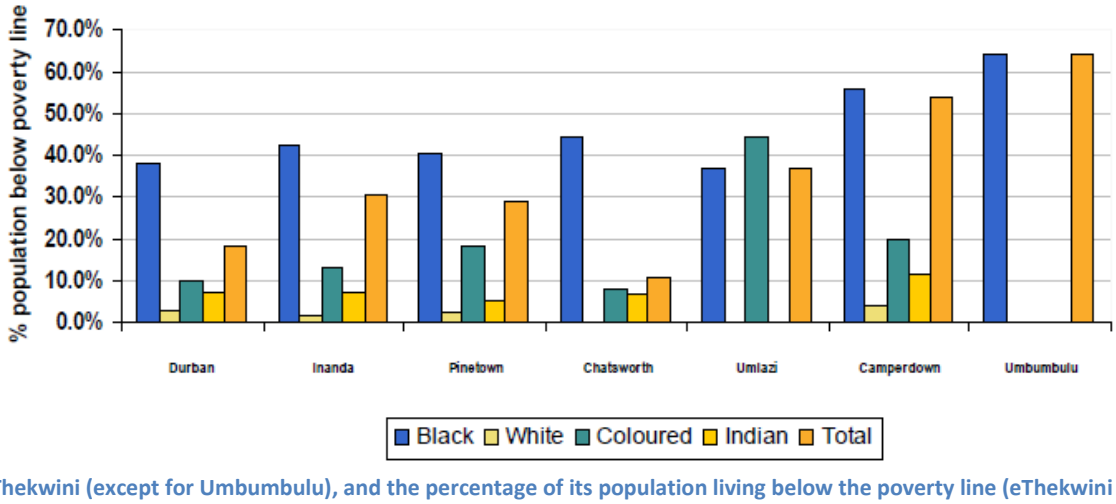


Figure 5: Urban eThekwini (except for Umbumbulu), and the percentage of its population living below the poverty line (eThekwini Municipality, 2006)

Figure 6: The township of Cato Manor, Durban, with upgraded housing (left) and thousands of illegal squatter shacks (right) (Photo by Jacob Knegtel)

Both figures seen above illustrate the story about the fundamentals of urban poverty in South Africa, which can be summed up by two words – 'urbanization' and 'relocation' – all within the context of Apartheid, a political system of racial segregation. From 1948 to 1994, this system was enforced by the Afrikaner National Party government, which made sure that the white minority in the country maintained control of the country's resources, and the black majority was stripped of most of its former rights. The 1950 Group Areas Act made sure that the urban population of South Africa's growing cities was to be racially segregated into different areas for African people, white people, colored people and Asians. These (mainly forced) relocations became one of the biggest sources for urban poverty in these cities, along with unauthorized urbanization, as the rural poor tried to escape poverty (Viljoen & Sekhampu, 2013). After 1994, poverty in rural KwaZulu-Natal reached an exceptionally high level, with more than 50% of its population suffering from poverty.

Especially the black urban population was relocated to 'townships', lying on the outskirts of the urban grid, as happened in Durban. Those not willing to move, gathered in informal settlements, which are still visible as of today. Together with the townships, they tell the story of Apartheid not only controlling the location of people, but also the housing condition. 1994 ushered in the end of Apartheid, but started a period of economic and political chaos, before the structural adjustments. The poor quality of housing, accompanied by a contracting urban formal economy, growing urban unemployment, freezing of wages and rising food prices resulted in urban income squeezes and a decline in urban productivity and development (Ellis & Sumberg, 1998; Viljoen & Sekhampu, 2013). The then blurry lines between crime, protest and resistance were accompanied by a period of urban poverty increase (Figure 4), which laid a foundation for poverty alleviation in today's city development. Mandela's 1996-1999 reforms in economy and policy improved this situation (Figure 4), with the replacement of the failed 'Resconstruction and Development Programme' of 1994 with the more succesful 'Growth, Employment and Redistribution Programme (GEAR)' (Hirsch, 2005). This paved the way for effective urban development, as the first programme only focused on the rural context, and secured an improvement of South Africa's role in the global economy. As of today, Apartheid left its mark on a significant portion of the urban population, especially the black communities (Figure 5), still struggling with perpetuating poverty (Viljoen & Sekhampu, 2013). The next chapter will scale down even more to the eThekwini Municipality, highlighting a current development strategy deployed by these urban poor, in the form of urban agriculture.

3.2.2. Urban agriculture

Although urban agriculture in practice is applied very differently around the world, the term as it is used in this paper can be understood as 'agricultural activity within the 'intra-urban' environment', in a developmental context. In academic literature, the concept is often accompanied by 'peri-urban' agriculture, which can be explained as agricultural activity practiced on the outskirts of cities (Thornton, 2008), but because this research is not focusing on these rural-urban gradient zones, this concept will be left out the analysis. In academics, urban agriculture is usually described as a practice carried out by people from all income groups and all nationalities, and is deemed to be essential as a survival strategy for the developing urban poor.

The rise of urban agriculture in eThekwini and South Africa can be linked with the aforementioned occurrence of post-Apartheid urbanization. Nowadays, while the production of South Africa's main crops – which are maize and wheat – fluctuates widely because of rainfall, it averages around the same production level each year. However, with this increase of the urban population, the agricultural sector can't keep up with the rising urban demand, which led to a massive increase of necessary wheat and maize imports. The rise of urban agriculture can be seen as a replacement of these agricultural imports, as it moves the rural agricultural tradition to the city, making these imports unnecessary (WWF, 2012).

Figure 7: A typical Cato Manor homestead garden, Durban (Photo by Jacob Knegtel)

Urban agriculture practices in the eThekwini Municipality are following the same characteristics as described above, both promoted by the local government, as well as existing informally (Rogerson, 2003). Epstein (1994) made a classification of urban agricultural initiatives found in Durban, eThekwini:

- Individual/ backyard gardens (Figure 7)
    - Non-viable in earning an income;
    - Supplement household diet and reduce costs
    - Vacant land or residential properties
- Community gardens
    - Produce for home consumption
    - A few houses pool their resources on a potion of land accessible to the homes

- Allotments
  - Seen as intensive activity/ income generating
  - Set in blocks sharing common infrastructure
  - Urban location
  - Supplement household earnings and food requirements
- Smallholdings
  - Commercially oriented
  - Periphery of urban areas

So, who are these cultivators? May and Rogerson (1995) gathered the following numbers of households in the urban and peri-urban regions of Durban, including the percentage of households with

Characteristic	Household size *de jure*	Age of head (*Years*)	Female head (%)	Household income (*Rands*)	Per capita income (*Rands*)	Households with agric. activity (%)
Homeland metropolitan						
Marginal	4.3	39.2	42.9	71	33	7.1
Welfare dependent	6.1	66.6	70.0	348	82	10.0
Remittance dependent	5.9	48.5	28.1	497	82	6.3
Wage-committed, average	5.3	40.9	30.3	484	153	1.3
Wage-committed, high	5.5	44.9	21.6	2238	449	5.2
Mixed wages, secondary	5.6	48.2	53.3	1290	334	6.7
Mixed wages, primary	6.5	55.4	42.3	1900	317	4.9
Homeland peri-urban						
Marginal	5.9	41.5	14.8	86	13	29.6
Welfare dependent	5.3	65.4	60.6	383	99	40.4
Remittance dependent	7.0	38.5	51.5	528	82	46.6
Wage committed, average	6.6	46.4	30.1	626	108	30.8
Wage committed, high	5.8	42.5	19.4	2121	423	22.4
Mixed wages, secondary	6.2	52.9	39.7	920	170	54.5
Mixed wages, primary	7.3	56.2	45.3	1412	215	32.8

Figure 8: Household profiles in urban and peri-urban Durban with the percentage of agricultural activity (May & Rogerson, 1995)

Figure 8 paints a clear picture of the agricultural engagement of households, classified by income group, in the greater urban area of Durban. As can be seen, out of all income groups, the marginal and welfare dependent households participate the most in urban agriculture, with respectively 7.1% and 10% of the metropolitan households engaging in agricultural activity. The higher the income becomes, the lower this activity seems to get, which suggests that urban agriculture in Durban is a pro-poor income or food strategy. Looking then at age and gender, this table gives the average age of the household head, and the percentage of these households having a female head. The numbers of the two aforementioned metropolitan groups with the lowest income give us an average household head age of 39.2 years within the marginal income group and 66.6 years of the group with the highest urban agricultural activity, the welfare dependent households. Respectively, the percentage of these household groups with a female head are 42.9% and 70%.

The above numbers suggest that most urban farmers in the eThekwini Municipality are women, as Rogerson (2003) concludes for most of Africa. A recent farmer survey in the Durban metropolitan

area confirms this hypothesis. This survey, held in 11 different wards across the city, has data from 165 farmers, and concluded that 78.4% is female and 21.6% male. Of these farmers, over 60% was over the age of 50, and 33.5% of the farmers stated they were older than 60 years. Looking at education, 67.7% of the respondents had either no education or only a primary school education. Only 29.1% of the farmers completed high school (Shackleton et al., 2010, p. 293-295). According to May and Rogerson (1995), cultivation for urban farmers in the urban and peri-urban zones of Durban serves mainly as a food security strategy. For a few urban farmers it even presents an additional source of income, instead of simply supplementing the wage income. They even concluded that the presence of a wage income facilitates agricultural production to a certain extent. Lastly, both authors state that urban agriculture is most practiced in African communities, especially townships, in Durban.

Where then do these farmers engage in their agricultural activity? From the above mentioned survey became clear that a vast majority of the urban farmers (92.7%) cultivated on their own land. A small portion of the respondents (9.3%) said they rented land from others, although a proportion of them actually owned land in addition. About one-sixth of the farmers (16.6%) practiced agriculture on land that was neither rented nor owned, mostly in the form of community gardens, owned for example by the Municipality, schools or churches (Shackleton et al., 2010).

For Durban and its surrounding cities in the municipality, officially sanctioned and promoted urban agriculture is also visible. Currently, the Municipality has an Agroecology Programme in place which complements other municipal policies which focus on poverty and unemployment. The programme aims at promoting appropriate and sustainable approaches to the way in which agriculture is planned and implemented. Six agricultural support hubs have been established or under development which contain demonstration sites of agroecology techniques, a research and development centre on agroecology, training sites, a packing and marketing hub and a future seed bank. The hubs are as follows: Northdene Agroecology research & development Centre, Newlands-Mashu Permaculture Centre, Inchanga, Scorpio Place in Mariannridge, Mariannhill Monastery and Umbumbulu (Figure 9). The programme primarily targets urban areas, and focuses on those who'd need this support the most, in locations where the biggest impact can be made with limited resources (eThekwini Municipality, 2014, p. 55).

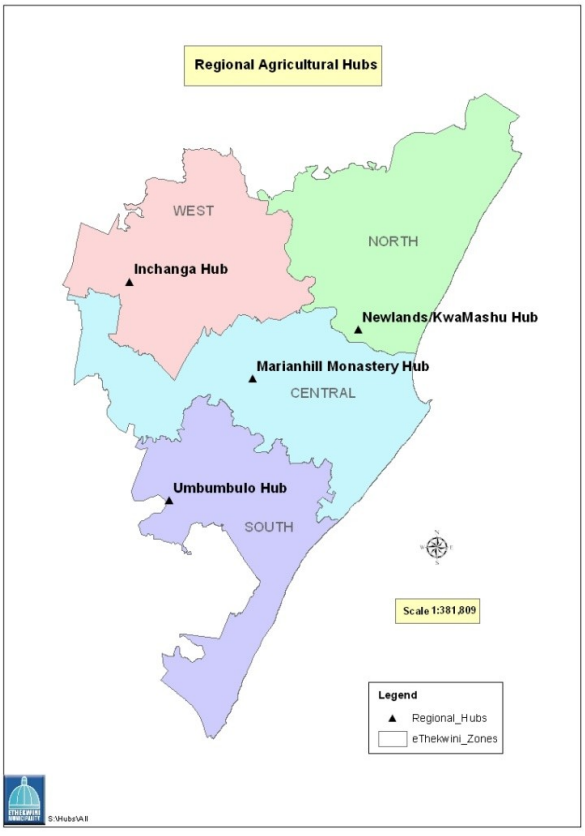


Figure 9: eThekwini's four major Regional Agricultural Hubs (eThekwini Municipality, 2014)

Although the above described agricultural hubs are supplying seeds and teaching farmers how to effectively produce, the practice of urban agriculture still remains a strategy deployed by these people themselves. This becomes more clear when looking at the following table, showing data of UA in Durban, that is part of a 1999 IDRC (International Development Research Centre) survey of urban planning professionals. They looked at urban agriculture facilitation and promotion in twelve cities across the globe (Quon, 1999, p. 54). It illustrated what is said before, namely that urban agriculture has a history of being promoted in eThekwini. However, it illustrates several notable policy gaps, such as no facilitation of land access. Of the twelve cities listed, it ranked about average, seeing that multiple other cities, such as Dar es Salaam, Tanzania and Kampala, Uganda showed more tools and strategies applied. The upcoming datasets in this research will cover the current urban agriculture policy situation in eThekwini.

Possible urban agriculture tools & strategies	**Applicable to Durban?**
Provides positive policy	✓
Ignores negative policy	
Creates distinct UA zone	
Permits UA under other zones	
Has permitting or regulation system	
Facilitates access to land	
Provides incentives	
Provides inputs	✓
Provides technical services	✓
Provides infrastructure	
Provides opportunities for loans and credit	✓
Facilitates programmes	✓
Supports demonstrations	✓
Provides development control	
Politicians express support in principle	✓

Table 10: Tools and strategies used to facilitate and promote urban agriculture in Durban (Quon, 1999, p. 54)

Apart from the policy gaps, urban agriculture does not come without barriers. Apartheid has left a bitter taste among the black city dwellers towards agriculture, as urban to rural subsistence farming was often the only strategy they could adopt during the worst years. This negative stigma towards urban agriculture is now mainly noticeable among the young urbanites, with a significant amount of them seeing urban farming as wasting time, exclaiming it to be 'not interesting', 'dirty', 'old-fashioned' and 'not worthy as a job'. (Thornton, 2008). Moreover, according to Rogerson, the poorest of the poor can farm for food, but won't make an income out of it, limiting funds for inputs. Also, the municipal policy environment regarding urban agriculture in South Africa has a history of being unfavorable, which has long limited support, trainings, etc. Apart from that, the urban environment also proves to be a big barrier to urban agriculture. Rogerson states that the fundamental constraints on urban cultivation in South African cities are access to secure land for cultivation, crop security, and access to water. (Rogerson, 2003). With farmers already coping to use their limited resources as sustainable as possible, these problems are the source of struggle for a lot of the urban poor.

Still, many authors refer to urban agriculture as a vital tool for securing food and income in the urban environment, with a additional positive impact to urban ecology and green spaces in South

African cities (May & Rogerson, 1995; de Zeeuw et al., 2002; Rogerson, 2003). Additionally, in line with de Zeeuw's conclusion (2002), May and Rogerson (1995) concluded after a Durban case study that urban agriculture, through community-based initiatives, can have an immense psychological impact on communities. Feeding schemes, for example, are community projects where community gardens are used as sources for food for the community. Very poor or underfed community members are usually targeted with these schemes. Apart from food production, they underline the importance of resource conservation, waste recycling and decreasing dependency on transport, and stress the fact that sustainable urban agriculture needs to be integrated into urban planning and development programmes.

Figure 10: The Newlands/KwaMashu Agrihub, Durban (Photo by Jacob Knegtel)

So what's the bigger picture? Looking at the national survey data between 1999 and 2008, the prevalence of food insecurity in South Africa appears to be only half of what it was nine years before, from 52.3% to 25.9%. However, the proportion of South Africans at risk of experiencing food insecurity remained virtually unchanged. The decline was noted in both urban and rural areas, where food insecurity dropped from 42.0% to 20.5% and from 62.0% to 33.1%, respectively. In contrast to the four rural provinces in South Africa, the predominantly urban province of KwaZulu-Natal scored stayed below this national trend, with the decrease of food insecurity from 46.5% to 22.0% (Labadarios et al., 2011). These numbers show that food insecurity is still a major problem in South Africa, and cities like Durban.

3.2.3. Climate change

The third notion of this thematic assessment is the concept of climate change, and the vulnerability to this phenomenon in South Africa's cities. The UNFCCC (Framework Convention on Climate Change) defines climate change as *"a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observer over comparable time periods"* (IPCC, 2014, p. 1450). Important to state here is that this definition highlights the human induced climate change in addition to the natural climate change, two important aspects of the phenomenon which should not be confused with one another.

The IPCC defines the term 'climate vulnerability' as follows: *"Vulnerability to climate change is the degree to which geophysical, biological and socio-economic systems are susceptible to, and unable to cope with, adverse impacts of climate change"* (IPCC, 2007, p. 779). Research on the vulnerability to climate change sheds a light on the development of policies that reduce the risks concerning climate change. The two primary response options to the risks posed by climate shifts are 'mitigation' of the effects of climate change and 'adaptation' to climate change. Mitigation entails the limitation of global climate change by eliminating greenhouse gases (GHGs) and enhancing their sinks. Adaptation refers to both moderating the adverse effects of certain climate change through a wide range of actions targeting the system itself, and harnessing the new opportunities brought about by climate change (Füssel & Klein, 2006). However, one can only respond to a problem like such, if it is actually 'perceived' as a problem. Riggio et al. (2001, p. 39) underline this assumption in their book as a lack of the first process of problem solving, which is 'defining the nature of the problem to be solved'. This translates to the awareness that a problem exists, the identification and definition of the problem, and the construction of its parameters.

Conventional views and studies have usually been geared towards mitigation, as it provides options and solutions towards eliminating climate change. However, in addition to these developments, there's a growing need for more comprehensive consideration of adaptation as a response measure to climate change (Füssel & Klein, 2006).

Looking at the prevalence of climate change itself, South Africa is the second-highest greenhouse gases (GHG) emitter of Africa, mainly because of its coal-based energy plants. Durban, being the largest port city on Africa's eastern coast and harboring 3.5 million people, is one of the country's key economic hotspots (Roberts, 2008). Within the province of KwaZulu-Natal however, the biggest source of climate change is not urbanization – despite popular belief – but rather its industrial heart: the city of uMhlathuze, with 47 tonnes of CO_2 emission per person in 2004 (Satterthwaithe et al., 2009). Durban, with its citizens' consumption accounting for about six tones of CO_2 per person, still contributes significantly to its country's emissions. At the same time, the city is located in an ecologically sensitive area, with climate change adding to an increase in daily maximum temperatures, an increase in rainfall and a rise in sea level. These climatic shifts will most likely lead to decreased agricultural output, increased soil erosion from flooding, and damage to not only biodiversity and ecosystems, but also social and physical infrastructure. Every of its city's 3.5 million citizens will be affected by these changes (eThekwini Municipality, 2007).

From 2000 onwards, the eThekwini Municipality received approval to give its Environmental Branch the lead regarding its climate change policy. This resulted in the Municipality Climate Protection Programme (MCPP), which developed in two phases (Roberts, 2008):

- Climatic Future for Durban project: A partnership established between the municipality and the Council for Scientific and Industrial Research, assessing the local climate change trends and its range.
- Headline Climate Change Adaptation Strategy project: The conclusions stated by the partnership resulted in headlining multiple climate change adaptation projects, mainly focusing on water and health.

After a few years, these mainstreamed adaptation strategies eventually took shape of the Climate Smart Communities pilot project. The municipality acknowledged the importance of greater societal

resilience, outside of local government action. As a result, community-based adaptation pilot projects were set up in two poor, high risk, low-income communities: Ntuzuma, representing the urban focus, and Ntshongweni, representing the more rural center of attention. Of importance within these projects were community-based adaptation planning, food security, the implementation of micro-scale agricultural water management technologies, the use of community theatre, community reforestation and sea-level rise modeling. Both the 2010 FIFA World Cup ™ and the Durban Climate Change Partnership played a supporting role in these projects (Roberts, 2010):.

3.3. eThekwini Community garden statistics

Although most of the literature findings in the theoretical chapter apply not only for individual homestead farmers but for community gardeners in the poor regions of the eThekwini Municipality as well, only around 10% of the urban farming activity happens in these community gardens. However, these small farm plots are immensely important to this research, as these are the places where municipal plans, via urban agriculture policy, get implemented within communities. They also serve as places where local farmers, volunteers and other interested people can learn to farm and to help to feed themselves and their community. Because of this link between the municipality and the communities, the eThekwini Municipality was able to gather a list of all the community gardens in the eThekwini Municipality, along with relevant specifications about each garden. From this dataset the following conclusion could be derived from 662 community gardens (eThekwini Municipality, 2010):

- Looking at the municipal rating, 112 were rated as 'poor', 131 as 'average', 191 as 'good', 132 as 'very good' and 82 as 'excellent'. Fourteen gardens weren't operating yet;
- Of all the gardens, 93 are located in Central eThekwini, 156 in East eThekwini, 117 in North eThekwini, 142 in South eThekwini and 139 in West eThekwini;
- On average, each garden has around nine official members. Only 18% of these nine members are active. This low number can partially be explained by the meager occupation of a majority of the gardens. Also, 23 gardens were inactive gardens at that time, fourteen were not yet operating, two were redundant, and 20 were abandoned;
- A community garden in eThekwini Municipality is on average around 6.9 years old and covers on average 0,7 hectares;
- Looking at production, 27 gardens were typified as commercially productive, 535 as semi-commercially productive, 42 as subsistence productive and 45 didn't have any production;
    - A majority of the gardens, 484 to be precise, only produces vegetables. 95 gardens focus on fruit and vegetables, Sixteen gardens on poultry, five on livestock farming, three on poultry and vegetables and one solely on fruit;
    - 342 community gardens produce organically, 148 both organically and non-organically, 85 have solely non-organic produce and two gardens weren't sure;
- When looking at their source of water, 309 gardens relied on natural resource, of which 97 used a nearby stream as water source, 70 gardens collected river water, 43 gardens relied on groundwater, nineteen collected spring water and seventeen gardens used dams to collect water. 258 gardens used potable water, of which 144 used a tap, 73 used a

communal standpipe, 41 a ground tank, five a simple pipe, two a horsepipe, two a standpipe, and two a water truck. 26 gardens relied on rainfall, nine on both natural resource and potable water and one on rainfall and potable water. 28 gardens didn't have a source of water;

  - 54 gardens didn't have water storage equipment. 57 gardens had tanks, 52 had drums, 39 had buckets, 20 had ground tanks, eight had a combination of storage types, and one had a jojo tank;

- 62 gardens were on an Eskom power grid, but 588 gardens didn't have electricity;
- 181 gardens had a formal fence, 227 an informal fence and 242 had no fence at all;
- Most of the soils measured were either poorly suitable for arable agriculture (155 gardens) or not suitable for arable agriculture (332 gardens).
- Looking at measured slopes, 87 gardens farmed on a flat surface, 71 on a gentle surface, nine on a moderately sloped surfaced and 22 on a steep surface. 29 gardens experienced erosion;
- 494 gardens sell their produce to their local community, 61 at a local market, 29 to schools, 24 at clinics, fourteen at a retail market, eight to crèches, two at retail shops, two to hospitals and 20 didn't sell at all;
  - Looking at charity, 87 gardens supplied food to orphanages, 84 to poor households, 82 gardens gave food to aged people in their community, 59 to sick people, 56 to disabled, fourteen to crèches, two to schools, one to a community office, and one supplied at a clinic. Two gardens didn't do charity;

- Looking at what immediate support these gardens wished for, 239 gardens requested fences/ gates or fence repairs, 142 requested tools and transport, 45 requested better water supply, sixteen requested financial aid, ten requested soil tests, ten requested chicken co-ops or chicken coop repairs, eight requested seeds, seven requested shelter, seven requested better road access, five requested storage facilities, four requested compost, four requested fertilizers, four requested better sanitation, four requested security guards, three requested irrigation systems, and the rest had minor requests.
- No data existed about trainings, type of support or sponsors;

4. Methodology

Along with the theoretical and conceptual framework, the methods used are the backbone of this research. Not only does a good set of methods translate the research questions to the practice of data gathering and in-field analysis, it also makes sure that the research objectives are fully addressed. This chapter will give an overview of the methodology, by first looking at the research location and the conceptual model, explaining the research site and design, followed by the operationalization of the main concepts used and ending with the methodological blueprint of this research.

4.1. Research location

The location chosen for this research is the greater Durban area, which is called eThekwini. eThekwini Municipality is located on the east coast of South Africa in the Province of KwaZulu-Natal (KZN) (see Figure 11), and is about 2297km² in size. Inhabiting approximately 3.442.361 people, compared to about 3.09 million in 2001, it consists of a diverse social unity which faces various social, economic, environmental and governance challenges (eThekwini Municipality, 2014a).

Figure 11: Map of KwaZulu-Natal (left) and the greater Durban area (right) (Saexplorer, 2014)

4.2. Conceptual model

The conceptual model, which can be seen below (Figure 12), illustrates the theoretical and contextual approach used in this research. The center of the model depicts the fundamental steps taken to cover the four research objectives stated before. Starting from the top, the framework is visible, showing the theoretical trinity of 'sustainable livelihoods', 'political economy' and 'ecosystems analysis' approaches. Along with the thematic background of the research topic, they form the building blocks of the concepts central to this study. Next, the contents of the main direction of research can be seen within the frame, starting with the concept of 'urban poverty'.

From this starting point, the phenomenon of adopting livelihood strategies is key to understanding the way these urban poor are currently developing within their metropolitan environment, with the barriers to this development accompanying these strategies. One of these activities is the practice of urban agriculture, which is different compared to its peri-urban and rural counterparts. One of these barriers affecting this activity however, is the occurrence of 'climate change', a new global phenomenon changing the ways these urbanites organize their livelihoods. These concepts both converge to a more 'evolved' type of farming, called 'climate-smart urban agriculture', which is the central concept in this research. Following the next steps taken, the second part of this research becomes clear, which revolves around the field of policy and practice. Looking at how climate-smart urban agriculture is perceived and practiced, opens up the possibility to start highlighting its strong points and its flaws within these two fields. Eventually, the data accumulated by scoping the perceptions and ideas of both urban stakeholders and urban farmers regarding climate-smart urban agriculture in the eThekwini Municipality, will lead to recommendations for a sustainable and climate change resistent urban farming environment in this urban part of South Africa.

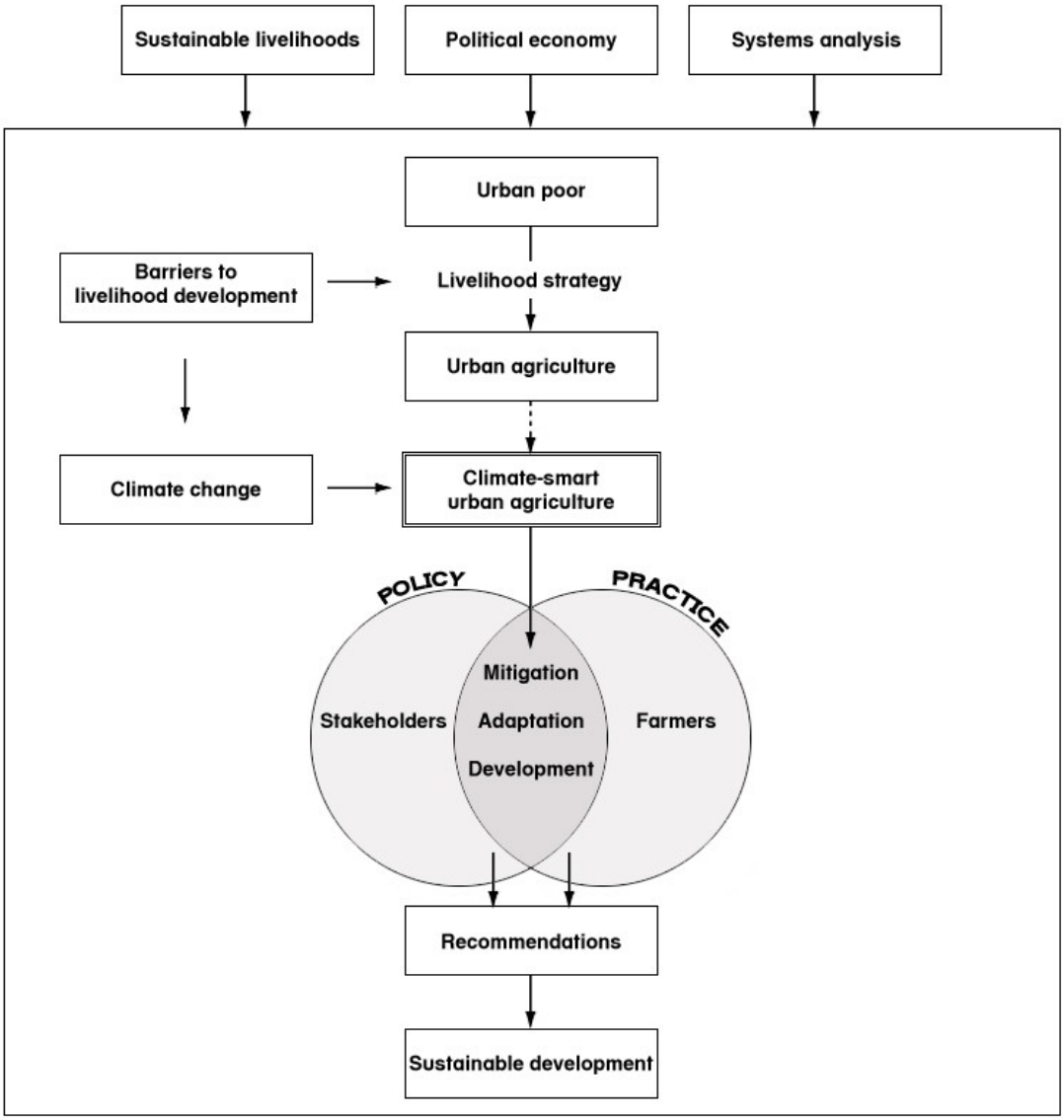


Figure 12: Conceptual model (made by Jacob Knegtel)

By looking at this model, the design of this research becomes clear. By writing up the framework and the methodology, the foundation for the initial research chapter is constructed. The research part itself is split up in two parts, with the first part addressing the first two objectives of this study, investigating the occurrence and characteristics of urban agriculture in the eThekwini Municipality. The second part, highlighting the effects of climate change and the response to this phenomenon, will address the third and fourth objective, which both revolve around perceptions, awareness and visions. The last set of chapters will cover the discussion which results from the data analysis, and the accompanying recommendations, along with the answers to the research questions in the conclusion.

4.3. Operationalization

In this part of the methodological chapter, the various concepts central to this research will be operationalized.

4.3.1. Urban agriculture

As stated in the thematic framework, urban agriculture as a phenomenon analyzed in South Africa can be defined as an 'agricultural activity within the 'intra-urban' environment'. Excluded will be the concept of 'peri-urban' agriculture, which can be explained as agricultural activity practiced on the outskirts of cities (Thornton, 2008). This research will not be focusing on these rural-urban gradient zones, and for that reason this concept will be left out the analysis.

4.3.2. Climate-smart

As defined by the FAO at the Hague Conference on Agriculture, Food Security and Climate Change in 2010, agriculture will be climate-smart when it contributes to a set of achievements regarding sustainable development. It integrates the three dimensions of sustainable development (economic, social and environmental) by jointly addressing food security and climate challenges, with these three main pillars as the central goals (FAO, 2013, p. 9):

- 1. sustainably increasing agricultural productivity and incomes ("development");
- 2. adapting and building resilience to climate change ("adaptation");
- 3. reducing and/or removing greenhouse gases emissions, where possible ("mitigation").

4.3.3. Stakeholders

Stakeholders, as described in this study, are the officials representing four different bodies of the organizational and institutional structure of the eThekwini Municipality – Municipality, NGO's, private companies and education – approached during data collection. They are all directly or indirectly involved in or affiliated with either urban agriculture, climate-smart agriculture or the combination of both in this municipality. In the methods section of this chapter, can be read why and how these people have been included in this research. They are not necessarily experts in the field of climate-smart urban agriculture, but instead represent a multidisciplinary field that has a direct or indirect link with (climate-smart) urban agriculture policy and/or practice. This way, their perceptions can provide an understanding of the extent of climate-smart urban agriculture

knowledge and promotion, as this phenomenon is still in its infancy here. Generally speaking, urban farmers are also urban agriculture stakeholders, but this research makes a distinction between policy 'stakeholders' and direct practitioners of urban agriculture ('urban farmers').

4.3.4. Perception

A large amount of the questions used across the data collection applied in this study involves the stakeholder's perception of different aspects and characteristics of urban agriculture and its climate-smart potential in the eThekwini Municipality. A perception, as used here, is the level of personal insight or the manner of individual understanding a stakeholder has. In some cases, the degree of significance regarding the respondents' perceptions will be investigated in the upcoming data analysis chapter. The term 'significance' here has nothing to do with statistical significance, used as a probability concept in statistical hypothesis testing, but instead refers to the degree of affirmation regarding perception.

4.3.5. Key-informants

One of the types of data collection in this study is the use of semi-structured interviews. These will mainly be used to interview key-informants. These individuals are experts within the field of climate-smart urban agriculture, and will represent one of each of the four stakeholder groups. This doesn't mean that these experts are guaranteed to be part of the stakeholder questionnaire participants. More clarification about these key-informants will follow in the methods section of this chapter.

4.3.6. The ABC Model

In one of the expert interviews, the private company expert illustrated the ABC model, which serves as a development framework within the field of urban agriculture policy and practice: *"The ABC is a sequential plan of phases. In phase A the introduction of 'homestead gardens' is promoted and facilitated. Phase B focuses on 'the commonage areas', with communal gardens and cash-crops or surplus food production; C stands for 'setting up cooperatives and aiming for market penetration'. So instead of focusing on the white elephant, first focus on production, and then on the market. A great example of this in action is the successful Dukuduku project, in the uMkhanyakude Municipality"*. This model can also be found in other case studies, such as Egziabher's 1994 study in Addis Ababa about urban agriculture in Ethopia. In his study he showed how individual urban farmers had a need to strengthen their position by working together. Their communal work eventually led to the formation of cooperatives, which in turn made sure their market position as a cooperative become more beneficial (Egziabher, 1994).

4.4. Methods

As mentioned earlier, to examine the perception and practice of climate-smart urban agriculture, correctly approaching both urban farmers and relevant stakeholders opens up the possibility to investigate both practice and policy gaps, along with strong and sustainable aspects of this type of agriculture. This objective is addressed by using three methods of data collection. By using a mixed-methods approach, it becomes a key objective to answer the research questions by cross-comparing these three techniques. The emphasis in this study lies on qualitative data collection and analysis, with additional quantitative data examination. According to Brannen (2005, p. 14), the design of

data collection in this case can be summarized as "QUALITATIVE + quantitative". These are the three methods used:

4.4.1. Questionnaires

The first method used is a large set of questionnaires, targeting stakeholders in the four fields of organization – Municipality, NGO's, private companies and education. The participants from education will (mainly) be working in higher education institutions, as academics are the main suppliers of knowledge transfer and community education, also regarding urban agriculture, and these people will be important for future policy improvement and knowledge enrichment about this topic. The same of course applies to the other three institutional groups, and their expertise.

The participants were mainly derived from official meetings that were attended, with all of the four stakeholder groups present. During those two meetings – with one about community agroforestry and reforestation projects in the eThekwini Municipality, and the other about sustainable urban agriculture in the eThekwini Municipality – the questionnaires were handed out. A total of 50 questionnaires were filled in anonymously, and were meant to scope the stakeholder's perception of urban agriculture and their understanding and ideas about climate-smart urban agriculture in the eThekwini Municipality. These meetings were mainly attended by stakeholders from the Municipality and from higher education institutions. As these two groups are the two most important target groups for my research objectives, as they represent both policy and knowledge, they will be central during my data analysis. The various participants from NGO's and private companies – grouped together as 'organizations' – will further enrich the dataset, but due to their limited participation in numbers, no significant conclusions will be derived from their answers.

The questions in the questionnaire were partly based off a twenty page meta-analysis of the various topics in literature revolving around climate-smart urban agriculture (in South Africa and the eThekwini Municipality), which was prepared before making the questions. The analysis eventually resulted in an overview of academic content per relevant topic addressed in this research.

The questionnaire consists of three types of questions, covering demographics, practice (direct/indirect) and knowledge/ awareness. It contained largely closed-end questions, and could be filled out in around ten to fifteen minutes. The results will form the main dataset from the perspective of the stakeholders, and will be analyzed in SPSS, with the relevant crosstabs as a results. The questionnaire itself won't be included in the appendix, as this is part of intellectual property. This decision was also made on behalf of the host organization.

4.4.2. Focus group

While the questionnaires will provide an important quantitative dataset, the focus group discussion will be equally important from a qualitative perspective. And whereas the questionnaires contribute to summarizing the stakeholder's answers, the focus group discussion covers the other important group in this research; the urban farmers. These types of discussions are based on the assumption that purposively chosen partakers will interact in a way that brings forth qualitative information on a particular concept or issue, and should expose and investigate issues rather than find single quantitative solutions (Martin et al., 2002). In this research, one focus group discussion will form a representation of the community perspective and perception of urban agriculture, climate change and climate-smart solutions. The community chosen, that will represent farmers in the urban built environment of the eThekwini Municipality, is Cato Manor (see Figure 13). It was chosen because of

its intra-urban location, its history with Apartheid influence, its well-known poverty prevalence and its history with community development and urban agriculture projects. These contextual aspect will be looked at below.

Cato Manor covers about 1800 ha of intra-urban land, and lies 10km away from the city centre. It has a population of approximately 93.000 people (eThekwini Municipality, 2014b). This part of this inner-city area within the municipality houses a large informal squatter settlement, which is the result of several historical events. During the Apartheid regime big riots broke loose in Cato Manor between Africans and Indians, dubbed the 'Durban Riots' of 1949, and led to more than a hundred deaths because of racial tensions. The original inhabitants of Africans (120.000) and Indians (40.000) were relocated two years later because of the Group Areas act of 1951. They ended up in controlled, racially sanitized township spaces of KwaMashu, Umlazi and Chatsworth, areas which still show a similar racial composition today. Cato Manor itself turned into a ghost town, and became increasingly targeted by informal housing activities (Popke, 2001). From 1993 onwards, the Cato Manor Development Project started, with substantial political support. It mainly focused on housing, restructuring and holistic development, and successfully tackled some of these big challenges, with fast infrastructure and housing improvement. Urban agriculture pilots were started as well. However, the project now struggles to reach a large part of the community, missing a deeper community and social development approach, which still proves to be a significant challenge nowadays. An important aspect here is that 62% of households are women headed. More than 90% of all job placements in the region went to men, largely because the bulk of placements were in construction and women are not trained in this field (Beall & Todes, 2004). This sheds light on the fact that most of the urban farmers in the municipality are female, as these women traditionally take care of the house and their children, combining this role with gardening.

The focus group discussion (held on the 7th of April 2014) involved 16 participants, 8 low-income urban farmers – 4 women between 40 and 60 years old and 4 men between 20 and 60 years old - from the community and 8 student interns from the municipal agriculture department, who spectated and gave an insight in their municipal training, community involvement and climate change awareness. Compared to the questionnaire questions, a similar question guide was used during the focus group discussion, to eventually get these answers compared with the questionnaire answers. Assistance was provided by a translator and a facilitator aid. Apart from the usual question and answer method, a ranking matrix and a seasonal calendar were used to get the most data out of their answers.

Alongside the focus group discussion data, field data was collected. This was done by performing transect walks and informal semi-structured interviews with the farmers on their plots. During these interviews the farmers could showcase their plots, their methods used, their barriers to urban agriculture and their understanding of climate change. These visits eventually led to invitations to the focus group discussion, after a good bond was build with these people. This was done while making sure an equal amount of male and female farmers were invited, as well as taking into account age and urban agriculture experience. As one municipal worker and a few municipal interns were present at this discussion, the focus group members' responses could've been influenced by bias. This, however, was anticipated while making the question guide, and during the focus group discussion itself, the farmers' arguments and wishes were often directed at the municipal worker present, seemingly without restraint. The focus group topic list itself won't be

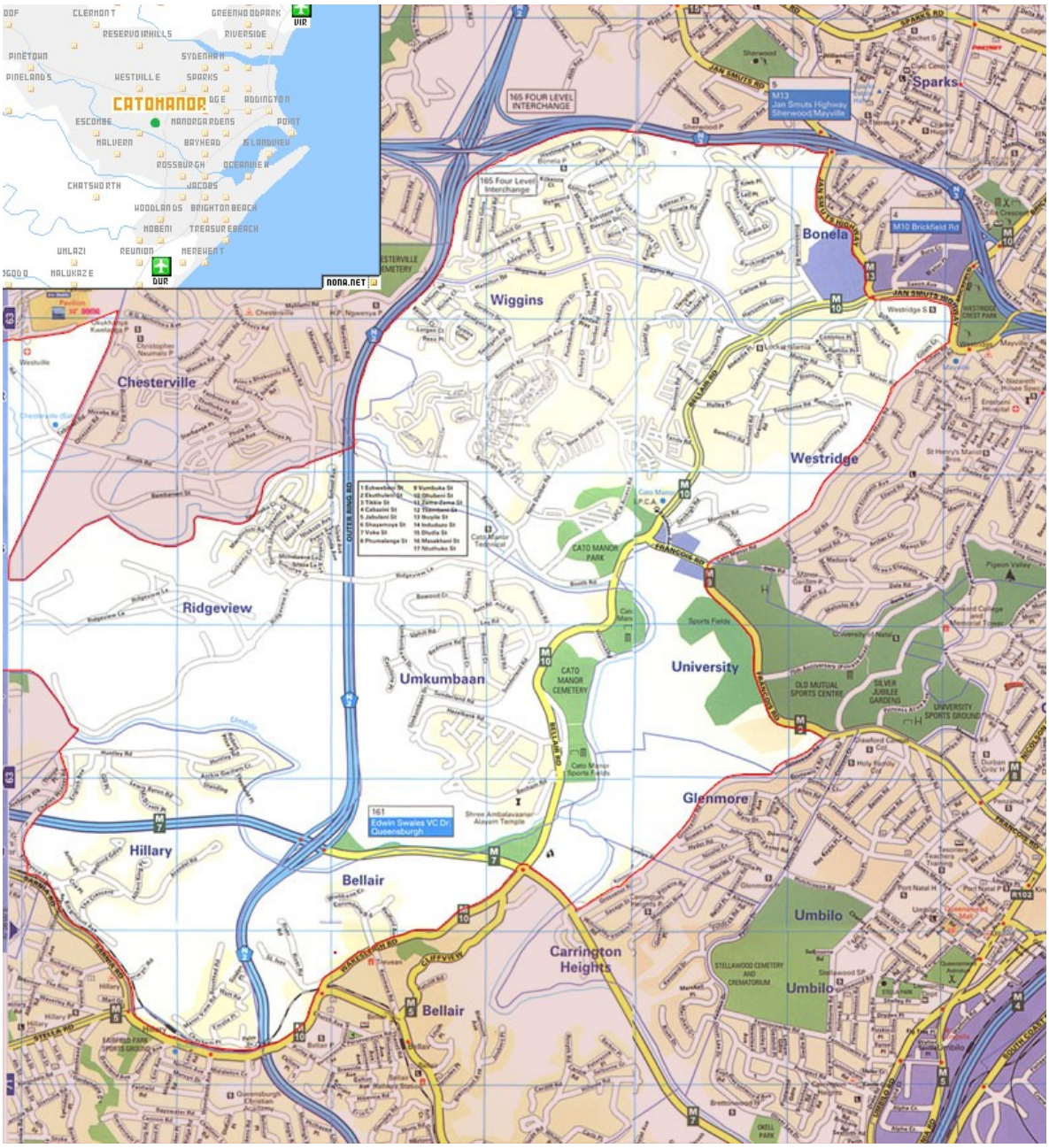
included in the appendix, as this is part of intellectual property. This decision was also made on behalf of the host organization.

4.4.3. In-depth interviews

The last research method adopted in this study are in-depth interviews. As mentioned earlier, these interviews were held with four urban agriculture experts in each of the stakeholder groups, after the main dataset was compiled. This was done because this last method used was primarily meant for triangulation, where the questions correspond with the preliminary results from both the questionnaires and the focus group discussion. Each respondent was chosen out of the network of contacts that was build up during the internship. The requirements each respondent needed to have were: 1. Direct experience with climate-smart urban agriculture practice and policy debate, 2. Acquainted with urban agriculture in eThekwini for at least five years, and 3. Representing one of the four stakeholder fields and having experience with inter-stakeholder communication within the field of climate-smart urban agriculture. Key to the in-depth interviews was scoping their perceptions and ideas on the specificities and contradictions that came out of the mixed methods used, and to probe recommendations they would find appropriate within this research context. The four interviews were semi-structured, meaning that the majority of the interview content was comparable across the four interviews, while each interview contained specific and relevant questions tailored for each institutional field. For example, the questions for the expert in higher education were more focused on knowledge transfer and training, whereas the questions for the municipal expert contained a more policy-oriented perspective. In the end, these interviews were all about triangulation within the complete dataset, to eventually strengthen the policy-oriented recommendations that will come out this study. Each interview lasted for about 30 to 45 minutes, and was recorded, transcribed and coded with Nvivo.

Each of the four experts represented their own stakeholder field, so the bias that arised had mainly got to do with them making sure the perspective of their respective fields is conveyed. However, the questions asked were tailored in a way that this perspective remained academically usable, instead of becoming too subjective and emotional. This was necessary, because of the fact that each field was represented by one interviewee, instead of multiple. This opened up a limitation as to cross-reference answers within a single field of expertise, thereby strengthening the representation. However, these four interviews were only used for triangulation, and do not form a major dataset. The interview topic list itself won't be included in the appendix, as this is part of intellectual property. This decision was also made on behalf of the host organization.

Figure 13: Map of the Cato Manor area, (left: green dot, Durban)(Cato Manor Tourism, 2014)



5. Data analysis

This chapter introduces the empirical data of this research, and follows up on the relevant methodology section, which displayed the tools and methods resulting in these upcoming datasets. It also follows up on the earlier theoretic and thematic sections, which provided the first set of information used in this research. As mentioned, the empirical data consists of three parts: the qualitative focus group data, the quantitative questionnaire data and the qualitative key-informant interview data. The character of the data analysis in this chapter is informative and total, and will be discussed cross-sectional later on.

5.1. Focus group data analysis

People interested in farming

As mentioned earlier, the focus group discussion on April 7th 2014 involved 16 participants, 8 low-income urban farmers – 4 women between 40 and 60 years old and 4 men between 20 and 60 years old - from the community and 8 student interns from the municipal agriculture department, who spectated and gave an insight in their municipal training, community involvement and climate change awareness.

Both through the focus group and the informal interviews, the farmers were very clear about their understanding of demographics regarding urban agricultural activity in Cato Manor. Here is, for each category, the most dominant demographic group according to the farmers:

- Gender: Female
- Age: Over the age of 50 years
- Employment: Unemployed
- Education: Not formally educated
- Historical race category: Black

While discussing this topic, the farmers explained that actually very few men are interested and involved in urban agriculture. The male farmers present at the focus group consisted of one older man of about 50 years old, and three younger men of about 24 years old. These younger farmers were interested in urban farming, but only if this activity is linked with a project, run under an organization. This way they could earn a bit of money and the outcome in terms of self-development was much more clear for them, and this gave them a clear incentive to farm. One of them said: *"When the opportunity comes, I would rather want to have a real job here in the city, so I could have a good income"*.

Kinds of farming practiced in the area

Within the area of Cato Manor, mainly community gardens and individual/ homestead gardens exist. Transect data revealed 10 individual plots and 5 community gardens within the Wiggins and Extension 1 districts. Most of these gardens were either started up by the Cato Manor people themselves, or allocated to them by the Municipality, remaining municipal property. Plot farming usually takes the form of tunnel farming, while using plastic bags to grow the seeds in. The advantages of this kind of farming is that it protects against insects (crickets, locusts), a phenomenon

that can be quite a hindrance to farming in the area. This method also protects the plants and crops against direct sunrays. Initially, this was only done in the form of projects and not for self-development, but this has now shifted to familiarity with the technique and they now naturally use this method. The initial project, run by the Municipality, had been happening for about 5 years in the area, and shows that municipal intervention can lead to positive uptake, but only if it is not top-down implemented, according to the farmers.

The overall types of crops they plant are spinach, beetroot, cabbage, green peppers, lettuce, cucumbers, tomatoes, onions, brinjal, maize, butternuts, bananas, pawpaw's, turnips, basil, lemons, avocados, potatoes, mustard, amadumbees, dry beans, sugar beans, chili's, peas, popo's and mealies. Flowers are also grown in some gardens, mainly destined for medicinal purposes.

The older farmers that had an understanding about seasonal agricultural activity, knew that they had to plant spinach, beetroot, green pepper, tomatoes, onions and cabbage in the winter, butternut, sweet potatoes, dry beans and mealies during spring, amadumbe, spinach and butternut in the summer, and harvest the produce in autumn, alongside compost collection. About half of the farmers spoken with actually had little understanding of seasonal planting and harvesting, let alone understanding climate change. These farmers explained that they plant the crops they plant because of the local demand for certain crops and the familiarity of these different kinds of crops. Constrained provision and a lack of training also plays a role in not exploring a vast range of vegetables. *"I know about seasonal planting, but I've never received any training about our local climate and climate change"*, one of them said, which means that these farmers mainly build upon their local knowledge instead of on formal knowledge. Further on, their relationship with climate change will be discussed in more detail.

They usually dig and mix the soil with manure, water the mixture, put this mixture in the bags, and leave these bags alone for about a week. After that they put in the seeds; a process which can be seen as permaculture. Fertilizer is commonly provided with the seeds. If not, they use compost. Seeds are either given to them by the Municipality (agrihubs), or bought by themselves in the community. Water is often gathered from nearby streams. Only a few farmers use water reservoirs provided by the Municipality.

Figure 14: A compost chute as a climate-smart urban technique, Durban (Photo by Jacob Knegtel)

Reasons for farming in the area

The urban farmers in Cato Manor clearly stated that the main reason for what they call "open farming" is improving their food security. This strategy can be subdivided in two forms:

- Subsistence/ household farming: The most popular method of urban farming in Cato Manor, where people farm on plots within the perimeters of their own homestead. Food security is the main reason for this form of farming, and according to the farmers it provides them with enough food to be food secure.
- Community gardening: This form of urban agriculture is mainly used in Cato Manor to provide for food schemes. This way, the produce not only feeds the farmers themselves, but also the community. Usually neighbors, homeless people and applicants are taken into this scheme.

Secondly, money inflow is a significant incentive to farm. In this case, poverty alleviation serves as the main encouragement. Income security, however, isn't achievable with urban farming, according to the farmers. Hardly any income is generated, and the money that does flow in only sustains basic needs, while no extra income is generated to advance their economic status. One of them said: *"I'm not sure if I want to further pursue urban agriculture in the future, because with a regular job I'm actually able to be income secure. At the moment, this is not the case, and climate change is making it more difficult for me to love urban farming*. *While my yield has dropped over the last year because of a severe drought, I still have to feed five children. I lost the passion for farming because of these events*".

Thirdly, leisure was commonly given as a reason for farming. All of the farmers said that they like to farm on a daily basis, and it gives them a sense of pride. Especially if you think of the fact that these people have lived in an urban environment their entire life, it's understandable to presume that these farmers should feel proud, seeing their commitment and persistence to farm. The community plots were all about five years old, whereas the household plots are older, around fifteen years old.

A small amount of the urban agricultural produce is sold via markets. Although markets exist in Durban where farming produce from the area can be sold, not one of the farmers spoken with during the focus group and informal interviews were engaging in this activity. However, a farmer couple approached during the informal interviews, of which the male farmer was also present during the focus group, runs a shop on their homestead where they sell their produce to locals. Also, one of the community gardens, with four of the active farmers present at the focus group, is currently working together with the South African Peace Network (SAPN). This NGO is currently supplying organic and open pollinated seeds to these farmers and teach them natural and/ or permaculture farming techniques. Currently they are setting up an organic market in the community, where future produce could be sold. Also, the SAPN is looking into a farm site with over 50 plots for the community to grow food. This lead to a positive community response, but the market penetration by the Cato Manor farmers is still underdeveloped.

Challenges and promoters encountered with farming in Cato Manor

Benefits

The Cato Manor farmers came up with numerous benefits regarding urban agriculture. Next to the reasons for farming they gave earlier, of which food security was the most significant, they also had other explanations to why they like to farm in the urban environment. First, they stated that it is easy to sell the planted vegetables to the neighborhood this way. As the activity is within or close to the confinements of their homesteads, they loved the fact that not only the farmers themselves, but also their neighbors and surrounding community could benefit directly from urban agriculture. *"I can feed the people that I know are food insecure"*, is what one of the female farmers said.

Secondly, they don't need any livestock, which would be a deliberate asset in peri-urban and rural parts of South Africa, and the city soil is of good quality. Some of the farmers expressed their desire to incorporate fowl farming into their future strategies. Although this needs a feasible plan, a number of these farmers said that they are currently trying to get these integrated crop systems to work, in the form of a chicken or fish farm, which have a climate-smart potential as illustrated later on.

Thirdly, these farmers see the advantage of urban agriculture directly while they produce, and it gives them a sense of pride and independency. Two of the farmers can almost live from their produce, as they are currently making a smallholding out of their agricultural activity. But even the ones that are making the slightest amount of money from selling their produce, said that they like urban agriculture as a leisure activity, and a part-time money making scheme. Nothing stops them from growing and harvesting food on their homestead plots and community plots, as there are no limited hours, and it's a safe and secure method of self- and community development.

Looking at the 1999 data in Table 1, the policy forms that were visible in Durban back then, are still mainly present in eThekwini today. Almost all of the checked boxes can still be checked nowadays. However, among the other barriers to UA in Durban, two of these policy forms conflict with the current status-quo. These barriers, along with these two contradictions, are discussed next.

Barriers

The farmers of Cato Manor also mentioned quite a lot of barriers to urban agriculture in their farming environment. Above all, lack of education and skills regarding agriculture was the most significant barriers, according to them. They said there is a need for workshops for more empowerment and enlightenment about this topic. People need education on what to plant when and how, and which crops to plant in which season. There is apparently already a lack of sustainable help and mentors, and their general education level is already quite low. This barrier contradicts the 1999 data in Table 1.

Next, they stressed the problem of limited land availability. They require more land for the type of urban agriculture they want to pursue, which surpasses their small household plots. This could be due to the same policy gap that is visible in Table 1.

The next barrier is constrained proper equipment and other necessities, which they need for the types of agriculture techniques they already use and wish to undertake, both of which including climate-smart urban agriculture. And because of the limited options of buying or receiving seeds, they mentioned seedling shortages, which limit them in maximizing their agricultural output. A lack of water tanks, cans and rainwater catchment barrels/gutters seems to be apparent as well, just as the need for nets to protect crops against insects, a problem that each of the farmers want to deal with as soon as possible, as they said. Some already took action, as they use crushed onions and sprinkle it all around the garden. This barrier contradicts the data in Table 1.

These farmers occasionally transform into cooperatives, a much sought after form of institution in the area. However, these often fail because of fighting and differences of opinion, suggesting the fact that these co-ops aren't structured well enough. One of the farmers explained this: *"There are differences stances on co-ops within the community. Some farmers try to persuade other farmers to join or to engage in a cooperation. Other farmers remain skeptical, because they think their fellow farmers will steal their produce, and tend to remain individual in their way of farming"*. A contextual argument in favor of this skepticism, is the lack of gates and fences in the area, mirroring the 1999 data of Table 1. This problem is intensified by another institutional problem, which is the lack of hours people can farm on community plots because of gate times and rules. Sponsors, like the Rotary Club or the municipality, usually govern these times and rules. Dependent landownership by such a funder can provide problems. For example, the Rotary Club provided seeds, compost and seedlings for one of the gardens, but they now discontinued this support because of money issues, which resulted in a lack of funds and supplies for this community garden. The young farmers on this plot are now losing their sense of responsibility because of this break up, and find it increasingly difficult to still like the work. The above problems are products of not only the amount of mutual trust within farmer groups – which is good and visible but certainly needs to grow – but also the lack of facilities and the lack of structure needed to organize and maintain a solid and sustainable coop.

Last but not least, the urban environment proves to be a barrier to agriculture. Having uneven land nutrients in the soil for example, because of height gradients in the landscape, makes farming in this area very difficult. These height variations also makes it physically tricky to farm, even with terraces. Above all that, monkeys steal occasionally, pests occur and in some places city clay in soil affects the produce. When this clay dries up for example it becomes a difficult type of soil to work with. Finally, they stated that climate change could be the missing puzzle piece to the questions they have regarding the weird and extreme weather patterns they coped with during the last ten years. More on this topic further on.

Climate change

What immediately became clear from both the focus group and the informal interviews was that the farmers of Cato Manor know very little about the global phenomenon of climate change. They also don't have the local knowledge about the occurrence to optimally adapt urban agriculture to climate change and mitigate its effects. Seasonal planting is commonly referred to when farmers get asked about their understanding of climate change. The often limited knowledge they have about which crops to plant in which seasons, can be attributed to seasonal weather shifts. This phenomenon frequently got mixed up with climatic shifts attributed to climate change.

Almost all the farmers that did know about climate change – a small amount within the total group of farmers interviewed – said that they didn't understand the local impact of climate change, although they did mention that their harvest has been decreasing tremendously. The remaining farmers who did know the local context, said climate change heavily affected their produce over the last ten years, mainly in the form of droughts and intense rainfall. Resulting from their experience and their point of view, they concluded that a sharp rise or fall in temperature resulted in floods. Because of these events they suffered from soil erosion, which was visible while visiting the different plots. *"Because of these extreme climatic events, my yield deceased sharply this year. I had to adapt my seed use because of these changes. It disrupted parts of my agricultural activity to the extent that I feel I want to abandon urban farming and find a job. The more this will happen, the more I'm starting to dislike agriculture here"*, said one of the solitary female farmers.

When posing the question of how they would envision better working and growing conditions for their agricultural practice, they answered by saying they wished for stable temperatures, and methods to establish this. They clearly expressed wanting climate change training on getting to grips with the subject matter, how this global phenomenon translates to local conditions and how to adapt to these changes, as the famers were very interested in knowing more about climate change and climate-smart activities. They mentioned having high hopes for climate-smart urban agriculture, but only if it would result in improved food security, better planting and harvesting conditions and less uncertainty regarding future yields.

Of the sixteen climate-smart urban agricultural techniques listed, Cato Manor actually showed applications of eleven of them already, although to a low extent. Although most of these techniques were introduced in the community by either extension officers – hired by the Municipality – or by knowledge sharing – for example via older and more experienced Cato Manor farmers – the application of the techniques in the community is rare and far from mainstream. Moreover, most of the farmers don't know of the climate-smart potential of these activities, but are curious to learn more about these techniques.

When asked what kind of municipal support the farmers would like to receive the most, all of the support types listed were needed. Some of these interventions were clearly needed more than others, which were:

- Training provision
- Farming support
- More land
- Help with the development of cooperatives

The other wishes were financing, water supply improvement, better infrastructure, community-to-market access improvement and the development of appropriate policies.

Figure 15: Female urban farmer and her dry soil, affected by climate change, Durban (Photo by Jacob Knegtel)

5.1.1. Sustainable Livelihoods Approach

By using DFID's Sustainable Livelihoods Framework, this chapter's last section focuses on the degree of sustainability regarding the way the Cato Manor community lives and farms, looking at their vulnerability, their assets and their strategies. As could be read earlier in the theoretical chapter, this framework consists of several concepts, representing the different notions of sustainability:

- Vulnerability context: In the thematic chapter, the political and spatial history of Cato Manor was illustrated. What became clear was that the events during and after Apartheid, in conjunction with the further development of this external environment became the main reason behind many of the inhabitants' hardships, and the fact that it still remains one of the poorest regions in urban eThekwini. As became clear out of the focus group and informal interviews, a lack of space, the harsh urban environment and the absence of sufficient municipal support add up to these contextual circumstances.

  Fitting it into the framework, the *shocks* in this case are mainly aftershocks, as the forced removal of specific race groups during Apartheid (conflict shock) and the global financial crisis (economic shock) surfaced some of the long-term problems in Cato Manor, such as unemployment, poverty, crime, income inequality and HIV/Aids. In addition to the Cato Manor farmers mentioning these problems, they are visible when driving though the area. An example is a "smash & grab" warning sign posted on a street light next to one of Durban's busiest roads, intersecting through Cato Manor. It refers to muggers smashing windows of stationary vehicles and grabbing everything they can, but the sign itself keeps getting removed by these criminals, sometimes on a daily basis. The road recently got

mugged of its lights, which were tapped illegally to feed the community. All to little avail, as the area is almost completely dark at night, allowing criminals to be more active.

Secondly, various *trends* in Cato Manor can be linked to vulnerability. Although a lot of people from the area got relocated during Apartheid, the vacant spaces it created got targeted by illegal squatters. The increasing amount of squatters led to a some of Cato Manor's areas to be densely populated, a population trend which is still visible and led to potential cultivatable land becoming more scarce. One of the most positive trends can be traced back to municipal policy, which is becoming more focused on a greener agenda. This already led to many Cato Manor houses receiving solar water heaters, which can be placed on roofs and provide a sustainable way of heating water. Their effectiveness however is disputed, as currently the discussion about benefit-cost ratios is well underway.

Third, *seasonality's* regarding vulnerability are especially relevant when looking at the practice of urban agriculture. As mentioned, not in every season can these farmers harvest their produce, which means stable food security is dependent on strategic seasonal farming. Not every farmer spoken with, had a good understanding about this strategy, leading to greater seasonal vulnerability. Climate change, with its effects on weather patterns, has definitely worsened this situation.

- Capital: Of the five capitals used in the framework, the farmers of Cato Manor embrace all of these to various extents.
    - First off, natural capital isn't abundant in this locality. Mainly the lack of trees as carbon *sinks* and the low amount of water that they can use as a *resource* are to blame. The terrain they have to deal with can also be quite harsh. One of the farmers said: *"I have to farm on a steep slope, and even with terraces it's hard to make sure every crop receives enough water and sufficient nutrients"*. However, natural *processes* are abundant in this semi-tropical city. As could be read in the thematic chapter, Durban is located in an ecologically sensitive area, with climate change adding to an increase in daily maximum temperatures, an increase in rainfall and a rise in sea level.

    - Despite of these natural processes being visible, there exists an absence of sufficient knowledge about these processes, such as climate regulation and understanding the carbon cycle, within the Cato Manor urban farming community. Overall, human capital seemed to be quite limited as well. Most of the farmers were formally uneducated, and with an average life expectancy of less than 60 years, there's much to improve on health alone. Although the capacity to work is high, they lack the essential knowledge and skills to fully engage in sustainable agriculture, let alone adapting to the changing climate. This was particularly visible with the younger farmers. The older farmers had more devotion to urban farming, and were better skilled because of their experience, regarding both farming techniques and environmental awareness. There were no significant differences between gender.

- Thirdly, these farmers had problems with acquiring enough physical capital. Looking at physical infrastructure, especially land quantity was a heavy discussion point. Security, water and energy problems on the other hand were less of an issue. Focusing on tools and technology, the farmers expressed they lack enough seeds, fertilizers and pesticides. Their innovative way of using traditional tools and technology however seems to be their strong point. The essential tools every urban farmers uses and has laying around are a hoe or shovel, a bucket and a watering can. They also use materials laying around to make compost bins, protective nets and plant beds. However some of the farmers lack even (one of) these tools. *"I don't have watering cans due to a low income, so the only thing I can use are my own buckets"*, is what one female farmer said.

- When discussing their financial capital, there were some mixed reactions. Although they mentioned being fairly income secure, this wasn't achieved because of urban agriculture. Although the practice gives them a welcome amount of money, they still relied on other sources of income to focus on savings, pensions and remittances. Although their income sources were quite diverse, most of them relied on welfare grants, just like the thematic chapter illustrated. A few of them partially relied on remittances from their children as well. Being fully income secure was one of their most important goals for the future. One farmer even said: *"My job as a contractor is of vital importance for me. This means that as long as my small household farm doesn't interfere with this job, I'm OK with farming"*. An interesting detail is the female dominance of urban agriculture in Cato Manor, as they are predominantly the ones farming and selling their produce, while their husbands have jobs in or around the inner city. The younger farmers expressed the most visible urge to make money, which is why they had doubts about liking urban agriculture, as its potential for income security is quite low according to them. Although the thematic chapter and the farmers' response made clear that urban agriculture as an income security strategy isn't that realistic, two of the involved farmers showed that with a humble smallholding a steady flow of sufficient income is in fact possible. Thus, workshops about income facilitation and urban agriculture have a huge potential.

- The fifth and last capital discussed, and also their strongest asset of capital, is social capital. Although some Cato Manor farmers said they were afraid of crop theft, there seems to exist communal relations of trust and mutual support. Proper fences and common rules and sanctions strengthened these relations. The community gardens can be seen as an activity were the Cato Manor network and connections meet urban agriculture. They also form meeting places where more experienced farmers can train beginner farmers when it comes to farming methods and climate-smart techniques. Also, cooperation's can form here, which serve as the ideal relationship between social capital and urban agriculture, requiring cooperation, trust and (knowledge) exchange. However, current co-ops in Cato Manor can be described as a disaster, with fights and indifferences leading to disbandment of these structures. Food schemes however are contributing to the strengthening of social capital.

- Policies, institutions and processes: The eThekwini Municipality is the governing body in Durban, thus also Cato Manor. The community works together with the Municipality via the Cato Manor Development Programme (CMDP), which mainly focuses on housing, education and pro-poor developmental strategies. Additionally, there are small programmes that run outside of this development plan. According to the farmers themselves, they require more support from the Municipality, as this programme doesn't focus on urban agriculture. This is in fact as good as true, as no CMDP influence regarding urban agriculture was visible in the field, and their website also lacks data and information about urban agriculture and shows no sign of relevant projects. Institutional influence was mainly visible in the form of property ownership, time limits and rules upheld by funders or organizations. The most important processes that could influence the Cato Manor farmers are the forming of cooperatives or the sustainable practice of working together on a community plot. Here, decision-making processes, norms and rules apply, in contrast to individual farmers on household plots, and should be focus points for future policy objectives, with regards to community building.

- Livelihood strategies and outcomes: Urban agriculture in Cato Manor is used as a pro-poor developmental tool, as the production and sale of the crops leads to consumption, income generation, food schemes and knowledge exchange. The fact that it requires limited funds and input, and can be carried out almost any time a day, makes it a worthwhile activity according to the farmers. The thematic chapter, focusing on urban agriculture more generally, backs this conclusion up. Both on an individual level and on a community level this lowers their vulnerability, increases their well-being, and strengthens their social capital, financial capital, human capital. From this starting point, improving and maintaining the available physical infrastructure is of vital importance for the sustainable potential of urban agriculture, and climate-smart activities can lead to securing and improving their natural capital, which still needs much attention. Sustainable use of their assets and a natural resource base are key to these objectives. Looking at gender, urban agriculture is beneficial to the male-female role in an urban environment. It creates an incentive for poor females, who traditionally stay at home and take care of their children, to work here and contribute to both food security and supplementing the household income, whilst building up a sense of pride. Serving as a leisure activity as well, it educates these farmers about their local environment, the climate and embracing nature for future generations. With climate change already impacting this city, mainstreaming climate-smart urban agriculture would be a welcome sight for them. *"Climate-smart agriculture could prove to be very helpful for me"*, is how one of the farmers summed up what the other farmers expressed as well.

The next chapter will zoom in on the other side of the policy spectrum, which are the stakeholders. The data from the stakeholder questionnaires will be analyzed below.

5.2. Questionnaire data analysis

The following chapter covers the results and accompanied analysis of the questionnaire data, as mentioned in the methodology section. All of the scores (unless stated otherwise) correspond with the percentages of the amount of participants stating 'yes', or in other words, ticking the box of the corresponding answer. The municipal stakeholders' response is visible as 'Mun.', the organizational respondents as N. + P. (NGO + private companies), the educational respondents as 'Educ.' and the combined scores are visible as 'Combi.'. First off, let's visualize the buildup of the stakeholder respondents:

Table 11: Background of participating stakeholders (n=50)

Type of organisation	Frequency	%
Government	18	36
NGO	2	4
Private company	3	6
Educational institution	25	50
No response	2	4
Total	**50**	**100**

As can be seen, more than 75% of the respondents were either in Government (Municipality) or educational institutions, such as the universities. The minority consists of the organizational respondents, adding up to 10% of the total respondent base. A list of the majority of organizations and institutions these respondents were affiliated with, can be found in the appendix.

Engagement in urban agriculture

Table 12: Aspect of urban agriculture engaged in or dealt with in the eThekwini Municipality (in %)(n=46)

	n=17	n=5	n=24	
Aspect of urban agriculture	**Mun.**	**N. + P.**	**Educ.**	**Combi.**
None	17.6	40	16.7	19.6
Community education	35.3	40	12.5	23.9
Education and training in higher education institutions	5.9	-	66.7	37
Fundraising	-	-	-	-
Urban agriculture research/ reporting	23.5	20	25	23.9
Policy review and development	11.8	20	4.2	8.7
Urban agricultural project planning and management	52.9	40	12.5	30.4
2 respondents were left out; 2 respondents (1 in Mun. and 1 in Educ.) had no response				

Overall, most of the stakeholders engaged in or dealt with 'education and training in higher education institutions' (C: 37%), with 'urban agricultural project planning and management' as a close second (C: 30.4%).

Urban agricultural approaches encountered

Table 13: Urban agricultural approaches encountered in the eThekwini Municipality (in %)(n=46)

	n=18	n=5	n=23	
Urban agricultural approach	**Mun.**	**N. + P.**	**Educ.**	**Combi.**
Individual/ homestead gardens	66.7	100	65.2	69.6
Community gardens	77.8	80	47.8	63
School gardens	66.7	80	26.1	47.8
Allotments	5.6	-	4.3	4.3
Smallholdings	27.8	20	13.0	19.6
Other, specify	11.1	-	8.7	8.7
2 respondents were left out; 2 respondents (2 in Educ.) had no response				

Both the stakeholders and the focus group members state that they mainly encountered UA in the municipality as either in the form of individual/ homestead gardens (C: 69.6%) or community gardens (C: 63%).

All the stakeholders encountered mainly individual gardens (M: 66.7% - N+P: 100% - E: 65.2%) and community gardens (M: 77.8% - N+P: 80% - E: 47.8%) as a form of UA activity in the Municipality. School gardens however, where encountered by the municipality and the organizations as major UA activity (M: 66.7% - N+P: 80%), whereas the educational institutions barely encountered school gardens (26.1%). Additionally, four respondents, two in the municipality and two in education, encountered an approach not listed, respectively 'community reforestation', 'large scale commercial agriculture', 'rooftop gardening' and 'public reserves'.

Perception of urban agricultural strategy of farmers

Table 14: Perception of urban agricultural strategy of farmers in the eThekwini Municipality (in %)(n=48)

	n=18	n=5	n=25	
Urban agricultural strategy	**Mun.**	**N. + P.**	**Educ.**	**Combi.**
To produce food for subsistence purposes	94.4	100	76	85.4
To generate income	88.9	100	84	87.5
For recreational and leisure purposes	33.3	20	28	29.2
For educational purposes	38.9	20	40	37.5
Feeding schemes	55.6	60	40	47.9
Connecting to nature	33.3	-	32	29.2
Other, specify	-	-	-	-
2 respondents were left out				

Both the stakeholders and the focus group members state that UA as a strategy is mainly in the form of subsistence food production (M: 94.4% - N+P: 100% - E: 76%). The stakeholders also perceive income generation (M: 88.9% - N+P: 100% - E: 84%) to be a highly adopted strategy, in contrast to the focus group member's perceptions on this strategy.

The urban farmers also highlight the significant importance of UA in their community for feeding the community and educate/ train people. To a lesser extent, this perception is shared by the stakeholders, with feeding schemes averaging around 50% (M: 55.6% - N+P: 60% - E: 40%) and educational purposes averaging around 30% (M: 38.9% - N+P: 20% - E: 40%).

Perception of demographic involvement in urban agriculture

Table 15: Perception of demographic involvement in urban agriculture in the eThekwini Municipality (in %)

Demographic category	Group	Mun.	N. + P.	Educ.	Combi.
Gender (n=44) M: n=16 - N+P: n=5 - E: n=23	Male	6.3	20	26.1	18.2
	Female	93.8	80	73.9	81.8
	No response	4 respondents (2 in Mun. and 2 in Educ.) had no response			
Age (n=41) M: n=15 - N+P: n=3 - E: n=23	Youth (age < 25)	6.7	-	8.7	7.3
	Adult (age 25-50)	46.7	66.7	69.6	61
	Elderly (age > 50)	46.7	33.3	21.7	31.7
	No response	7 respondents (3 in Mun., 2 in N. + P. and 2 in Educ.) had no response			
Level of income (n=41) M: n=14 - N+P: n=5 - E: n=22	Low	92.9	80	72.7	80.5
	Middle	-	20	22.7	14.6
	High	7.1	-	4.5	4.9
	No response	7 respondents (4 in Mun. and 3 in Educ.) had no response			
Employment (n=40) M: n=12 - N+P: n=5 - E: n=23	Unemployed	100	100	78.3	87.5
	Employed	-	-	21.7	12.5
	No response	8 respondents (6 in Mun. and 2 in Educ.) had no response			
Education level (n=37) M: n=13 - N+P: n=3 - E: n=21	No formal education	76.9	66.7	42.9	56.8
	Secondary completed	23.1	33.3	28.6	27
	Post-matric qualification	-	-	28.6	16.2
	No response	11 respondents (5 in Mun., 2 in N. + P. and 4 in Educ.) had no response			
Race category (n=41) M: n=15 - N+P: n=4 - E: n=23	African	100	75	73.9	83.3
	Colored	-	-	-	-
	Indian	-	25	-	2.4
	White	-	-	26.1	14.3
	No response	7 respondents (3 in Mun., 1 in N. + P., and 2 in Educ.) had no response			
2 respondents were left out					

The questions here was: within the given demographic categories, which group engages the most in urban agriculture within eThekwini Municipality? Comparing the focus group answers to the stakeholder response, the following conclusions can be made:

Looking at this table, while taking into account the literature and the focus group data, it becomes clear the municipal stakeholders have a better understanding about the urban farmers'

demographics than the other two groups, with the educational group scoring visibly worse. Looking at gender, the municipal stakeholders' answers ('Female engagement' → M: 93.8%) correspond with the other data, agreeing that females are most involved in urban agriculture in the eThekwini Municipality. This pattern also becomes apparent with the other categories. Looking at the answers of all the stakeholder groups, the Municipality's answers correspond the most with the focus group data and the literature, across all the categories.

Perception of barriers to urban agriculture

Table 16: Perception of barriers to urban agriculture in the eThekwini Municipality (in %)(n=47)

	n=18	n=5	n=24	
Urban agricultural barrier	**Mun.**	**N. + P.**	**Educ.**	**Combi.**
Lack of funds to purchase agricultural inputs	66.7	20	54.2	55.3
Amount of land available is insufficient	61.1	40	29.2	42.6
Lack of suitable land available for agricultural practice	83.3	40	50	61.7
Poor water supply	72.2	40	33.3	48.9
Poor tenure security	66.7	60	70.8	68.1
Lack of interest in agriculture	50	100	58.3	59.6
Poor infrastructural support and services	44.4	40	37.5	40.4
Lack of training	44.4	40	58.3	51.1
Limited agricultural skills and knowledge	50	-	70.8	55.3
Limited labor	27.8	-	12.5	17
Time constraints	38.9	20	16.7	25.5
Changing climate/ weather	33.3	20	20.8	25.5
Other, specify	5.6	20	-	4.3
2 respondents were left out; 1 respondents (1 in Educ.) had no response				

The twelve barriers listed above all came out of the meta-analysis of the literature, which was carried out before making the questionnaire. Mainly Robertson (2003) contributed to this debate, as a theoretical and contextual background on these barriers can be found in the theoretical chapter.

Looking first at the stakeholders perceptions, it is clear that there are a quite some differences between these three groups in answers. The most significant differences are with the perception of the barriers 'Lack of funds to purchase agricultural inputs', 'Insufficient land availability', 'Lack of suitable land available for agricultural practice', 'Poor water supply' and 'Limited agricultural skills and knowledge'. At the same time, these five barriers were among those with the highest perception score among the focus group members, which suggests that there exists little consensus between stakeholders and urban farmers regarding the actual urban agriculture barriers in eThekwini.

The following list of barriers, significantly perceived by the focus group members themselves (beginning with the most important one), will be compared with the stakeholder response:

- 'Lack of training': With the focus group members highlighting this barrier as most considerable, the stakeholder's perceptions of this barrier were less convincing, with a total score of 51.1%;
- 'Limited agricultural skills and knowledge': The second most important barrier for the Cato Manor farmers proved to be their own limited skills and knowledge on agriculture and how

to sustainably adapt to climate change. The stakeholders were not so certain about that, scoring a 55.3%;

- 'Insufficient land availability': The Cato Manor farmers deemed the insufficient amount of available land to be their third most perceived barrier. Looking at the low perceptions of the stakeholders (C: 42.6%) however, less than half of them thought likewise;
- 'Lack of funds to purchase agricultural inputs': A barrier that also came out of the focus group discussion as noteworthy is the farmer's lack of funds to purchase proper agricultural inputs. When the question was asked to the stakeholders whether they perceived this barrier to be existent, just about half of the respondents were convinced (C: 55.3%);
- 'Poor water supply': The fifth and last barrier to urban agriculture mentioned by the Cato Manor farmers during the focus group was 'the poor supply of water'. Especially the absence of good water tanks was perceived to be an eyesore for them. Looking at the stakeholder's perceptions however, the average score lies below 50% (48.9%).

As can be observed above, when asked for their perception of the barriers to urban agriculture in the eThekwini Municipality, there seemed to exist significant differences in perception among the stakeholder groups, and between the stakeholders and the urban farmers.

Perception of how eThekwini Municipality can support/ promote urban agriculture

Table 17: Perception of how the eThekwini Municipality can support/ promote urban agriculture (in %)(n=48)

	n=18	n=5	n=25	
Urban agricultural support	**Mun.**	**N. + P.**	**Educ.**	**Combi.**
Provide microloans/ financial incentives	38.9	-	36	33.3
Provide agricultural extension support	66.7	80	72	70.8
Identify land that can be used and ensure community access	72.2	60	72	70.8
Improve water supply systems for agricultural purposes	66.7	80	36	52.1
Improve infrastructure	50	40	32	39.6
Support the development of cooperatives	83.3	20	44	56.3
Assist communities to access markets	83.3	60	36	56.3
Develop appropriate policies	66.7	40	60	60.4
Provide training and capacity development opportunities	88.9	60	84	83.3
Other, specify	-	-	-	-
2 respondents were left out				

When it comes then to asking the different target audiences in this research about their perception of how eThekwini Municipality can promote or support urban agriculture in the future, there seems to be a similar trend visible compared to the discussion of the barriers to urban agriculture. On several support options given, the municipality workers were often far more convinced about perceiving these options to be important to pursue, compared with the other two groups, of which the educational stakeholders in particular. It looks like they acted far more diffuse on their options, something that was particularly visible looking at the perceptions on 'improving water supply' (M: 66.7% - E: 36%), 'supporting the development of co-ops' (M: 83.3% - E: 44%) and 'assisting communities to access markets' (M: 83.3% - E: 36%).

Focusing now on the comparison between the urban farmers' opinion and the stakeholder's view on how both think the Municipality can optimally support or promote urban agricultural activity, it's relevant to address the Cato Manor farmer's stance first. Although they wished for every support option to be encouraged by the Municipality, they had some preferences across these choices (In order from importance, beginning with the most important);

- 'Provide training and capacity development opportunities': Mentioned as by far the most important type of support the Cato Manor farmers would like to receive from the Municipality, training and capacity development could address not only agricultural techniques, but also climate change education and climate-smart responses for them. The stakeholders were equally convinced by this type of intervention, as it is their highest perception score as well (C: 83%).
- 'Provide agricultural extension support': The second most important type of support addressed by the focus group members was the provision of agricultural extension support. A good supply of seeds and tools was among the most significant wishes. The stakeholders also scored high on this perception, with all groups above 66.7%, which is two-thirds of each group (M: 66.7% - N+P: 80% - E: 72%).
- 'Support the development of cooperatives': Given as the third most desired municipal support intervention, cooperative development support was a major point of discussion for the Cato Manor farmers. Although they've experienced past indifferences and problems with working in groups, they had high hopes for solid co-ops and joint ventures, to eventually get communal farming on a next level. Looking at the stakeholder's perception of this intervention, only the Municipality had high scores (M: 83.3%), whereas the other two groups were less convinced about this type of support (N+P: 20% - E: 44%).
- 'Identify land that can be used and ensure community access': The lack of land for future agricultural plans and developments was also high on the wish list for the focus group participants. The stakeholders had an equal vision on this matter, with the Municipality and education scoring higher than 70% (M: 72.2% - E: 72%), and the organizations scoring a relatively low, with almost two-thirds of them ticking this box (N+P: 60%). Additionally, one of the municipal respondents stated he/ she would like to see more communal gardens where the land is available. According to him/ her this is the case where land is under Ingomyama Trust Board.

Perception of negative impact of climate change and adaptation to climate change

Table 18: Perception of negative impact of climate change and adaptation to climate change in the eThekwini Municipality (in %)

Urban agriculture is negatively affected by CC (n=46)*		**Mun.**	**N. + P.**	**Educ.**	**Combi.**
Yes	* M: n=17 - N+P: n=4 - E: n=25	70.6	50	88	78.3
No		29.4	50	12	21.7
No response		1 from Mun. and 1 from N. + P.			
Urban farmers are coping with/ adapting to CC (n=42) *		**Mun.**	**N. + P.**	**Educ.**	**Combi.**
Yes	* M: n=14 - N+P: n=5 - E: n=23	64.3	80	43.5	54.8
No		35.7	20	56.5	45.2
No response		4 from Mun. and 2 from Educ.			
2 respondents were left out					

During the focus group meeting, the participants stated that they were unaware of the term 'climate change', and adding to this statement that they haven't experienced any adverse effects from the phenomenon because they never knew what it was. When explaining the phenomenon after that, a number of farmers mentioned some abnormal events over the last few years, including floods and intense droughts, but also said they weren't actively adapting to these occurrences. In short, the majority of the farmers were unaware of changing climatic shifts, therefore not adapting to its effects.

The stakeholders were approached with the same two questions, which were: "Do you think that urban agriculture practices in the eThekwini Municipality are negatively affected by climate change/ changing weather patterns" and "Do you think that farmers engaging in urban agriculture are coping with/ adapting to changing climate patterns". With both the literature and some of the Cato Manor farmers (who were aware of the phenomenon) stating that it has a negative impact on agriculture, the stakeholders predominantly thought likewise ('Yes' → C: 78.3%). Two of the three groups – Municipality and education – had values above 70% with the first question (M: 70.6% - E: 88%), meaning that the majority answered a "yes", with only the members of the organizations being less convinced (N+P: 50%). Looking at the second question, the focus group members and the stakeholders had opposing answers for the most part. While all of the Cato Manor farmers said they weren't adapting to climate change, only the stakeholders in education had a majority supplying the same answer as well (E: 43.5%). The other two groups – Municipality and organizations – both had a majority answering that urban farmers in the eThekwini Municipality are actively adapting to/ coping with climate change (M: 64.3% - N+P: 80%). All in all, the average stakeholder score for a 'yes' answer is just above 50% ('Yes' → C: 54.8%).

Awareness and encouragement perception of climate-smart urban agriculture practices

Table 19: Awareness of climate-smart practices and perceptions on encouragements in the eThekwini Municipality (in %)

	n=18	n=5	n=24		n=13	n=4	n=22	
	Awareness of practice (n=47)				Should be encouraged (n=39)			
Type of urban CSA practice	Mun.	N.+P.	Educ.	Comb.	Mun.	N.+P.	Educ.	Comb.
Permaculture	77.8	100	41.7	61.7	76.9	50	54.5	61.5
Agroforestry	38.9	20	41.7	38.3	7.7	25	36.4	25.6
Raised-bed gardens	72.2	40	20.8	42.6	23.1	-	27.3	23.1
Integrated crop systems	44.4	-	33.3	34	38.5	75	50	48.7
Intercropping	44.4	40	50	46.8	30.8	75	31.8	35.9
Crop rotation	72.2	40	41.7	53.2	38.5	25	22.7	28.2
Improved fallow cropping	27.8	20	33.3	29.8	7.7	25	22.7	17.9
Erosion control	61.1	40	37.5	46.8	38.5	75	40.9	43.6
Windbreak control	55.6	20	25	36.2	15.4	25	13.6	15.4
Wastewater usage for irrigation	72.2	20	58.3	59.6	69.2	100	40.9	56.4
Damming	38.9	20	45.8	40.4	15.4	-	13.6	12.8
Rainwater harvesting	83.3	60	41.7	59.6	53.8	75	54.5	56.4
Drip irrigation	38.9	20	12.5	23.4	30.8	25	22.7	25.6
Composting	72.7	40	50	57.4	61.5	75	40.9	51.3
Urine/ sewage reclamation	44.4	20	41.7	40.4	38.5	50	31.8	35.9
Alternative energy use	50	-	33.3	36.2	30.8	75	36.4	38.5
Other, specify	-	-	-	-	7.7	-	-	2.6
No response	1 from Educ.				5 from Mun., 1 from N.+ P. and 3 from Educ.			
2 respondents were left out								

The last two questions for both the focus group members and the stakeholders, including a list of sixteen different climate-smart agricultural practices, were as follows: "Are you aware of the following agricultural practices within eThekwini Municipality?" and "Which of these agricultural practices should be encouraged within the eThekwini Municipality?". The last of these two questions proved to be a hard question for the focus group members, because within the context of climate change and their limited understanding of this global phenomenon, they weren't sure about the benefits of these activities for their own plots. Hence, only the stakeholders could answer this question, as their knowledge on this subject was sufficient enough. Here are the results for each climate-smart urban agriculture activity listed:

- Permaculture:
  - **Stakeholder awareness combined: 61.7%**
  - **Stakeholder encouragement combined: 61.5%**

As illustrated in the theoretical chapter, permaculture (from permanent agriculture or permanent culture) is an agricultural approach that takes nature itself as its model, mimicking the patterns and relationships seen in natural systems. It actually serves as an umbrella term for several of the climate-smart approaches listed here, but it only qualifies as permaculture as the corresponding ethics and principles are respected, looking at waste re-use for example.

- Agroforestry:
    - **Stakeholder awareness combined: 38.3%**
    - **Stakeholder encouragement combined: 25.6%**

Agroforestry involves agriculture incorporating the cultivation of trees. It not only helps mitigating climate change, by storing CO_2 in the ground, but also protects intercrops, provides shelter against the wind, the sun, the rain, and holds the soil in place to combat erosion. Moreover, it stimulates soil microfauna and microflora.

- Raised-bed gardens:
    - **Stakeholder awareness combined: 42.6%**
    - **Stakeholder encouragement combined: 23.1%**

Raised-bed gardens offer a space efficient and high yield agriculture technique for urban spaces. These beds are higher than ground level, and consist of soil framed into place, usually by planks. They are efficient in the way the soil looseness and depth stimulates crop growth.

- Integrated crop systems:
    - **Stakeholder awareness combined: 34%**
    - **Stakeholder encouragement combined: 48.7%**

Integrated crop systems combine fish and/or livestock farming with agriculture. Seen a lot within permaculture designs, it makes sure that this combination optimizes crop growth and promotes recycling. An example would be using pigs to get rid of weeds and roots, or using their waste as fertilizer.

- Intercropping:
    - **Stakeholder awareness combined: 46.8%**
    - **Stakeholder encouragement combined: 35.9%**

Intercropping means growing more than one crop in the same field, especially in alternating rows or sections. It not only saves space, but it also diversifies the soil. Moreover, planting flowers and herbs next to vegetables increases the chance of attracting insects to manage pests.

- Crop rotation:
    - **Stakeholder awareness combined: 53.2%**
    - **Stakeholder encouragement combined: 28.2%**

Crop rotation is another way of keeping soil healthy. It involves growing a series of dissimilar/ different types of crops in the same area in sequential seasons. It thus preserves the balance of nutrients, organic material, and microorganisms, which is vital for maintaining healthy soil.

- Improved fallow cropping:
    - **Stakeholder awareness combined: 29.8%**
    - **Stakeholder encouragement combined: 17.9%**

This means leaving a portion of the agricultural plot unused so that the soil can rejuvenate. This is done by planting and managing leguminous trees, shrubs and cover crops. These help revitalize the soil in one or two seasons, so that agricultural productivity won't drop.

- Erosion control:
  - **Stakeholder awareness combined: 46.8%**
  - **Stakeholder encouragement combined: 43.6%**

Erosion control is the practice of preventing soil erosion that may affect agriculture. A climate change example is increased rainfall, which can lead to water erosion, thereby obstruct farmland productivity. By ways of terracing or planting trees for example, erosion can be controlled and prevented.

Figure 16: Terracing as a climate-smart urban technique, Durban (Photo by Jacob Knegtel)

- Windbreak control:
  - **Stakeholder awareness combined: 36.2%**
  - **Stakeholder encouragement combined: 15.4%**

Related to the practice of erosion control is windbreak control. This method comprises of ways to combat and prevent wind damage to agriculture. A good example is the planting of hedgerows or trees to guard the crops against wind.

- Wastewater usage for irrigation:
  - **Stakeholder awareness combined: 59.6%**
  - **Stakeholder encouragement combined: 56.4%**

This method involves using wastewater for irrigation practices. Wastewater – called greywater when the water is generated from washing activities – can perfectly be used for agricultural purposes unlike popular thinking. Simple systems like these can have a big impact on the water use of small-scale farmers.

- Damming:
  - **Stakeholder awareness combined: 40.4%**
  - **Stakeholder encouragement combined: 12.8%**

Another effective and nature friendly source of irrigation water is the method of damming. By redirecting rainwater into manmade or natural pools or basins, this water can then be used for agricultural purposes.

Figure 17: A climate-smart example of damming water for agriculture, Durban (Photo by Jacob Knegtel)

- Rainwater harvesting:
  - **Stakeholder awareness combined: 59.6%**
  - **Stakeholder encouragement combined: 56.4%**

The third way of climate-smart water use is implementing rainwater harvesting systems. By directing rain gutters to rainwater tanks for example, farmers will almost always have a substantial and free source of water for their plots.

- Drip irrigation:
  - **Stakeholder awareness combined: 23.4%**
  - **Stakeholder encouragement combined: 25.6%**

Drip irrigation involves the use of dripping systems for irrigation purposes. These usually take the form of rubber tubes which regulate water use for crops economically and eco-friendly, by dripping the water on the crops. This saves water and can thereby be considered climate-smart.

- Composting:
  - **Stakeholder awareness combined: 57.4%**
  - **Stakeholder encouragement combined: 51.3%**

The use of compost is an age-old but effective way of providing nutrition to crops. By using a compost bin for example, organic household or garden waste can be accumulated and decomposed. Thereby recycled organic matter can form the basis of a rich fertilizer or soil amendment.

- Urine/ sewage nutrient reclamation:
  - **Stakeholder awareness combined: 40.4%**
  - **Stakeholder encouragement combined: 35.9%**

Not only wastewater, but also urine and sewage water can be used for agricultural fertilizing. The nutrients in this human or animal waste can be reclaimed by simple systems. Unlike popular belief, this method can have a big impact on nutrient use in agricultural gardens.

- Alternative energy use:
  - **Stakeholder awareness combined: 36.2%**
  - **Stakeholder encouragement combined: 38.5%**

Alternative energy use serves as an umbrella term for multiple techniques of harnessing the energy nature itself provides, such as sunshine, wind and water. One of the most popular examples is solar power, which could increasingly be integrated with agriculture these past years.

Overall, the stakeholders mainly had high hopes for 'permaculture', 'wastewater usage' and 'rainwater harvesting' as activities to encourage in the future, which are the same three activities observed the most in the municipality. This can be explained by the fact that the Municipal Climate Protection Programme (MCPP), which was launched in 2004 by the Municipality, installed rainwater harvesting systems in a few eThekwini areas and covered permaculture trainings. Wastewater usage projects have also been undertaken in Durban, as the academic expert mentioned in her interview. Most of all the other climate-smart activities listed score below 50% for awareness, which suggests that there haven't been many climate-smart programmes or pilots undertaken yet in eThekwini. This corresponds with one of the private company expert's statements during the interviews: "*The fact that you don't see these climate-smart initiatives in communities, means that no one showed them these applications*". Also, the community garden statistics (Chapter 3.3) show no data regarding trainings or support. What also stands out in the data is the large amount of non response, relative to the other questions. This strengthens the assumption that climate-smart activity isn't yet mainstream in eThekwini.

Figure 18: A community garden project in Extension 1, Cato Manor, Durban (Photo by Jacob Knegtel)

5.3. Interview data analysis

In total, four interviews were held with different stakeholders representing each of the stakeholder groups: Municipality, NGO, private company and education. **The municipal expert** is a Projective Executive (Community and Emergency Services Cluster) at the eThekwini Municipality and affiliated with urban agriculture policy, and was aided by Sibusiso Mkhwanazi, Senior Manager: Natural Resources and Specal Services within the Parks Recreation and Culture department. **The NGO expert** is a programme director of the Edamame Development Programme in Marianhill. **The private company expert** is a Project Manager and Sustainable Development Consultant at Wirikuta Permaculture centre. **The academic expert** is an academic researcher on microbiological and environmental aspects of sustainable water supply and sanitation at the University of KwaZulu-Natal. More background information on these four interviewees will follow in the first sub-chapter.

This analysis of the coded interviews is split up into three parts, which are 'Urban agriculture', 'Climate-smart urban agriculture' and 'Stakeholders and climate-smart urban agriculture'. The first part focuses more broadly on the stakeholder's experience with and knowledge on urban agriculture in the municipality. The second part looks at their knowledge and perception on climate change and the potential of climate-smart urban agriculture. The last part bundles up the two previous parts, looking at their understanding of and view on climate-smart urban agriculture policy and intra-stakeholder relationships within this sphere.

5.3.1. Urban agriculture

Starting off with a short elaboration on the experts' urban agriculture background, each of them had experience with community trainings, both climate-smart related activities and regular trainings. The municipal expert's role as a municipal official entails facilitating these community trainings, whilst maintaining a link with the research division. However, she remarked: *"Urban agriculture is currently not properly promoted as a food security and income generation strategy, but instead as a substance practice"*. The academic expert's work has mainly been to do with greywater, as she's been involved with the municipality in terms of what they do with greywater. The NGO expert set his NGO initiative up in 2000, called the 'Edamame soy bean programme', and has been involved in a lot of trainings revolving around urban agriculture. The private company expert started his permaculture centre in 2012, undertaking projects for example in urban agriculture settings in eThekwini.

Agrihubs

The four of them all exclaimed they've mainly come across household plots and community gardens in eThekwini, an answer which corresponds with all of the other datasets used in this research. Apart from that, urban agriculture happens at the agrihubs scattered around urban eThekwini, which are the agricultural training centres. The NGO expert manages one, called Marianhill, and said: *"The interest has grown out of the activity happening at these agrihubs, but at the moment, nothing much is really happening in Durban within the context of urban agriculture"*. According to him, urban agriculture is fizzling away in the parts of the city that are not receiving support via agrihubs. The other three experts also mentioned seeing no increase in urban agriculture in the eThekwini Municipality at the moment. The municipal expert explained that this is probably because the Municipality does not have Extension Officers active yet to promote. Also land availability is forming

a barrier against income security promotion at a larger scale. According to the private company expert, there also exist agrihubs south of the municipality where extension officers are operative, resulting in high agricultural productivity of the urban farmers.

Development

Asking them about their opinion of urban agriculture as a pro-poor developmental tool, the answers were positive. Although the municipal expert started off by saying that implementing this as a tool is a difficult task, due to the level of literacy and the lack of exposure to climate and technology knowledge, the other three stakeholders approached this question more from a bottom-up perspective. The NGO expert exclaimed that urban agriculture has a lot of potential for food security, while at the same time underlining the importance of how to introduce it as such. For instance, he gave an example of Cato Manor, where there are lots of poor people that would love to farm and take pride out of growing their own food. However, for the last ten years the Municipality has approached the community from a top-down perspective, introducing their perspective on urban agriculture as a developmental tool, leaving little room for the community's needs and wishes. The private company expert also said that urban agriculture is definitely a pro-poor developmental tool. To popularize growing your own food and save the money you would otherwise spend, is to him an effective way of mainstreaming development in eThekwini. *"And also from a nutritional point of view, the quality is very high. Also this healthy way of food production can build up better immune systems in these regions".* This mirrors the perspective of the academic expert: *"A lot of the work lies with the link between the municipality and the communities"*.

Looking at the future, the municipal expert said that "*the establishment of a division and promotion of urban agriculture will undoubtedly bear fruits in the next 5 years"*. The three other experts added that urban agriculture in eThekwini needs more ongoing support. The academic expert worded it as such: *"I think that urban agriculture work needs to be more ongoing, compared to how it was conceptualized in the beginning. The interventions need to be revisited, and the participants need to be given new enthusiasm"*. She thus stresses the importance of continuous support and feedback regarding support. The NGO expert also exclaimed that urban agriculture policy needs to be continuously driven. *"There is a massive need for urban agriculture here and there is a massive interest in making it happen"*. What the private company expert has been preaching for a long time in the municipality is the ABC model, which has been illustrated in the methodology.

5.3.2. Climate-smart urban agriculture

All of the four experts have also been affiliated with climate-smart urban agriculture activities. Not surprisingly then, the four experts had very similar definitions of climate-smart urban agriculture, although each definition has the stakeholder's own field of work ingrained into it:

- The municipal expert: *"This means production of plant/food crops that are able to adapt to the harsh conditions such as the drought that are the effects of climate change".*

- The academic expert: *"Agriculture that takes into account that we're going to have higher temperatures and lower water volumes available in the future. So it uses robust plants, it*

uses plants that are resistant to dry conditions and it uses water in innovative ways, for example greywater re-use and rainwater harvesting".

- The NGO expert: *"It needs to employ the principles of urban agriculture that deal with the climate issues facing us, coming down to water management, ways of farming, mulching, clever types of adaptation, soil health, alternative fertilizers and other organic processes we can use. This needs to be adapted to the collective farming knowledge already out there in the communities"*.

- The private company expert: *"Urban agriculture with an holistic approach. This means that you need to take into account a broad array of relevant climate change and sustainability aspects whilst farming in the city. Permaculture is actually a good science that integrates everything"*.

Barriers

When listing barriers to climate-smart farming in Durban, the four interviewees each had their specific perspective on this matter. The municipal expert stressed the fact that the understanding of climate change and its effects is lacking and changes are viewed as normal, hence the unwillingness to adapt and change the mindset. The academic expert zoomed in on the barriers known within scientific circles: *"The biggest barriers are probably land availability, water availability, fertilizer availability and knowledge"*. The NGO expert emphasized the fact that the needs of the community regarding climate-smart urban agriculture are not heard: *"The need needs to come from the community itself, not the Municipality"*. The private company mentioned the lack of support and the lack of enough officials who know they are doing. *"And also the fact that the city thinks it can do with all by itself, but it can't. You need NGOs in this sector, and you need to fund these NGOs because they are certainly struggling in this country".*

Benefits

Apart from the barriers to climate-smart urban agriculture, the four respondents could name various benefits it creates. The municipal expert mentions the benefit of growing plant/food crops that are able to adapt to the harsh conditions such as increased droughts. With the right knowledge and application, this could balance agricultural activity in Durban, according to her. The academic expert's big promoter is food security. She thinks the municipality is very much aware of benefits that make communities as self-sustainable as possible and that they are very open with trying and experimenting with these things. The NGO expert knows a few teachers that he thinks are fantastic in their field of expertise, and they could give these urban farmers a great understanding of their country's geography and current setbacks. *"A good example is a project from the Wildlands Trust, with people getting taught about seeds, growing these in a pod and sell it for money. What a great idea"*. The private company expert advocates for the creation of microclimates, small-scale permaculture systems that are low-maintenance and very productive. *"I honestly think that if you just create your own microclimate, you are substantially there. And the job creation that could come from that is amazing. Green waste recycling is also very effective in making Durban more eco-friendly and climate-smart. You just have to show it once in a community, and they all know what to do after that"*.

Climate change

In their answers, the interviewees often linked up the phenomenon of climate change with farming itself. This way, they had much to say about the climate-smart aspect of urban agriculture. When asked about one of the conclusions of this research – which is that the majority of stakeholders think that urban farms are currently adapting to climate change, whereas the urban farmers themselves state that they have a poor knowledge on both climate change and climate-smart adaptation – the municipal expert replied by saying that mainly due to the fact that between them the level of literacy and exposure to the latest information and technology regarding climate change differ, they view things differently. This is a notable barrier to effective climate-smart urban agriculture promotion, but at the same time an interesting challenge for the Municipality to join forces with other stakeholders.

The academic expert surfaced a similar thought as seen above, but added an explanation on how to tackle this barrier: "*I think what happens is that the farmers would inherently would make changes that would be considered climate-smart, if they would notice for example that their crops are failing or water is scarce, because of their own knowledge and experience. However, they wouldn't realize that these are climate-smart adaptations. They could perform these techniques much more effectively, if they would know that climate change is affecting their crops and they would know how these techniques actually work. Important here is the communication between the Municipality, trainers and the community*".

The NGO expert said the exact same as stated above, and even took one step backwards by stressing the importance of knowing what climate change actually is. *"This year for example was a very hot year and a lot of people's crops didn't come up. I think some of the farmers have a genuine interest in getting taught about the phenomenon, and others maybe need some schooling or training if they are interested. Some of the teachers I know are fantastic in their field of expertise, and could give these guys a great understanding of their country's geography and current setbacks"*. He adds to that, however, that more than 50% of the teachers in the Municipality are only in it for the job, and don't share this passion. Therefore, he advocates for a way to somehow interweave teaching, climate change and money making in one programme, like Wildlands Trust is already doing. So practicality regarding the phenomenon of climate change is most important, according to the NGO expert. He concluded his train of thought by saying: *"A decrease in yield because of this phenomenon does have an effect on them, but does it really affect their lives as much as we think it does? If you don't know climate change exists, it's not a problem for you*". That last sentence pretty much sums up the problem the municipal expert described as well. Without proper training or knowledge transfer, climate change will remain a silent problem. This thought is backed up by Riggio et al. in the theoretical chapter, stating that one can only respond to a problem like such, if it is actually 'perceived' as a problem.

Lastly, the private company expert linked his answer to Municipality's response to the problem sketched above: *"They understand the implications of climate change, so they say. And they have undertaken a few urban agricultural community projects, but it's not that they are deeply rooted in permaculture and other climate-smart techniques yet".* He says that the policy is great, but it needs fueling with the right institutional structure. He underlines the importance of this process with hard facts: *"This year, in May, we only had 240 mm of rain instead of the usual 500 mm of rain, so we are*

way behind. We also had a lot of dry leaves and wood burn in our garden. The heat is just intense. And this is climate change. And this changed a lot in the field and especially small-scale farmers are experiencing this. I've stressed this in workshops. You can control your own climate change down by planting trees for example", says the private company expert, as he refers to agroforestry. He concludes by saying that the problems stem from the scene management where you have a lot of different types of management not cross-correlating. According to him it's going to be four degrees hotter, sea levels will rise, rainfall will increase, only because the Municipality is trying to persist the current system. For him, climate-smart urban agriculture is a welcome paradigm shift.

Cooperative farming vs. individual farming

The idea of strengthening cooperatives has already rooted frequently in this thesis, with the added belief that it could well kindle climate-smart urban agriculture to a higher intensity. At this moment, cooperative forming in eThekwini is in its infancy, and often works counterproductive. The municipal expert explains this trend: *"The co-ops are new concepts for rural communities who for the past years used to operate their fields independently and dispose of yield as they please whilst there is a benefit in affiliating to co-ops , the system seems to be an imposition to people who may still wish to operate as individuals"*. Apparently, individual farming still has a major foothold in the city, which suggests that the ABC model the private company expert mentioned, could well be the puzzle piece that Durban needs to develop and promote climate-smart urban agriculture.

When asking the academic expert then if she thinks household urban agriculture would at the moment be a more appropriate option for a setting like Cato Manor, she nodded. *"Yes, certainly in Cato Manor. It depends very much on the type of community in where it's located. In peri-urban and rural areas, with communities with higher mobility, cooperatives are more likely to work and communal gardens as well. It's not impossible to make these co-ops work in urban areas, but it requires a lot more input from an outside agency like the Municipality or an NGO for example. So first, climate-smart individual household gardening should be promoted in this municipality, and if these farmers than see the potential of these activities on this scale, it can be upscaled to setting up cooperatives and communal gardens. There is no such thing as a one size fits all solution, so all the stakeholders need to first look at the what type of community they are focusing on, before applying workshops and cooperative structures"*. Again, an answer in line with the ABC model, in this case with regards to Cato Manor.

The private company expert, who mentioned the ABC model himself, not surprisingly answered positive to this question as well, just like the academic expert: *"Definitely, as I said. And to implement greywater recycling and putting in swells and wind towers would be a great way to start household farming up. Basically, every climate-smart technique we use here on the farm should work for household plots. After that, focus on community gardens and strengthen cooperatives"*.

The NGO expert, finally, concludes this paragraph with the same train of thought: *"The cooperatives were set up wrong, especially in Cato Manor. I really wouldn't like to have anything to do with the co-ops you find there, because they encourage fighting and not capacity development. When farmers work together, it makes a lot more sense. The facilities were ok, but they couldn't capitalize on this. I think to start off now it's best to improve homestead gardens and existing community gardens. Find out who is growing, ask for limitations, and scope their interest in community farming. If a farmer*

finds out he/she is actually on the same page as a lot of others, the potential for joint farming is huge". According to the NGO expert, trust is key to good community development. First the history of the community needs to be understood before developing these cooperatives with these farmers. The different stakeholders need to be very clear on what there are going to put in, and it needs to be managed according to what they can deliver, also according to development principles. He also states that everybody needs to 'read the book', and delve into the case studies before they sit down and discuss.

Implementation and uptake

The above paragraphs already gave quite some information away regarding official climate-smart urban agriculture implementation and uptake. In summary, this implementation is barely visible in this field and uptake is almost non-existent. One of the reasons for this trend can be attributed to the new generation of potential farmers, according to the municipal expert. "*Sending pupils to do garden work as a form of punishment in schools has created a negative perception amongst the youth, hence few see agriculture as a career"*.

A lack of workshops about climate-smart urban agriculture, is the academic expert's explanation. According to her, these programmes can be successful, but only by looking at long term goals, instead of short term profit. She also stresses the importance of revisiting these communities, and re-doing these workshops and evaluate. *"And everyone needs to know what the phenomenon of climate change is, and what climate-smart agriculture is. Only then adaptive strategies can be more effective, no exception*." The academic expert added that the Municipality barely scratched the surface in terms of how they rolled these things out and how this is benefiting the communities.

The NGO expert followed up on the academic expert's view, with an example of the city once giving an organic farmer a ton of fertilizer as a prize. Because he doesn't use fertilizer, he eventually sold all of it. Stories like these need to be a thing of the past, according to him. This also applies with implementing initiatives like rainwater harvesting in communities. "*You can't just install these facilities without introducing proper trainings beforehand*".

The way the private company expert looked at the current implementation and uptake of climate-smart urban agriculture in eThekwini had more to do with the curse of climate politics. *"The Municipality thinks that we should carry on business as usual and adapt everything to this vision, just to persist their current policy, which is not the way to go."* All the actual climate change trends nowadays predict bad outcomes for countries like South Africa, so, according to the private company expert, the sooner you begin creating smarter cities, the sooner people will adapt to these changes. *"Show it to them! I have a lot of great permaculture applications in my garden here, like worm towers and compost cages, but the fact that you don't see them in communities, means that no one showed them these applications"*.

Policy

This section mainly revolves around misalignment between either the stakeholders and the urban farmers or between the relevant stakeholders, considering climate-smart urban agriculture policy. An example was given earlier in this chapter – which was that the majority of stakeholders think that

urban farms are currently adapting to climate change, whereas the urban farmers themselves state that they have a poor knowledge on both climate change and climate-smart adaptation – among other examples given. When asking the municipal expert to comment on this conclusion and suggesting a way to prevent future misalignment in climate-smart urban agriculture policy, she left this one unanswered, which accounts for data as well.

Apart from suggesting more climate-smart agriculture workshops, the academic expert advocates for good downscaling. She thereby advocates more decentralization within climate-smart urban agriculture politics: *"Only then it could work. Obviously, you have economies of scale, so with more people using these techniques, the better climate-smart agriculture will work. Also, the more it becomes a community benefit instead of an individual benefit, the more effective these techniques will be.* As the academic expert said earlier, limiting this effectiveness is the amount of land and the availability of water. The Cato Manor farmers exclaimed in their focus group however that water availability is reasonably well-regulated.

The NGO expert was also very certain about his stance towards climate-smart urban agriculture and how sound policy could make it happen in eThekwini. According to him it's a great concept if it works, but only when all the stakeholders and the farmers look together at this single goal, or 'bridge their social capital' as Woolcock and Narayan explained in the theoretical chapter. "*This is too much a top-down perspective. So we have to find something to introduce it on a logical realistic level, and maybe the best way is just to show them that a square meter of space is actually enough to grow healthy food on".* He adds a footnote though, saying that cultural sensitivity, green open spaces and economic levels of income are topics that need some alignment between stakeholders, which will be covered in the upcoming sub-chapter.

The private company expert thinks the Municipality can still do more about the homestead situation, especially with the recycling of greywater, as he refers to the ABC scheme. According to him, an allotment scheme would also work really well in Durban, and where they have created community gardens, take the assets from these, carve it up, and institutionalise it. Even more important in his view is the need to look at this implementation via capitals, following up on the theoretical chapter in this research: *"The natural capital is looking at the latent potential in the landscape. And then designing it from a water harvesting point of view, means integrating it with rainwater harvesting. And then the human capital, the development of people's skills to understand their natural capital and how the built capital is plugged in, must be prioritized. Only then you create social capital. And that's a community glue that keeps everything together. Once you have this down, then the whole local economics are better understood, and can be mainstreamed via social-economic development"*. The private company expert shares an interesting way of putting theory into practice here, which runs par with the suggestions that are coming out of this research. The ABC model could prove to be an effective way to mainstream climate-smart urban agriculture policy, while this implementation must take in to account the ethics of creating sustainable livelihoods and strengthening each of its capitals.

5.3.3. Stakeholders and climate-smart urban agriculture

What became apparent from the last two sub-chapters is the fact that among the various barriers to climate-smart urban agriculture implementation in eThekwini, a big obstacle is to undo the misalignment among the relevant stakeholders themselves and mitigate the mismatch between relevant stakeholders – especially the Municipality – and the urban farmers. As all of these actors have such an impact on making climate-smart urban agriculture happen or not, the last sub-chapter will focus solely on these actors. The first paragraph will zoom in on the knowledge and policy debate.

Knowledge and policy

As highlighted before, the municipal expert points out that Durban lacks an army of Extension Officers that could mainstream knowledge transfer and training in the field, accompanied by relevant teachers, NGO's and companies. The academic expert said the same thing, also mentioned before: "*The urban farmers could perform climate-smart techniques much more effectively, if they would know that climate change is affecting their crops and they would know how these techniques actually work. Important here is the communication between the Municipality, trainers and the community"*. The NGO expert, in addition to what he already said about knowledge and policy, summed up his thought about this debate in one sentence: *"So, high-up, the energy and ideas concerning urban agriculture and its selection process are promising, with even the Deputy Major talking about it and supporting the concept, but the concept of doing it in the right way is unfortunately wrong"*. The private company expert comments on this debate as such: "*The Municipality should cooperate more with other stakeholders, instead of always trying to solve the problem themselves"*. According to the private company expert, the knowledge and policy aspect of climate-smart urban agriculture is all about sharing expertise beyond your field and planning together.

Relationship: Between Municipality and communities

All of the above references to the relationship between the Municipality and the poor communities can be summarized to 'existent', but 'improvable'. The three non-governmental stakeholder groups are all mostly disappointed in how the Municipality realizes and communicates its urban agriculture policy – climate-smart or not – towards the urban farmers and potential farmers in the eThekwini Municipality. The municipal expert's own answers don't involve statements on how to better this relationship. The academic expert's view on this matter has already been featured in earlier section, but comes down to the need for more communication between the Municipality, trainers and the community. However, she does say that when a municipal project is operational, the Municipality provides training in terms of permaculture, seeds and tools, all via the agrihubs. This system is working – confirmed also by this research – but the communication between both the Municipality and communities is mainly one-way.

This one-way mentality has been confirmed by the NGO expert, as he gave the following example: *"The Municipality once sent a consultant and an expert from the city who didn't know too much about agriculture. So we said: "Guys, let's do a selection process, participatory research, let's find out who is doing what, and let's mould the programme toward the needs". They said: "No no no, we'll do that, you just come and train". 40 people came to the training, 75% of them weren't interested in*

agriculture. Basically everyone just came along for the ride". The NGO expert added to this community development is important to combat this. According to him, building capacity takes time but is vital, and the Municipality needs to understand that.

The private company expert had a similar perspective on the matter: *"Also talking about agricultural techniques, a lot of urban farmers in Durban aren't farming efficiently. For example they use the wrong plowing techniques, because the Municipality hasn't showed them properly how to do this*".

Relationship: Between stakeholders

As mentioned earlier, the interview with the municipal expert sadly didn't contribute to the debate about inter-stakeholder relations. This last paragraph is meant to summarize the answers of the other three stakeholders regarding this matter, which are already interwoven with the other answers above. Within the arena of climate-smart urban agriculture policy in eThekwini, the academic expert advocates for more communication and shared expertise between the municipality, trainers and the community. Municipalities, in her opinion, are inherently ignorant, and can't solve problems on their own. The NGO expert had similar experiences in projects where there wasn't a lot of inter-stakeholder activity, for example staff members being plucked away, poor management, poor communication, lots of egos and issues, whilst not focusing on community development, which led to a lot of money underutilized. The private company expert stresses that within the scene management, where you have a lot of different types of management not cross-correlating, you need to get actors from other fields into the project. He says that while the city thinks it can do with all by itself, it in reality can't. You need NGOs, and you need to fund NGOs because they are certainly struggling in this country, is what the private company expert concluded.

6. Discussion

With the analysis wrapped up, the datasets can now be discussed more thoroughly. This chapter covers this part of the research, and focuses on the main question and sub-questions posed in the beginning of this paper. Each of the two section discuss the findings of both the questionnaire data and the focus group data. Each section ends with the triangulation of the main findings with the relevant interview data.

6.1. Urban agriculture in the eThekwini Municipality

The first part of this research covers the general characteristics of and perceptions on urban agriculture in the eThekwini Municipality. All the datasets point out that eThekwini's main forms of urban agriculture are homestead gardens and community gardens. In conjunction with these, the agrihubs form the teaching centres and sources of seed distribution.

Both the stakeholders and the urban farmers state that urban agriculture as a strategy is mainly in the form of subsistence food production, as can also be found in literature. The stakeholders also perceive income generation to be a highly adopted strategy. Despite the fact that the urban farmers think that UA for them is important for profitability, they state that they hardly make any money out of it. The income they do generate is only able to sustain basic needs, and there is no (extra) income generated to advance their economic status. On this subject, both groups thus contradict. The same contradiction – but then the other way around – can be observed when mentioning the strategy of feeding schemes and education, with the focus group members stating these urban agricultural strategies are important for their community, while the stakeholders think otherwise.

When scoping the perceptions on demographic engagement in urban agriculture in the municipality, there is a clear trend visible in the data. According to both the urban farmers and the literature, the typical urban farmer in the eThekwini Municipality is an unemployed black woman, older than 50 years, with a low income and no formal education. The stakeholder groups were also quite aware of these demographics, especially the municipal group. However, there needs to be more future attention to making sure these stakeholders are aware of the social-demographic context of urban agriculture in the eThekwini Municipality, as these data results were less unanimous than unexpected. This is in line with the political economy of development perspective, discussed in the theoretical framework. The better the relationship is between state and society, and mutual understanding of each other's role and context is, the more developmental policy can be improved. This thought is backed up by the interviews as well.

Focusing then on the perception of the barriers to urban agriculture in the eThekwini Municipality, there existed not only differences between the stakeholder groups, but also between the stakeholders and the urban farmers. Most of the barriers mentioned by the farmers as commonly perceived, were the same barriers that had low overall perceptions by the stakeholders. The most significant barriers mentioned by the focus group members were 'lack of training', 'limited agricultural skills and knowledge' and 'insufficient land availability'. The NGO expert explained this disconnection during the interview, as he exclaimed that the needs of the community regarding

climate-smart urban agriculture are not yet heard by either Extension Officers or the Municipality itself, which results in these barriers remaining existent.

Following up on the different barriers to urban agriculture in the eThekwini Municipality, the next step was asking both the stakeholders and the urban farmers how the eThekwini Municipality could support/ promote urban agriculture. Unlike the previous paragraph, across the three groups most of the stakeholders perceptions on future support and promotion corresponded with the wishes of the farmers. The Cato Manor farmers mainly perceived the 'provision of training and capacity development opportunities', the 'provision of agricultural extension support' and the 'support of developing cooperatives' to be the most important changes they hoped would be realized by the Municipality. What became apparent though were the huge differences between the stakeholder groups, which suggests that urban agriculture policy isn't yet aligned across stakeholders in eThekwini at the moment. This misalignment can be partly explained by looking at the interview data. During the interviews it became clear that, although the three non-governmental experts (NGO, private company and education) thought urban agriculture in the eThekwini Municipality is an effective pro-poor food security tool, the practice of urban agriculture itself isn't properly promoted yet as a food security strategy – according to the municipal expert the municipal expert.

The Cato Manor farmers themselves said they are in fact food secure because of their farming activity. This strengthens the aforementioned assumption that urban agriculture in Cato Manor is used as a livelihood strategy, as the production and sale of the crops leads to consumption, a bit of money, food schemes and knowledge exchange. The fact that it requires limited funds and input, and can be carried out almost any time a day, makes it a worthwhile activity according to the farmers. The NGO expert mirrored this thought during his interview, by saying that urban agriculture has a lot of potential for food security: *"To popularize growing your own food and save the money you would otherwise spend, is to him an effective way of mainstreaming development in eThekwini."* The literature, focusing on the relationship between urban agriculture and sustainable livelihoods, also backs this conclusion up. Both on an individual level and on a community level urban agriculture lowers the farmers' vulnerability, increases their well-being, and strengthens their social capital, financial capital and human capital. After looking at Cato Manor via the Sustainable Livelihoods approach, it became clear that their social capital has already strengthened because of urban agriculture. Moreover, climate-smart activities, such as permaculture, can contribute to improving their natural capital. The private company expert summarized these benefits as such: *"I honestly think that if you just create your own microclimate, you are substantially there. And the job creation that could come from that is amazing. Activities, such as green waste recycling, are also very effective in making Durban more eco-friendly and climate-smart".*

The interviewees also state that urban agriculture in eThekwini isn't an income strategy, overlapping with the answers of the focus group members. The stakeholder questionnaire data, suggesting that urban agriculture in eThekwini is a highly adopted income strategy, is now disproven by three credible sources: the farmers, the four urban agriculture experts and the literature. Second, the interview answers also made clear that 'limited land availability', 'lack of knowledge' and 'lack of training' were indeed the biggest barriers. Third, three of the four experts agreed with the highest ranked future urban agriculture support and promotion options, which were 'more training', 'more tools' and 'better co-op development'. However, they stated that these options could only be

realized with better communication among the stakeholder groups and more attention to the communities' needs. What became clear during the interviews was that, apart from the questionnaire data suggesting that the Municipality wants these three objectives supported, realization of these objectives is far from practiced in eThekwini, despite the farmers' demands.

6.2. Climate-smart urban agriculture in the eThekwini Municipality

As mentioned in the data analysis chapter, the focus group participants clearly said that they were unaware of the term 'climate change', having never experienced any adverse effects from the phenomenon because they never knew what it was. Various attendees however mentioned some abnormal events over the last few years, including floods and intense droughts, but admitted that they were not actively adapting to these events. In short, the majority of the farmers were unaware of changing climatic shifts, therefore not adapting to its effects. This inability is explained by Riggio et al. in the thematic framework chapter as the lack of problem solving because of the lack of problem identification. The NGO expert stated it likewise: *"If you don't know climate change exists, it's not a problem for you"*.

The stakeholders answered the same two questions – 1. "Do you think that urban agriculture practices in the eThekwini Municipality are negatively affected by climate change/ changing weather patterns" and 2. "Do you think that farmers engaging in urban agriculture are coping with/ adapting to changing climate patterns". While the thematic framework chapter, along with some of the Cato Manor farmers (who were aware of the abnormal climatic shifts), clarified that climate change has a negative impact on agriculture, about three-fourth of all the stakeholders thought likewise.

Looking at the second question, the urban farmers and the stakeholders had contrasting views for the most part. All of the Cato Manor farmers clearly stated that they weren't adapting to climate change. More than half of the stakeholders however answered 'yes' to this question. Thus, despite the fact that the urban farmers exclaimed they aren't coping with or adapting to climate change at the moment, the majority of the stakeholders thought otherwise. Only the educational stakeholders shared the same perspective as the farmers on climate change adaptation. What became apparent earlier is also visible here, as the data seems to reflect the role of education institutions as knowledge providers. According to the academic expert during the interviews, this educational role seemed to work well with earlier climate-smart urban agriculture projects, such as the greywater project she worked, along with the Municipality.

Following up on above results, the last two questions answered by the Cato Manor farmers and the stakeholders revolved around adaptation to and mitigation of the effects of climate change and the sustainability of future urban agricultural activities. These are all central aspects to the concept of climate-smart urban agriculture, which was explained earlier in the contextual approach. The first question – "Are you aware of the following agricultural practices within eThekwini Municipality?" – was meant to scope their awareness of climate-smart practices in the municipality. The urban farmers were aware of half of the activities listed, eight out of sixteen to be exact. At the same time, they also stated not being aware of the potential these activities harbor for adaptation to adverse climatic shifts and mitigation of the effects climate change. The academic expert stressed the problem here earlier: "*Everyone needs to know what the phenomenon of climate change is, and*

what climate-smart agriculture is. Only then adaptive strategies can be more effective, no exception".

Looking at the stakeholders' response, each of the sixteen climate-smart activities listed were observed in the eThekwini Municipality to a certain extent, though only five of the practices had an awareness rate of more than 50%, with 'permaculture', 'wastewater usage' and 'rainwater harvesting' as the most observed practice. These three practices were also observed by the urban farmers. The Municipality scored good on this awareness, which strengthens the assumption that it has more in-field experience and a better understanding of urban agricultural activity in the municipality than the other two groups.

The same table (Table 10) shows the stakeholders' perception of whether the aforementioned climate-smart agricultural activities should be encouraged or not. The focus group members couldn't give any answers in this regard, as they weren't aware of the effects and potential these practices could generate for improving climate-smart urban agriculture. The stakeholders mainly had high hopes for 'permaculture', 'wastewater usage' and 'rainwater harvesting' as activities to encourage in the future, which are the same three activities observed the most in the municipality. This can be explained by the influence of the Municipal Climate Protection Programme (MCPP) with its climate-smart urban agricultural interventions in eThekwini, as observed earlier. The other activities on the list, which had low scores, correspond with what has been said during the interviews, namely that they aren't yet implemented because nobody has showed the urban farmers these methods. This assumption is strengthened by the fact that the municipal 'no response' with this last question is surprisingly high compared to the other stakeholder groups, suggesting that there should be more knowledge transfer between all the stakeholder groups about the climate change context in the eThekwini Municipality, with the obligation of educational stakeholders serving the role of catalysts.

Of paramount importance here is a good situational and contextual analysis, with right and realistic goals, as mentioned in the ecosystems chapter when discussing the climate-smart urban agriculture framework. These goals should be compiled by bringing in specialists from relevant backgrounds, to concentrate on choosing the correct parameters for achieving these goals, and to eventually communicate these goals to all relevant actors engaged in climate-smart agriculture policy and practice, which can start the project cycle.

The above mentioned way of thinking via the framework of climate-smart urban agriculture, has quite some overlap with most of the interview answers. The three non-governmental experts (from NGO, private company and education) all advocated for more inter-stakeholder communication, in the form of knowledge transfer, and collaboration, in the form of joint field practice. The gravity here lies with the notion of climate change itself, which as a global phenomenon with local adverse effects needs to be translated effectively to all the relevant actors in the field.

The first part of this second discussion section covered the debate surrounding farmer knowledge of climate change. The four interviewed experts were in line with the focus group members and the literature, stating that the poor urban farmers in eThekwini indeed have no idea what climate change is and that they're not purposefully adapting to it. This again disproves the questionnaire data, with a majority of the stakeholders thinking that these farmers are in fact adapting to climate

change. Without proper training and knowledge transfer, this general ignorance will remain, and climate change will continue to linger as a silent problem, as said by the four experts.

Second, in contrast to the overall low numbers out of the questionnaire regarding climate-smart technique promotion, three out of the four interviewees referred to almost all of the climate-smart methods listed in this research. Without having even seen this list, they underlined the importance of climate-smart urban agriculture, not only as a food security tool and pro-poor developmental tool, but also as a smart way of effectively adapt to climate change and/or mitigate the effects of climate change. Just like mentioned above, the present-day role of the Municipality in facilitating the support of this activity is disappointing. As the private company expert summarized: *"The policy is great, but it needs fueling with the right institutional structure"*. As mentioned before, according to him it's going to be four degrees hotter, sea levels will rise, rainfall will increase, only because the Municipality is trying to persist the current system. Climate-smart urban agriculture is therefore a welcome paradigm shift. The ABC model could prove to be an effective way to mainstream climate-smart urban agriculture policy, while this implementation must take in to account the ethics of creating sustainable livelihoods and strengthening each of its capitals.

7. Conclusion

As stated in one of the previous chapters, the research aim of this thesis is to gain a better understanding of the effect climate change has on urban agriculture, how 'climate-smart agriculture' contributes to adapting to and mitigating the effects of climate change, and how policy on 'climate-smart urban agriculture' can be optimized, thereby safeguarding the development of the urban poor.

This research aim was then subdivided into various objectives, four to be exact. The first objective was to get a solid understanding about the phenomenon of urban agriculture in the eThekwini Municipality, by asking the question: *Who is practicing urban agriculture in the eThekwini Municipality, and why do they practice it?*. From the literature and all the datasets arose that primarily individual/ homestead gardens and community gardens can be found as urban agriculture examples in the municipality, serving the purpose of farming for mainly poor urban citizens. This purpose was also researched, and eventually it became clear that food security is the main incentive for urban citizens to farm in their community. Answering the question who practices urban agriculture, the data and literature clearly showed that the typical urban farmer in the eThekwini Municipality is an unemployed black woman, older than 50 years, with a low income and no formal education. On average, this answer pattern was more clearly visible with the municipal stakeholders' response than with the other two groups, suggesting that of all groups the Municipality has the best understanding of the in-field context regarding eThekwini urban agriculture. However, after interviewing the four urban agriculture experts, it appeared that urban agriculture policy is currently very top-down and barely promoted by the Municipality.

Following up on this first question, the second objective was all about placing the practice in to context. The concept of barriers to urban agriculture, which was vital to understanding urban agriculture in an African city like Durban, was central to the next question asked: *What are the barriers to urban agriculture in the eThekwini Municipality?* The most significant barriers mentioned by the focus group members were 'lack of training', 'limited agricultural skills and knowledge' and 'insufficient land availability', and resembles the academic perspective on urban barriers to agriculture in the city. Overall, the stakeholders perceived these barriers to be less existent, and it also showed that there exists significant differences in views on these barriers between these three groups. This suggests that to a certain extent there is a lack of understanding among stakeholders regarding the challenges urban farmers face these days. To answer the question then how urban agriculture should overcome or adapt to these barriers, the data consisting the perception of encouragement options by the municipality was relevant. The farmer respondents unanimously mentioned 'provision of training and capacity development opportunities' to be the most important change they hoped to be realized by the municipality, as they lacked vital knowledge on both basic sustainable agricultural techniques and outside phenomena like climate change. Also high on the farmers' wish list was the 'provision of agricultural extension support' and the 'support of developing cooperatives'. A majority of the stakeholders, not surprisingly the municipal stakeholders in particular, also thought these three types of improvement should be promoted in the future. However, as stated by the literature, the urban farmers and the interviewees, these improvement options should be approached more from a bottom-up perspective, by listening more to the needs and wishes of the community, as today's urban agriculture policy is still too much top down.

Moving on then to the second part of the thesis, the final two objectives zoomed in on climate change and the accompanied existence or non-existence of climate-smart responses to this phenomenon, all within the context of urban agriculture.

To study these objectives, the third question was meant to get an understanding of the first of these two objectives, resulting in the following question: *To what extent is climate change a consideration in urban agriculture policy and practice in the eThekwini Municipality?* The academic literature review made clear that the eThekwini Municipality is indeed negatively affected by climate change, which can also be said about the agricultural activity within this urban environment. More than three-fourths of the stakeholders on average, especially the education respondents, also stated that urban agriculture is negatively affected by climate change. Surprisingly however, they largely neglected the phenomenon as a barrier to urban agriculture. Looking at the Cato Manor farmers' response, only a few of them clarified they were aware of abnormal climatic shifts, which occurred during the past few years, and explained this negatively affected their farming activity and produce. However, they were not aware of the global phenomenon of climate change itself, let alone adaptation and mitigation options. This contrasts with the perceptions of the stakeholders, of which a slight majority on average expected that urban farmers in the eThekwini Municipality are in fact coping with/ adapting to climate change. Moreover, the extent to which climate change is taken into account within urban agriculture policy at the moment is negligible, according to the interview data. The academic expert, NGO expert and private company expert advocated for more communication between the Municipality, trainers and the community regarding climate change. They suggested more climate-smart agriculture workshops in eThekwini and the introduction of qualified Extension Officers. Also, as the climate-smart agriculture framework shows, these initiatives should be preceded by a thorough situational and contextual analysis.

Finally, the last question can be addressed, which is: *According to whom is promotion of climate-smart urban agriculture in the eThekwini Municipality needed, and which institutional changes can to be made to fit these needs?* Out of the focus group came the conclusion that the urban farmers' agricultural activity, to a certain extent, can be typified as climate-smart by design, but not climate-smart by consciousness, as most of the urban farmers weren't aware of its climate-smart potential. The stakeholders, being asked if they were aware of these sixteen climate-smart activities in the eThekwini Municipality, had an awareness rate above 50% for five of the practices, with 'permaculture', 'wastewater usage' and 'rainwater harvesting' as the most observed practice. Apart from these three, the overall scores for encouragement of these techniques were low as well, suggesting again that climate-smart urban agriculture is still in its infancy right now in eThekwini. The interview data confirmed this assumption, as each of the four respondents exclaimed that climate-smart urban agriculture still has a long way to go in eThekwini.

Climate-smart urban agriculture, as they explained earlier, must be promoted from a bottom-up perspective. The ABC model could prove to be an effective way to mainstream this, by first focusing on household plots, after which community gardens could be promoted, leading to the formation of cooperatives and possible market penetration. This implementation must take in to account the ethics of creating sustainable livelihoods and strengthening each of its capitals. This requires sound

community and capacity building, and the collaboration of all relevant stakeholder groups, such as NGO's, private companies and education.

All in all, looking at the covered objectives above, the main question can be answered, which was:

To what extent is urban agriculture within the eThekwini Municipality climate-smart, and according to whom?

Based on this research, urban agriculture on itself is already benefitting urban livelihoods via a broad array of livelihood capital improvements, making the most out of the limited spatial capital the urban environment and its infrastructure provide. Especially through self-developed food security enhancement and developing social capital through community gardening and feeding schemes, the positive feedback received by the farmers and stakeholders involved spoke for itself, and through its sustainable character it already followed the Sustainable Livelihoods framework to a certain extent, aligning with the academic literature. Focusing then on the extent of urban agriculture being climate-smart, depends on how one looks at it. From a practical design perspective, there seems to be climate-smart methods used in urban agriculture in a Sub-Saharan metropolis like Durban. However, from a conceptual and theoretical design perspective there seems to be a lack of understanding of climate change as a phenomenon, and the role it plays within the climate-smart movement. For adaptation to and mitigation of the effects of climate change to work in this context, the farmers first require the understanding of what climate-smart agriculture is, and more training and experience to get the most out of the climate-smart methods they already use. Apart from the significant potential climate-smart urban agriculture has in eThekwini, the Municipality is too absent in seizing this potential. As came out of the interview data, the city first needs to listen more to its targeted communities' priorities. This way, the relationship between the Municipality and the communities will strengthen as illustrated in the theoretical chapter:

> ***"Thus, the above implies that the more the government listens to its communities while acting as a strong state respecting human norms, values and rights, the more likely it is that development cooperation will be successful and sustainable"***

Taking into account all of the data from this research, climate-smart urban agricultural programmes and pilots need to be preceded by a situational and contextual analysis, as the ecosystems approach illustrated earlier in this research. This analysis should be strengthened by the Sustainable Livelihoods approach, which can map the vulnerabilities, assets and strategies of the farmers. The next step is application. The ABC model, preceded by FAO's climate-smart agriculture framework, looks like a suitable approach to safeguard a sustainable form of climate-smart urban agriculture in eThekwini. Eventually, to strive for this kind of agriculture, is to strive for further improvement of livelihood development in Sub-Saharan urban communities like the ones seen in this metropolis. Thus, the following recommendations results from this research:

- Among stakeholders and between both stakeholders and urban farmers, there needs to be more knowledge transfer regarding urban agriculture as a pro-poor developmental strategy, especially looking at its social and spatial characteristics. Equally important is the knowledge transfer regarding the global phenomenon of climate change and its adverse effects on

urban agriculture. Based on both the quantitative and qualitative data, the stakeholders in education should be the catalysts of this knowledge transfer facilitation;

- Looking at the sometimes contrasting opinions between stakeholders and urban farmers, there needs to be more interaction between these two groups, especially regarding collective criticisms and desires. The Municipality should start as soon as possible with properly promoting urban agriculture as a food security strategy, and at the same time teaching these farmers about climate change and possible climate-smart solutions for their affected crops. The ABC model should be looked in to, as it provides a framework for a step-by-step introduction of climate-smart urban agriculture;
- There needs to be a better understanding of the climate-smart potential of urban agriculture, and the way different climate-smart practices can optimally unlock this potential, eventually striving for site-specific adaptation and mitigation strategies and safeguarding sustainable development. This can be optimally realized by using the Sustainable Livelihoods framework. Based on both the quantitative and qualitative data, the stakeholders in NGO's and private companies (organization) should be the catalysts of this training and workshop facilitation;
- Promoting farmer cooperatives could further strengthen sustainable community farming in the eThekwini Municipality. However, this will fail without proper case-specific regulations and a framework for developing these cooperative structures, and will require the involvement and monitoring of not only the different stakeholder groups researched in this study, but also the urban farmers. Only with a decentralized approach and long-term community development, while listening to the communities themselves, these cooperatives can succeed and possibly lead to market penetration. The Sustainable Livelihoods approach should serve as a framework for sustainable community development.

The results and recommendations out of this research will be published in the full-colour, quarterly, popular science magazine Quest, directed at a target audience comprising learners, educators and the general public in the whole of South Africa.

8. References

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9. Appendix

9.1. Questionnaire respondents: background organizations/ institutions

- Council for Scientific and Industrial Research (CSIR), Stellenbosch, South Africa
- EarthQuest Management Consultants, Durban, South Africa
- Futureworks, Durban, South Africa
- eThekwini Municipality, South Africa
    - Biodiversity, Climate, and Green Project Implementation Branch
    - Biodiversity Planning
    - Community and Emergency Services Cluster
    - Environmental Planning & Climate Protection Department
- Municipal Institute of Learning (MILE), Durban, South Africa
- North-West University, Mafikeng, South Africa
- Rhodes University, Grahamstown, South Africa
- Stellenbosch University, Stellenbosch, South Africa
- University of Cape Town, Cape Town, South Africa
- University of Johannesburg, Johannesburg, South Africa
- University of KwaZulu-Natal, Durban, South Africa
- University of Pretoria, Pretoria, South Africa
- University of Witwatersrand, Johannesburg, South Africa
- Wildlands Conservation Trust, Pietermaritzburg, South Africa