

The understanding of local knowledge in climate change adaptation

Research of small-scale local farmers in Naivasha, Kenya

MASTER THESIS INTERNATIONAL DEVELOPMENT STUDIES
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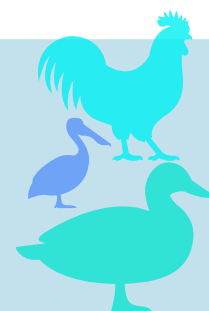
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Abstract

Climate change is experienced on different communities all around the globe. Climate change adaptation and mitigation strategies are used to minimize the impact of climate change. This research is contributing to bridge the knowledge gap by researching the role of local knowledge in climate change adaptation strategies of the small-scale local farmers in Naivasha, Kenya. Sub-Saharan countries are coping with severe consequences of climate change, as is Kenya. Naivasha is an area with some floods, but mostly the brunt of severe droughts. This is why farmers need to adapt to the changing climate fast. The data used was gathered using semi-structured in-depth interviews and personal observations. The findings of the research are suggesting that the local knowledge is influencing climate change adaptation strategies of local farmers. Core examples are weather predictions and arable farming strategies. Thereby, local knowledge and adaptation strategies are influenced by modern technologies who create together a new type of knowledge.

Keywords

Local knowledge, small-scale farmers, adaptation, climate change, strategies, Kenya, Naivasha.

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Table of Contents

1. INTRODUCTION	6
PROBLEM DEFINITION AND RESEARCH CONTEXT	6
ACADEMIC RELEVANCE	9
RESEARCH AIM	10
RESEARCH QUESTIONS	10
STRUCTURE OF THESIS	11
2. LITERATURE REVIEW	12
THEORETICAL EMBEDDING	12
<i>Operational definition of Local knowledge</i>	12
OVERVIEW OF THE LITERATURE	13
<i>Rural livelihood of small-scale farmers</i>	13
<i>Rural livelihood in Kenya</i>	14
<i>Crop cultivation adaptation to climate change</i>	15
<i>Crop cultivation in Kenya</i>	15
UNDERPINNING LOCAL KNOWLEDGE	16
<i>Worldviews</i>	16
<i>Local knowledge versus scientific knowledge</i>	16
<i>Climate change adaptation</i>	18
REGIONAL THEORETICAL FRAMEWORK	18
<i>Kenya</i>	18
<i>Naivasha</i>	20
3. METHODOLOGY	22
ETHNOGRAPHIC APPROACH	22
DATA COLLECTION	24
<i>Study sites and small-scale local farmers</i>	24
IN-DEPTH AND SEMI-STRUCTURED INTERVIEWS	25
<i>In-depth interviews</i>	25
<i>Semi-structured interviews</i>	25
<i>Selection criteria of interviewees</i>	26
<i>List</i>	27
PARTICIPANT OBSERVATIONS AND FIELD NOTES	28
VALIDITY AND RELIABILITY	28
REFLECTION AND POSITIONALITY	29
4. RESULTS	30
DEMOGRAPHIC INFORMATION OF SMALL-SCALE FARMERS IN NAIVASHA	30
PERCEPTION OF CLIMATE CHANGE.....	30
<i>Floods and droughts</i>	31
<i>Consequences of droughts and floods</i>	32
THE DIFFERENCE THEN AND NOW OF PEOPLE'S PERCEPTION OF THE CHANGING CLIMATE	33

LOCAL ADAPTATION PRACTICES	35
THREE MAIN PRACTICES	37
<i>Weather forecast</i>	38
<i>Water</i>	40
<i>Farmland management</i>	44
TRANSFORMED KNOWLEDGE IN PRESENT DAYS	46
INSTITUTIONAL SUPPORT FOR STRENGTHENING LOCAL KNOWLEDGE AND PRACTICES.....	48
5. DISCUSSION.....	51
LOCAL KNOWLEDGE VERSUS SCIENTIFIC KNOWLEDGE	51
ADAPTATION PRACTICES AND CHANGING KNOWLEDGE.....	51
<i>Adaptation Strategies Employed by Small-Scale Farmers</i>	52
<i>The Value of Local Knowledge</i>	54
<i>Integration with Scientific Knowledge</i>	55
INSTITUTIONAL SUPPORT: BRIDGING THE GAP	56
6.CONCLUSION.....	57
LIMITATIONS OF THE STUDY.....	57
<i>Social implications</i>	57
<i>Method limitations</i>	57
<i>Potential research topics</i>	58
CONCLUSION	58
<i>What diverse experiences and perceptions do small-scale farmers in Naivasha have regarding floods, droughts, and their effects?</i>	58
<i>What strategies do small-scale farmers in Naivasha employ to adapt to and survive extreme weather events?</i>	59
<i>Can the local knowledge of small-scale farmers in Naivasha enhance their resilience to climate change? If yes, how?</i>	60
<i>How does knowledge of local communities in Kenya influence climate change adaptation?</i>	60
7. REFLECTION.....	62
SUCCESSES	62
<i>Methodology</i>	62
<i>Conducting research</i>	62
CHALLENGES FACED.....	63
<i>Methodological approach</i>	63
<i>Conducting research</i>	63
<i>Interview scheduling</i>	63
<i>Distance</i>	64
<i>Language barrier</i>	64
<i>Limited resources</i>	64
<i>Safety issues</i>	65
RECOMMENDATIONS.....	65
REFERENCES	66
APPENDIX 1.....	72
APPENDIX 2.....	73

1. Introduction

Problem definition and research context

Humanity currently faces significant challenges such as climate change, biodiversity loss, land-use change, and ocean acidification. On top of these challenges, evidence indicates that we may have already passed crucial planetary limits (Ford et al., 2020). Present and future exposure to climate-related risks, in combination with limitations in adaptive capacity, means that certain environments and populations are more vulnerable to climate change and its long-term effects than others (Nilson, 2008). Although we know we have only "one Earth," resilience and vulnerability to environmental change vary widely between national and household levels, influenced by factors such as age, class, gender, ethnicity, income, and livelihood (Ford et al., 2020).

Indigenous peoples depend on natural resources for their way of life, often inhabiting in varied yet fragile ecosystems. However, they also endure and experience marginalization, poverty, and vulnerability. Given their strong connection to the environment, many indigenous communities are especially easily affected to the effects of global warming because their livelihood is deeply intertwined with their environment (Baird, 2008).

For indigenous populations across the globe, climate change introduces a variety of hazards and potential benefits, endangering cultural continuity and threatening their survival. The side-effects of ecosystem transformations affect the utilization, preservation, and regulation of wildlife, fisheries, and forests. Thereby they disrupt old traditions related to culturally and economically vital species and resources which endangers their ability to adapt to this changing climate (Nilson, 2008).

Climate change significantly affects the indigenous way of life. However, the significance of indigenous peoples' local knowledge and ancestral wisdom is often disregarded by international experts as claimed by Baird (2008). As discussions surrounding climate change essentially center on scientific and technological adaptation and mitigation measures, Indigenous people face the increased challenges in adapting to the changes in their environment and society. Moreover, global and local initiatives to address climate change are increasingly posing threats to indigenous communities' territories and resilience strategies. For instance, forming monoculture plantations for biofuel production can disturb ecosystems and jeopardize water sources in regions inhabited by indigenous populations (Nilson, 2008).

Local communities around one of the biggest lakes in Kenya, Lake Naivasha, face challenges in maintaining their livelihoods daily (Nakuru County, 2021). There are various reasons why

the number of challenges is increasing. One of the main reasons is the effects of climate change. In particular, the changes in weather events, such as floods and droughts, have developed into a pressing issue for the farming community in Naivasha (Shames & Scherr, 2019). To overcome these challenges, the farmers are looking for new methods to enhance their resilience and adapt to the changing climate.

Climate change has become more severe, with African countries being hit especially hard. Sub-Saharan countries are known for high rates of undernutrition and infectious diseases, which are expected to increase due to climate change. Climate change doesn't just limit soil fertility and crops' ability to grow; it also increases polluted water, affecting entire ecosystems (WWF, 2018). Many Sub-Saharan countries depend on rainfed agricultural systems for their livelihood, and precisely these systems are most vulnerable to climatic changes. Relative poverty often limits the adaptive capacities of the local population and thus increases vulnerability (Serdeczny et al., 2016). However, this doesn't and shouldn't mean that local communities are foreordained to be defeated.

On the contrary, indigenous people and local communities are groups of people known to maintain worldviews and knowledge different from the scientific Knowledge of Western societies (Maweu, 2011). Indigenous groups are affluent in ecosystem-specific knowledge, biodiversity, soil systems and water (Leal Filho et al., 2022). Indigenous and Local Knowledge (ILK) has a long history of informing responses to climatic variability and change. This knowledge is acquired over generations through living in contact with nature. Hence, it could be argued that local communities are better positioned to acknowledge the environmental conflicts because they are 'closer to the problem'. The knowledge of local communities is known in academia as Indigenous Local Knowledge (ILK), Traditional Ecological Knowledge (TEK), Indigenous Ecological Knowledge (IEK), Indigenous Knowledge Systems (IKS), or Local Ecological Knowledge (LEK). There are a lot of different names for similar knowledge systems.

In the literature, claims can be found that state that local communities feel vulnerable and do not see a future in their way of living, as the Maasai in Kenya (Torfinn, 2011). A few studies have focused on the impact of climate change on local communities in Kenya and what it means to continue their way of living (Torfinn, 2011). Farmers would go to the city and look for another job if agriculture is precarious, but because farmers are so dependent on the crops, they still need to pay for the higher food prices when the harvest fails (Serdeczny et al., 2016). This means moving to the city and finding another job is no option. Socio-economic conditions reflected in most studies are prominent in describing climate change's impact. Despite the importance of local specificity to adaptation strategies, little attention has been paid to it

(Apraku et al., 2021). Thus, showing the importance of ILK is necessary for a sustainable way of adaptation to climate change for local communities. It is shown that local communities are using ILK and innovating their most common practices, such as crop diversification and crop rotation (Ndalilo et al., 2020).

The well-being of humanity depends on the climate, which is worsening each moment. The United Nations Sustainable Development Goals (SDGs) are drawing attention to different problems occurring in the world, like inequalities between nations, starvation, illiteracy, and poor health. This indicates that, there is a need to pay more attention to the environment, and development should focus more on improving the living standards of all people. By protecting our ecosystems, we can create sustainable futures for all. However, it is crucial to incorporate indigenous and conventional methods to increase agricultural productivity to solve these problems (Masinde, J., 2019). Traditional education was centered on putting the group's interest above personal interest. This means that including students' knowledge in educational programs enhances innovative thinking (Mawere, 2015). In learning the old knowledge, new knowledge is discovered, making indigenous knowledge more dynamic (Owuor, 2007).

Thus, local communities have much ecological knowledge and know how to deal with, adapt to, and predict their environment (Lemi, 2019). So, implementing ILK in community-based approaches can positively affect climate change adaptation. Community-based adaptation can create jobs, response to disasters, and improve food security and water constraints (Roberts, 2010). It shows that local knowledge should be given more consideration to regional powers and governments to address their knowledge in adapting to climate change. Ayaa et al. (2016) even go as far as to state that the decline in the use of Indigenous environmental knowledge systems harms the state of the environment.

Local knowledge has its limitations; it maintains a narrow perspective, and although it adds value to studies and academic knowledge, it can also be a disadvantage as local knowledge is often only locally relevant (Chalmers & Fabricius, 2007). This often leads to local inhabitants having a weaker understanding of the processes that are taking place in their environment, especially processes that take longer. Faster variables are more accessible to identify and observe. Even though the local inhabitants cannot understand or see all changes around them, they try to adapt to these changes with their knowledge. However, they have a limited capacity to adapt to slower variables into their understanding as they are harder to track, because of their more globalized nature (Berkes and Jolly, 2001). Therefore, combining local and scientific knowledge is necessary to improve people's understanding of our ecosystem and all processes (Chalmers & Fabricius, 2007). This is important because knowledge varies within any group of people, including local communities. Not everyone has a holistic understanding

of the environment, and in rural areas, different groups of people use the land for various reasons (Kaschula et al. 2005). These different ways of using the environment results in local experts: individuals with extensive knowledge about a specific ecosystem (Donovan & Puri, 2004). Local and scientific perceptions of expertise shouldn't be merged, but scientists believe a bridge should be built between local and scientific knowledge to benefit and complement each other (Chalmers & Fabricius, 2007).

In this thesis, 'local knowledge' is used because the term 'indigenous' is quite delicate in some circumstances. The definition of local knowledge handled in this thesis is: *Local Knowledge is acquired over generations through living in contact with nature.* Adaptation and mitigation to climate change strategies are instruments to cope with climate change. There is too little information about local knowledge and how it influences adaptation skills and strategies even though it is essential. Therefore, this research will contribute to bridging this knowledge gap by researching the role and importance of local Knowledge (LK) in a local community in Kenya. This research is about how the farmers' local Knowledge in Kenya influences their adaptation to climate change strategies.

Ultimately, the findings of this thesis could contribute to a broader framework for climate change adaptation, offering valuable lessons and strategies that can be implemented in other regions facing similar environmental challenges. By examining this specific case and more in-depth understanding of the significance of local knowledge of the small-scale farmers in Naivasha, we can gather valuable insights can be gathered that could be applied to assist other communities experiencing similar challenges. These insights and knowledge for adapting to the changing climate and environment contributes to farmland management and environmental knowledge which other famers can use.

Academic relevance

Around the world, the positive role of local and indigenous knowledge in adapting to climate change has been confirmed at the community level, where there is limited access to scientific information. In addition, uncertainty makes adapting to the more complex (Shackleton et al., 2015). ILK has the potential to fill the information gap in modern scientific knowledge. However currently, ILK faces severe challenges due to a lack of proper knowledge transfer and documentation, lack of recognition of forecasters, and environmental degradation (Leal Filho et al., 2022). The combination of knowledge could be a win-win opportunity, but it has been underutilized. Therefore, gaining scientific knowledge is difficult for local communities due to various barriers, such as the lack of education or general awareness of the existence of the science.

The issue at hand is that local communities attempt to adapt to climate change using their own traditional knowledge and methods. However, the increasing complexity of climate adaptation poses significant challenges and endangers their livelihood. This thesis aims to investigate this problem by identifying the types of knowledge local communities currently utilize and the perceived gaps in their knowledge. By identifying the specific assistance and knowledge these communities require, we can more effectively bridge these gaps with existing scientific knowledge, thereby integrating local knowledge with scientific expertise to enhance adaptive strategies. Thus, there is an urgent need to conduct research on climate change adaptation in Kenya, particularly because of the profound effects that climate change has on small-scale farmers and local communities (Kabubo, 2007). These local communities and farmers are highly vulnerable, and it is crucial to develop sustainable adaptation strategies to support them.

Research aim

The primary objective of this research is to gain a thorough understanding of how local small-scale farmers in Kenya adapt to climate change's impacts. This includes exploring the different methods they apply and assessing the effectiveness of these strategies. Additionally, this study aims to investigate the role of indigenous knowledge in shaping these adaptation strategies. By profoundly examining the indigenous knowledge systems and how they influence adaptive practices, this research seeks to provide a comprehensive view of the adaptation processes at the community level.

Research questions

This thesis aims to research and explore the strategies used by local communities in Kenya to address the impacts of climate change. Additionally, it seeks to delve into the detailed aspect of the indigenous knowledge systems that play a crucial role in guiding their adaptation initiatives. The general research question is:

How does knowledge of local communities in Kenya influence climate change adaptation?

With the following sub-research questions answer to the main question:

- What diverse experiences and perceptions do small-scale farmers in Naivasha have regarding floods, droughts, and their effects?
- What strategies do small-scale farmers in Naivasha employ to adapt to and survive extreme weather events?
- Can the local knowledge of small-scale farmers in Naivasha enhance their resilience to climate change? If yes, how?

Structure of thesis

Following the introduction, the next chapter will discuss the relevant literature through a review. This chapter will also cover the regional setting of the research in combination with their existing knowledge. In chapter three, the methods used in this research will be discussed and explained, as well as how the data is gathered. It also considers the validity and reliability of the study and methods chosen. Chapter four is dedicated to the presentation of the data obtained. This data is discussed in chapter five, which includes the impact of climate change, the difference between knowledge through the years, adaptation, and local knowledge and farmland strategies. Chapter six concludes with a discussion of the analysis and findings during the research. The relationship between local knowledge and resilience to climate change and the difference between local and scientific knowledge is discussed in this chapter. Chapter seven concludes the thesis with a reflection on the research experience from a methodological and personal view.

2. Literature review

Theoretical embedding

International development involves social processes that cross national borders, cultures, and various levels of society. It includes multiple diverse people and groups, each with their ways of thinking and living, working together, and interacting in complex ways (Mosse, 2013). Potter et al. (2012) state that international development is inherently cross-disciplinary, incorporating various fields to study poverty and inequality. This includes fields like geography, politics, international relations, and urban and regional planning.

“The classic aim of development, modernization or catching up with advanced countries, is in question because modernization is no longer an obvious ambition. Modernity no longer seems so attractive in view of ecological problems, the consequences of technological change and many other problems” (Pieterse, 2010).

The view of Pieterse is essential because it acknowledges the importance of development strategies other than modernization, which shows local knowledge can be important. Looking at the development sector, ecological issues and the impacts of technological change have gained increasing importance. Several decades of development efforts have fallen short of expectations, particularly in parts of America, South Asia and Africa (Pieterse, 2010). This has caused a significant shift toward local culture and cultural diversity, and especially emphasizing its importance in sustainable development. This shift is considered a leading guideline for researching a sustainable future for local small-scale farmers.

The theoretical background aims to give a detailed overview of the existing literature and key themes in development studies required for this thesis. This thorough foundation is necessary to create a strong theoretical base from which the exploratory research begins.

Operational definition of Local knowledge

For this thesis, it is essential to define local knowledge because this research looks at how knowledge has changed over the years and affected local farmers' livelihood and adapting skills. This thesis is primarily interested in small-scale local farmers because these people are coping with climate change with little to no money due to failing crops. These people have less access to scientific knowledge and are using their LK. However, ruling out any scientific influence on their knowledge is too hard because of the difficulty of searching for information online. Referring to Gilchrist et al. (2005) again, local knowledge is acquired through a person's life, which different sources can influence. Time could be considered as a criterion for when knowledge will pass for local knowledge. It is not necessary to differentiate between such types

of knowledge for practical purposes. What counts is that local individuals have the opportunity to apply their own learning and skills they regard as relevant, this is not influenced by time (Baldus, 2009). So, the understanding in this thesis is that LK is what the community has done for years, what they have learned from each other and their environment, what they assume, and primitive knowledge. Summarizing it in one sentence: *Local Knowledge is acquired over generations through living in contact with nature.*

Overview of the literature

This summary aims to capture the domain of research related to the fundamental concepts of this study. These concepts are (1) Rural livelihood of small-scale farmers and (2) crop cultivation. Unfortunately, the literature is limited of publications based on studies that have taken place in Kenya, especially Naivasha. Nevertheless, I did find literature from other similar situations. Although few of these sources were available, they still provided a foundation to build upon. Furthermore, essential concepts are integral to this research's foundation. These concepts' meaning have been thoroughly examined in supplementary literature, ultimately contributing to a deeper understanding of the research area, and are used accordingly to analyze the data obtained.

Rural livelihood of small-scale farmers

In 2017, approximately 3.4 billion people worldwide lived in rural regions, with the majority located in low (15%) and middle-income (79%) countries. A major part of these populations relied on small-scale agriculture as a source of income, including farming, fishing, and livestock rearing (Thornton et al., 2019). Rural livelihoods face more significant pressure, with the income gap between rural and urban areas widening despite economic growth in many regions (Bues, 2011). For example, starting in 2001, approximately 227 million hectares have been either sold, leased, licensed, or are currently being negotiated for large-scale land deals. Most of these transactions took place after 2008 (Oxfam, 2011). The main force behind this trend is the favorable market conditions for the agricultural sector, population growth and changing consumption patterns that require more land for food production. Moreover, there has been a notable increase in land speculation, where land is bought and sold for investment purposes, contributing to this phenomenon (Bues, 2011). This is also known as 'land-grabbing' and leads to an increasing demand for land. Many people see the opportunities for low-income countries to increase their capital flow. On the other hand, other people are worried that this pressure on land has a genuine impact on the food security of the local population when fertile land is used for producing export goods (Bues, 2011). Another effect of the increasing demand for land is lack of access to available farmland. Insufficient farmland causes a bigger gap between men

and women. Women have to sell their labor to cash-crop-producing farms where they are paid less than men (Oxfam, 2011).

Climate change worsens the existing challenges and is expected to worsen these conditions further, especially for small-scale farmers. Extreme events and unpredictable weather patterns make agricultural production more challenging. These weather events disproportionately affect poorer countries and people (Thornton et al., 2019). These extreme weather events exist in different forms, such as heavy storms, floods, droughts, and extreme heat events. Small-scale farmers also face other additional challenges such as plant and animal pests, price fluctuations, unreliable markets, transportation issues, and health and nutrition concerns (Thornton et al., 2019). This has an inevitable impact on the hunger levels and makes it harder to counteract malnutrition. Small farmers also have to deal with health issues, conflicts, and economic problems. As an example, crop failure can lead to less cash-flow and so defaulting loans or unable to pay school fees (Rigg et al., 2016).

Migration, particularly for the poorer migrants, has been temporary and seasonal and primarily within the rural areas. Migrants did this for example to have fresh grass to graze for their livestock. Due to all the challenges stated above, the patterns are changing significantly in Sub-Saharan Africa. And this has resulted in an increase in migration from rural to urban areas (Thornton et al., 2019).

Rural livelihood in Kenya

Despite the aridity, Kenya's arid and semi-arid lands support about 25% of their human population, 60% of the livestock population, and the largest proportion supports wildlife (Ngugi & Nyariki, 2005). These areas produce a variety of goods, including timber, charcoal, fruits, honey, vegetables, and traditional medicines. The production of goods contributes significantly to the local and national economy. However, these pressures are mostly reducing the grazelands' ability to meet the current needs. As a result, it is getting more difficult for the grazelands to support the fast-growing and more non-migratory population. The ecological health of the grazing lands has declined due to over-cultivation, overstocking, and deforestation, resulting in livelihood insecurity (Ngugi & Nyariki, 2005).

Kenya faces a severe food insecurity: in 2017, over 3.4 million Kenyans were acutely food insecure, this is a 67% increase from 2016. This food insecurity is mainly due to poor rains, rising food prices, and reduced imports (Mutea et al., 2017). Almost 75% of Kenya's labor force depends on agriculture, which is heavily dependent on rainfall (Bryan et al., 2010). The variability of the changing climate is increasingly having an impact on agricultural livelihoods and food security, making adaptation crucial to survive. Drought is the primary climate change in Kenya, affecting over 80% of households in the past five years. Other significant climatic

disruptions include erratic rainfall, floods, and hailstorms. This reduces crop yields, food shortages, and livestock losses (Bryan et al., 2010). People are trying to cope with these shocks by purchasing food (instead of growing it), reducing consumption, or selling/buying livestock. Others rely on credit, social safety programs, or off-farm employment (Bryan et al., 2010).

Crop cultivation adaptation to climate change

Climate change impacts the production of vegetables by influencing the distribution of pests, diseases, and weeds (Deuter, 2008). Crops like eggplants suffer from heat exposure and rainfall variability that affects production, reducing crop profits (Fadairo et al., 2019). The increased air pollution caused by carbon dioxide and high temperatures lowers the vegetable's nutritive value, it reduces the plants' vitamins and sugar content. Less precipitation and higher temperatures cause water stress, which affects water irrigation and increases evapotranspiration (Datta, 2013). These changes shift planting schedules and reduce potential harvests.

African indigenous vegetables (AIVs) are crucial in sub-Saharan Africa's food systems; they include over 45,000 species of plants, including around 1,000 edible species (Muhanji et al., 2011). Exotic and commercial crops were introduced during colonial times and overshadowed traditional AIVs, which were seen as "poor people's" plants at the time. Farm-Africa, an NGO located in 5 African countries, has reintroduced AIVs, which are now vital in people's diets and are an additional income source for small-scale farmers in Tanzania and Kenya. AIVs are robust, productive, and essential for feeding vulnerable populations, with some of species being more resilient to the climate than commercial crops (Muhanji et al., 2011)

Combined with AIV's, farmers worldwide plant a various high-value crops. This helps spreading the risk of losing income due to bad weather or market changes, making their livelihoods more secure (Kemboi et al., 2020).

Crop cultivation in Kenya

There is scarce literature on crop cultivation concerning livelihood sustainability of small-scale farmers in Kenya. Nevertheless, there is some exciting information for this research.

Crop diversification is crucial for managing agriculture's income, production, and market risks. It sustains the productivity and addresses marketing challenges due to fluctuations (Kemboi et al., 2020). Kenya Vision 2030 emphasizes boosting agricultural productivity, food security, and income through crop diversification. The county has a strategic plan to promote high-value crops and livestock. For instance, small-scale farmers should consider adding passion fruit

farming to their diversified crop practices (Njeru, 2013). Also, exotic species in combination with AIV's could increase the potential yields (Kemboi et al., 2020).

Underpinning local knowledge

This section explores three concepts through the literature that are pivotal to this thesis and form the basis of the analysis.

Worldviews

Throughout anyone's life a worldview is created, formed by socialization and social interaction. Worldviews are a set of beliefs, values and assumptions held by several people, an individual, group or society (Hart, 2010). However, it has to be noted that people change over the years, and worldviews change with them. Worldviews affect our decision-making, thinking patterns, and how we perceive the world and define events and solutions to occurring problems. Humans use perceptual and emotional maps to clarify the world, their land, animals, and people (Hart, 2010). Worldviews influence how we act on climate change and our perception of it (Rudiak-Gould, 2014). Understanding worldviews is essential to understanding local knowledge (LK). Local knowledge influences our worldviews and understanding of the world. Western or Euro-American culture has influenced Western science knowledge, which is understood as mainstream modern science. Western science could be considered a 'subculture science' based on the worldview presuppositions that nature and the universe are ordered, uniform and comprehensible (Zidney et al., 2020). So, the farmers' worldview in Naivasha must be considered during this research.

Local knowledge versus scientific knowledge

Western scientific knowledge represents the 'Western' or 'Euro-American' science, that is understood as mainstream science by the Western World (Zidney et al., 2020). Western scientific knowledge is driven by theoretical models and testing hypotheses, often generalized, generated by institutions, and documented in written form (Charnley et al., 2007).

LK is gathered through watching ecosystems. LK is mainly practical information that helps people to survive and maintain their resource-based life (Charnley et al., 2007). This knowledge is generated through experiences with nature in their daily life and is spread verbally or through demonstration (Charnley et al., 2007). In science, local knowledge is known as 'ethnoscience'. This system classifies and interprets objects, activities, and events in a particular culture (Zidney et al., 2020). LK is often used in articles in combination with the term Indigenous. Traditional or local knowledge is captured through observation. Hence it is not limited to indigenous Knowledge (Gilchrist et al., 2005).

LK sees natural phenomena as interconnected and inexplicable in separation, where scientific knowledge breaks down every piece of information to understand the phenomenon. Another significant difference between local and scientific knowledge is the influence of culture. While Western science often separates culture and nature for two purposes, local communities see nature and culture as two actors connected to human actions (Blaser, 2009). Local knowledge is practical experience and is not seen as scientific knowledge mainly due to lack of documentation (Persson et al., 2018).

Words like 'modern' and 'traditional' are related to ideal types of worldviews for analytical purposes, but they are conceptually equivocal. Hence, according to Gilchrist et al. (2005) local knowledge can be acquired through a human's life, and changing worldviews and global dynamics can be integrated into their knowledge. 'Traditional' knowledge can be seen as 'current local knowledge' and is equivalent to 'modern'.

Many different terms are defined for local Knowledge: TK, LEK, IK, etc. Traditional Knowledge (TK) encompasses a web of insights, convictions, and customs to safeguard, convey, and frame cultural connections with the environment across generations (Bruchac, 2014). Tradition is often seen as cultural tradition even though faith and science are also a part of tradition (Morris, 2010). Local Ecological Knowledge (LEK) is ecological knowledge held and used by traditionally living indigenous people with a historical continuity of resource use (Joa et al., 2018). Indigenous knowledge is ordinary people's knowledge of their environment (Morris, 2010). Indigenous knowledge goes beyond ecological knowledge, such as traditional housing. Local knowledge is based on people's interactions with their surroundings, using a trial-and-error basis through learning from feedback and interaction (Chalmers & Fabricius, 2007).

The terms above are similar yet distinct. "Ecological" might be overly limiting, while "traditional" or "indigenous" might not align with the focus of my thesis. What is considered local knowledge and what is not is difficult to define. Practical traditional knowledge can be held by both indigenous and non-indigenous people (Baldus, 2009). Therefore, as I have already mentioned, it is indigenous, a sensitive name, and it won't draw a line between traditional and indigenous knowledge. Knowing the difference between conventional, indigenous, traditional, and local knowledge is also challenging, as new knowledge could be added recently. Then, time would become another criterion. How old does knowledge need to be to be considered traditional? However, in this thesis time isn't considered as a criterion for local knowledge. What's important is that local communities use their own relevant knowledge and skills to sustain themselves (Baldus, 2009). Because of these reasons, I have chosen to use the term Local Knowledge.

Climate change adaptation

Strategic adaptation pathways are vital for reducing exposure and vulnerability to climate change. Climate change adaptation is “the adjustment process to actual or expected climate and its effects to moderate harm or exploit beneficial opportunities” (Lavell et al., 2012). This means that the ability to react to conditions not faced before depends on human adaptive capacity. Local communities in sub-Saharan African countries have constantly been adapting their livelihood strategies like every other community. Conversely, this community must adapt more swiftly to their environment due to climate change.

Nonetheless, the terminology ‘climate change adaptation’ emerged in Western science. Local communities are unaware of this terminology or do not understand this scientific concept due to a lack of education or access to scientific knowledge (Mburu et al., 2015). Even though local communities are aware of the changing climate, adapting has many constraints. Adaptation measures include planting drought-tolerant crops, burning charcoal, and harvesting rainwater. Nevertheless, limitations identified in Kenya embody financial constraints, lack of relevant skills, and lack of scientific and technical knowledge. Therefore, the kind of climate-changing events with the most impact also needs further research (Mburu et al., 2015). A complete picture of how farmers see, feel, and experience climate change is essential to understand how they apply adaptation strategies. These strategies are based on their perception of the changing environment. To create the adaptation strategies, the farmers use their local knowledge. This means that their perception of climate change influences their knowledge usage.

Regional theoretical framework

A regional framework is relevant for this thesis because it allows for a targeted analysis of localized issues, ensuring that this research addresses the specific needs and challenges of the study area.

Kenya

Kenya is a Sub-Saharan country coordinated on the equator, bordering Tanzania, Uganda, Southern Sudan, Somalia, and Ethiopia. Approximately 47,6 million people live in Kenya (NCPD, 2020). The country consists of 47 counties and is led by the current President William Ruto. There are two official languages spoken in the country: English and Swahili. Both languages are permitted and utilized in government duties. The average age in Kenya is very young; the population averages at 19,2 years old. The capital is Nairobi, which is advanced. For example, they have already paid for over 15 years with an app on their cellphone and since 2017, the usage of plastic bags has been prohibited and may be punished with a €33.000,-

fine (NOS, 2017). Several national parks exist, but the government does not enforce these area's regulations. A railway track runs directly through Nairobi National Park towards the ocean. The city is expanding so fast that it gives a surreal view, the city skyline in the back with zebra's and gazelles in the front. Half a million new residents join the slums of Nairobi every year. So even though the city is, on the one hand, so progressive, it certainly has its struggles on the other hand (NOS, 2017).

Challenges of Kenya

Other struggles are the development challenges that Kenya is facing, like harvest losses because of climate change. The poverty rate is low in the capital. Contradictory, the poverty rate around the country is 52%, and over 73% of the inhabitants' livelihoods depend on agriculture (Bryan, 2013). Agriculture is responsible for food security in the country. Unfortunately, the expanding population, rapid urbanization, and shortage of arable land, mainly because of climate change, cause this imbalance between demand and supply for food (Kabubo, 2007). According to Kabubo (2007) the agricultural sector's performance is declining, and it is struggling to feed the inhabitants of Kenya. Farming is becoming difficult because temperatures will increase around 4 degrees Celsius, and there will be variability in rainfall. These weather events could have severe socio-economic impacts, such as water shortage, food, and other fundamental problems (Kabubo, 2007). Adaptation to climate change at the agricultural level includes better crop management, land use, water management, and livelihood activities (Bryan, 2013). Currently, there are many droughts and floods across the country, which will occur even more with global warming and the climate changing. The region of Naivasha is struggling with all these issues, has many small-scale farmers, and struggles with climate change. Hence, the area of Naivasha is interesting to research on the local scale, and it provides significant societal relevance for this thesis to be conducted in this format.

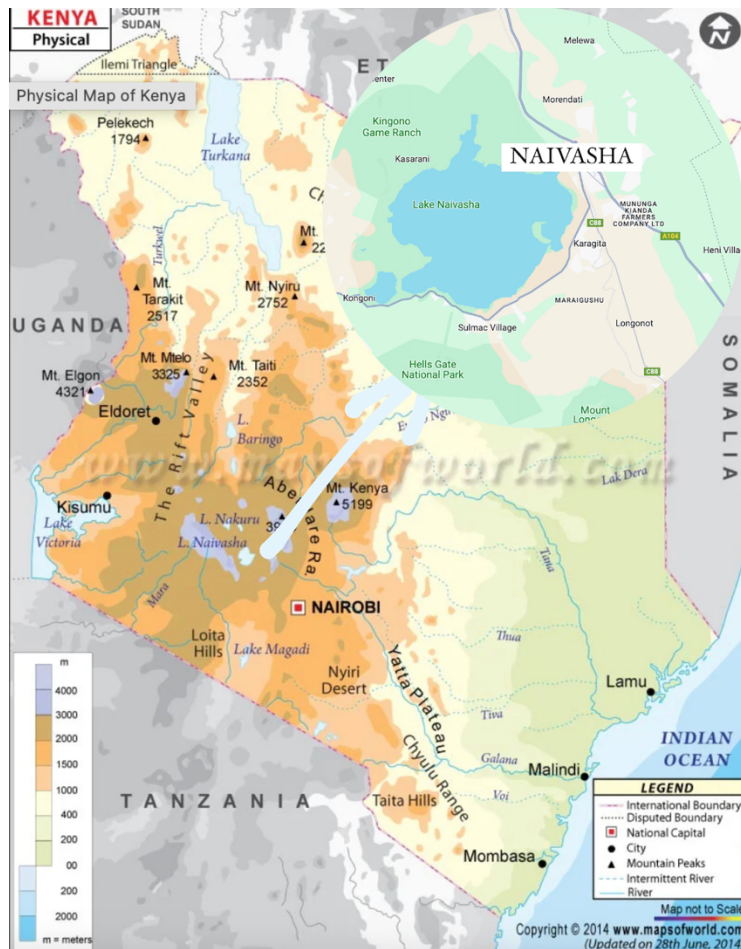


FIGURE 1 MAP OF KENYA

FIGURE 2 MAP OF LAKE NAIVASHA

Source: *Mapsofworld.com*

Source: *Google Maps*

Naivasha

Naivasha is a two-hour drive away from Nairobi, and located northwest of Nairobi. It has almost 200,000 inhabitants (KNBS, 2019). Naivasha is located in one of the ‘wetter’ regions of Kenya and because of the higher altitude and close access to fresh water, it is a good spot for farming. Due to this spot, the biggest export in the Naivasha lake district is flowers. This industry has been good for the economy but bad for the environment. There were a lot of migratory paths along the lake, but the flower industry destroyed these. Fortunately, there are more places becoming parks and welcoming the animals back. Tourists visit the scenery around Naivasha town, which has beautiful fauna and flora (Nakuru county, 2021).

In this area, floods are the most destructive consequence of the changing climate (Huho, 2015). It is worsening to the point that even Lake Victoria is flooding. These floods are happening more frequently, but this is not the only effect of climate change. The heavy precipitation and the uncertainty of how long and when it will fall destroys the crops (Baraka,

2022). This is creating a challenging climate in which to grow crops because of the uncertainty of rain. Farmers need to find new ways to grow crops or new species.

Naivasha is a place where many different tribes live together in one city. This brings various types of farming and crops to the fields. The soil around Naivasha is fertile and therefore attractive for agriculture. There are many farms; 70% of the land is used for farming (Nakuru county, 2021). Studies show that crops grow below levels that small-scale farmers realize profit (Muteru, 2013). The adaptation processes need to be improved for these people to survive. Some institutions, such as Muungano (SDI), WWF Kenya, and schools, are already working on projects to enhance food security in the Naivasha Lake area. People depend on rain and their crops. To make a living and secure sufficient intake of nutrients, there are innovations for growing crops in the garden, on the balcony or next to the house (Muteru, 2013). This research is focused on the small-scale farmers in Naivasha, because these are the groups that are least influenced by scientific knowledge, and farms mostly use their local knowledge.

Partner Organization: Slum Dwellers International (SDI)

The organization that I am working with is SDI Kenya. SDI is a network of community-based organizations for the urban poor in 22 countries across Africa, Asia, and Latin America (SDI, 2023). They have a small sister organization in Naivasha called Muungano wa Wanavijiji, which means union of villagers. The Muungano wa Wanavijiji organization aims to improve slums. They are trying to influence national policies for urban development. On a local scale, they are trying to improve the quality of life of slum dwellers (Muungano, 2023). This organization in Naivasha operates on a small scale related to Muungano, YMCA Kenya. This is a safe place for young and older adults to chill, learn in a small library, take some courses, and get free food in the community garden. In this garden, they teach people new ways of urban farming because of the high food insecurity. I chose SDI as my partner organization because they possess extensive knowledge about the people in need in Kenya. Their focus extends beyond slums to include other vulnerable groups, such as small-scale farmers. SDI connected me with their sister organization, Muungano, which assisted me in conducting my fieldwork and interviews. The contacts from Muungano were instrumental in locating small-scale farmers, municipal officials, and facilitating interviews. Muungano enabled me to travel throughout the area and provided essential background information about the region and its inhabitants, offering a comprehensive understanding of the issues at hand.

3. Methodology

This research applied a qualitative research design to answer the research questions. According to Boeije (2010), the qualitative study aims to clarify and comprehend the complex social phenomena by examining the meanings individuals assign to them and understanding the significance of their social actions.

Qualitative research is a practical approach conducted in natural settings, allowing researchers to gather detailed insights through direct involvement in actual experiences (Creswell, 2009). This type of research involves a range of interpretive practices that aim to make the social world more visible. Moreover, social science research collects and analyzes non-numerical data to seek meaning, helping us understand social life by studying specific populations or locations (Mohajan, 2018). It involves observing and interpreting individuals' perceptions of various events, capturing a snapshot of their views in a natural context (Gentles et al., 2015).

Qualitative research is a way to understand how people make sense of their experiences and social realities. It uses methods such as interviews, diaries, journals, observations, immersions, and open-ended questionnaires to gather, analyze and interpret data. It also examines visual and written materials and oral histories (Zohrabi, 2013). This type of research is exploratory, aiming to explain 'how' and 'why' certain social phenomena or programs function as they do within their specific contexts. The goal is to help us better understand the social world and why things are the way they are (Polkinghorne, 2005).

In my research, I used qualitative methods to deeply understand social phenomena, including the behaviors and perspectives of small-scale local farmers. This approach combines primary qualitative methods with secondary data, resulting in a holistic analysis. By looking at local knowledge and adaptation abilities from different perspectives, like personal views and climate change maps, this qualitative research gives a detailed understanding of the social phenomena needed to answer my research questions.

Ethnographic approach

I used an ethnographic approach, which involves studying an intact cultural group in its natural setting over a long period. This method mainly uses observations and interviews, which lets the research stay flexible and adjust to real-life situations in the field (Creswell, 2009).

Ethnographic observation is the most thorough and detailed approach of qualitative research. The term ethnography comes from the Greek words 'ethnos', meaning 'folk, people, and

nation,' and 'grapho' meaning 'I write' (Mohajan, 2018). Hence, ethnography has its roots in anthropology, signifying a 'portrait of a people' (Mohajan, 2018).

Ethnography focuses on understanding small societies' beliefs, social interactions and behavior through long-term participation and observation. This method involves observing and interpreting the collected data to provide a nuanced 'portret of the group's way of life' (Deznin & Lincoln, 2011).

Ethnography can be described as: "the systematic process of observing, detailing, describing, documenting, and analyzing the life ways or particular patterns of a culture (or subculture) in order to grasp the life ways or patterns of the people in their familiar environment" (Leiniger, 1985). This definition highlights the carefulness and detail of ethnographic research, showing its ability to capture the complex details of a cultural group's life and how they adapt.

Thus, the ethnographic approach involves the researcher engaging in long observations of a group's day-to-day life, intensely studying, describing, and interpreting their behaviors, values, and interactions (Mohajan, 2018). This approach fits precisely with the aim of the thesis.

Gathering detailed qualitative information using an ethnographic approach provides valuable insights into the reasoning and underlying norms within the data and among participants (Hennink et al., 2020), which is essential for achieving the primary objective of this research. The three qualitative methods used in this research are in-depth interviews, semi-structured interviews and participant observation & field notes. This research strategy enables to the exploration of local farmers' adaptation strategies and the primary interpretations of these strategies. Table 1.1 illustrates how these methods apply to the goals of this research. In the next section, I will elaborate on this data collection further.

TABLE 1 RESEARCH METHODS USED TO ACHIEVE THE GOALS

Goal	Research method
Diverse experiences and perceptions small-scale local farmers have regarding weather events	<ul style="list-style-type: none"> - Semi-structured interviews - In-dept interviews
Strategies implemented by small-scale local farmers to survive weather events	<ul style="list-style-type: none"> - Semi-structured interviews - Participant observation
Local knowledge enhances resilience of small-scale local famers	<ul style="list-style-type: none"> - Participant observation - Field notes - Semi-structured interviews

Data collection

A significant part of this research depends on qualitative data that is gathered through, semi-structured interviews, in-depth interviews, participant observations and field notes. The data was collected in Naivasha, around 100km northwest of Nairobi, Kenya, over nine weeks from March 22 2023 to May 26, 2023. The participants and interviewees will remain anonymous.

Study sites and small-scale local farmers

Naivasha is a diverse city where many different tribes coexist in one city. This brings various types of farming and crops to the fields. The soil around Lake Naivasha is particularly suitable for agriculture. There are a lot of farms, and 70% of the land is used for farming (Nakuru county, 2021). However, studies indicate crops yields are often below profitable levels for small-scale farmers (Muteru,2013). The adaptation processes need to be improved for these farmers to survive. This research is focused on the small-scale farmers in Naivasha. This study focused on small-scale local farmers because these groups are least influenced by scientific knowledge, and farms mostly use their local knowledge.

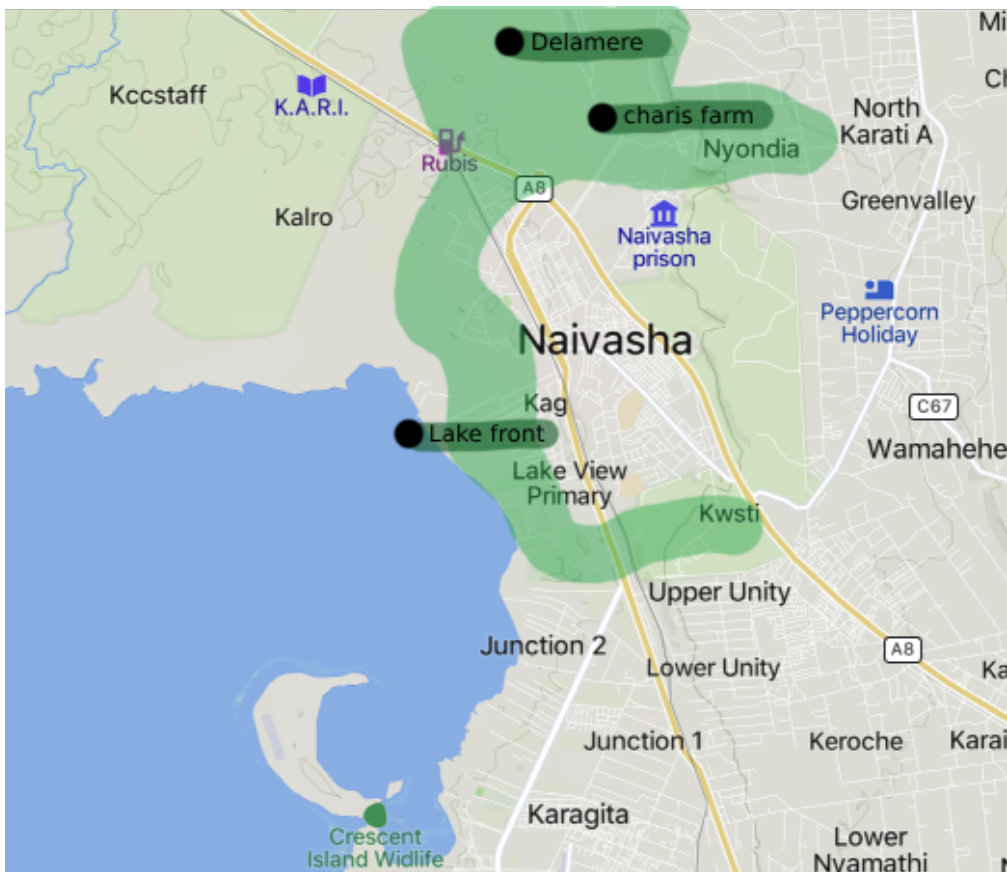


FIGURE 3 GREEN AREA IS FOCUS AREA

Source: Mapcarta.com

In-depth and semi-structured Interviews

In-depth interviews could be described as conversations with a purpose. A researcher aims to gain insight into issues using a semi-structured interview guide (Hennink et al., 2010). Qualitative data was gathered through semi-structured, in-depth interviews to find out what local knowledge is and the perception of climate change among small-scale farmers.

In-depth interviews

Three in-depth interviews were conducted to better understand the resilience of small-scale farmers and influence of the government in adaptation strategies. Two of these interviews were conducted with municipal employees. The third interview was conducted with the person who built her own sustainable farm called 'Charis Farm'.

The in-depth interviews followed a structured questionnaire format, balancing engagement with the interviewees and the ability to ask questions and have a dialogue. This approach provided comprehensive perspectives allowing us to answer the research questions regarding the knowledge of local communities and their influence on climate change adaptation.

Both interviews with municipal employees were in English, with occasional translation support for certain words. The interviewees did not consent to be recorded; therefore, these interviews were documented in writing. The interview with the owner of Charis Farm was also conducted in English, with additional translation assistance for some specific sentences and names of traditional species. This interview was recorded and transcribed.

Semi-structured interviews

For the semi-structured interviews, I developed an interview outline that was adjusted to each interviewee and the context. The format varied to fit the situation best, ultimately resembling more of a list of topics I wished to explore further. These interviews were guided by a set of issues and included some open-ended questions to ensure participants had the opportunity to share their experiences. This approach encouraged a conversational atmosphere where the interviewees could freely share their stories (Hennink et al., 2010). I discovered that following my interview guide closely during the interviews provided more of a framework that enabled participants to share more illustrative stories, which uncovered themes and issues I was previously unaware of.

The interview guide was carefully made to enable me to dive deeper into existing knowledge by utilizing the questions provided. Before each interview, participants formally consented by signing a document and verbally confirming their agreement. Detailed notes were carefully written down for each answer given in the interviews. Furthermore, my contact (fixer) shared

additional background information during selected interviews to enrich the understanding of the context.

I used a notebook and a digital journal on my laptop to carefully document and reflect the information gathered daily. In collaboration with a member of the Muungano organization, we went through the process of locating suitable participants and bridging language barriers by translating from Swahili to English. This individual played a crucial role in ensuring that the participants were informed about our intention to visit their fields to conduct interviews, thereby encouraging their presence and willingness to engage.

Initially, the first three semi-structured interviews were based on the interview-outline structure in my original interview guide. However, as the interviews proceeded, I observed that specific questions proved ineffective or irrelevant information, while participants naturally deviated towards discussing other intriguing topics. Recognizing the need for adjustment, I took the opportunity to review and adjust my interview guide by following these initial interviews. The revised guide, modified by insights gained from the initial interviews, served as a more focused and practical framework for conducting successive interviews.

Selection criteria of interviewees

I conducted 30 interviews with small-scale local farmers in the Naivasha region. This is a number I considered sufficient to thoroughly 'mine' each participant's experiences (Hennink et al., 2010). Unfortunately, I could not conduct more interviews due to time and resources constraints. To understand local knowledge and adaptation strategies in the area, I conducted interviews with a variation of small-scale farmers. These interviews are facilitated with support from the Muungano organization. My contact within this organization, is a well-known and influential community member. This contact used his connections and knowledge to carefully select various interview locations to ensure the representation of different parts of the Naivasha region. Furthermore, he facilitated meetings with three key figures from the county/municipal government, which provided an extra layer of perspective on the ongoing issues in the area.

The interviewees were chosen carefully, considering different factors to ensure a thorough exploration of the topic.

- small-scale local farmer
- in various locations / various income

Among the 30 interviewees, 18 were male and 12 were female. While gender was not a primary focus during the interviews, the distribution was close to 60/40; this provides a fairly balanced representation. All interviewees lived in Naivasha, although not all of them were originally from the region. Gathering standard background information proved helpful in understanding how

these farmers acquired their local knowledge and their reasons for relocating or starting farming activities.

List

Prior to the fieldwork, I had no way of knowing what different types of local knowledge were being used by the farmers. Hence why I created a method to determine the different types used and to distinguish them from one another. The different types were categorized as 'question' in table 2. During the semi-structured interviews, the number of answers (categorized as 'explanation answer') differed from farmer to farmer. This consequently offered a greater understanding of local knowledge and cumulatively enabled me to ask the following farmers about their usage of local knowledge. What types they used, had they used them before and if they would be interested in using them in the future - if they knew how to implement these strategies.

This list consisted of:

TABLE 2 LIST OF LOCAL KNOWLEDGE CRITERIA

Question	Explanation answer
Description of Local Knowledge	What do the farmers see as local knowledge and not local knowledge
Weather forecast	How do they predict the weather? Local knowledge? <ul style="list-style-type: none"> - animals - insects - sky
Changes in climate/weather	How do they see the climate changing in their daily life? Why are they adapting
Methods for field	Did they change their ways of: <ul style="list-style-type: none"> - harvesting - preparing field - collecting water - Yes, why?

Participant observations and field notes

Anthropologists comment that observation is not just a method but also an intrinsic way to critically reflect on theoretical ideas and presumptions of the study population (DeWalt and de Walt, 2011, as cited in Hennink et al., 2011, p.257). In addition to the survey and interviews, I used participant observation. Through participant observation, I acquired deep understanding of the local community's daily lives, struggles, and perceptions regarding governmental issues and climate change. During this extended observation period, I adopted the role of an observer, to understand the details of community interactions and listen closely to their stories. To immerse myself fully in the community, I regularly visited various locations such as churches, the YMCA (community center), restaurants, public beaches, and gardens. These interactions provided valuable opportunities to hear firsthand the challenges faced by the community and their perspectives on governmental actions, or lack of those actions regarding climate change.

Instead of interrupting the natural flow of the conversation by making detailed notes during these interactions, I chose to reflect on my observations and write them down in my notebook afterwards. This approach allowed me to have more natural conversations. This method allowed me to have more organic discussions and ensured that my observations were recorded accurately because the observations were not forced/interrupted.

These immersive experiences and the notes I took afterward, helped enrich the background information and deepen my understanding of the struggles faced by farmers and residents. These experiences highlighted connected issues like the local school systems, poverty, and government actions, which indirectly affect how the community adapts to climate change. People's behaviors and actions are better understood by culture looking at their interpretations and meanings (Greetz, 1973, as cited in Hennink et al., 2011, p257). These observations and field notes were not coded but were used to provide context and add meaning to the collected data. This approach helped create a more accurate picture of the findings from the field.

Validity and reliability

Validity is determining whether meaningful and useful conclusions can be drawn from the research data and the analysis and interpretation (Creswell, 2009). The chosen method employs triangulation, utilizing various sources and methods for data collection to provide supporting evidence and ensure the validity, credibility, and authenticity of the research data. This approach shows different perspectives, enriching the depth and complexity of the research (Creswell, 2013). This method was used during the interviews by asking confirming questions throughout the duration of the interviews. The data and sources were researched to ensure that this is a validated and reliable study. The sources used in this research were carefully selected by my support organization (Muungano), ensuring that quality was attached

to the information given. The secondary data resources used are scientific articles and official publications. This information provides an overview of knowledge that inspires and adds to this research. The information given by the municipality was verified by asking the same questions to different employees. In addition, information gathered informally was supplemented through informal conversations and discussions with Naivasha residents.

Reflection and positionality

It's valuable to briefly reflect on my role as a researcher within this domain in light of the chosen research framework. A deeper analysis of the methodology's execution will be presented in the concluding chapter of this thesis. In qualitative research, it is essential to acknowledge subjectivity and be aware of your position as a researcher. Each participant reflects their subjective views, while as a researcher, you bring your subjective influence on the research process. Therefore, reflecting and being conscious of your potential influence is essential (Hennink et al., 2011).

Despite having prior knowledge of Kenya's history, political landscape, and challenges by reading articles and talking to people from Muungano, I lacked insight into the culture. I assumed integrating into the community and conducting interviews would be relatively easy. However, I am aware of the fact that I will always be perceived as a white European woman conducting research for a university. Nonetheless, I was unprepared for the blast of questions regarding my presence in Naivasha. It wasn't until after a few weeks that I began to pick up some Swahili phrases and words that communication with the locals became easier. They recognized my efforts to connect and learn from them, acknowledging that my intentions extended beyond my personal benefit.

When I arrived in Kenya, I had certain expectations about how things would be and what the culture might entail. Thankfully, I dove myself into the local culture, and some welcoming individuals guided me around, introducing me to fascinating places and new people. This experience helped me find my groundwork during the fieldwork, allowing me to empathize and see life through their eyes. When discussing sensitive topics such as politics and personal struggles during interviews, it is normal to evoke emotional responses from participants. It is crucial to be mindful of the potential harm that could arise from asking sensitive questions. Additionally, cultural differences must be taken into account, as they can lead to discomfort for the participants rather than showing respect.

4. Results

This chapter describes the multifaceted dynamics of climate change as observed and perceived by local farmers in the Naivasha region. It explores how small-scale farmers interpret and respond to the changing climate patterns, particularly in light of the challenges caused by floods and droughts. Their experiences are used to uncover the severe consequences on agricultural livelihoods and community resilience in the changing climate. Additionally, the adaptive strategies that these farmers use are examined. This sheds a light on the changing landscape of agricultural practices and its knowledge systems. Finally, this chapter assesses the role of institutional support, which studies the extent to which governmental and non-governmental entities are assisting farmers in the complexity of adapting to a changing climate. The practices employed will be examined in the discussion to determine whether they can be classified as local knowledge.

Demographic information of small-scale farmers in Naivasha

The data collected through the semi-structured interviews reveal a relatively uniform group of farmers with diverse views on climate change and adaptation strategies. Among the interviewees, 40% were female and 60% were male, aged 24 to 62 years old. This demographic mix highlights the range of perspectives represented in the study. Most of the farmers primarily cultivate vegetables, which is a common agricultural practice in the region. However, a small number of the farmers also raise livestock, diversifying their sources of income. This variation in farming practices indicates a different approach to economic stability and resilience in the face of the environmental changes.

Perception of climate change

Climate change can be interpreted and explained in different ways. According to the UN (1992) climate change is described: *“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 observed over comparable time periods”*. The following weather events are consequences of climate variability and explain the farmers' experiences of these effects of climate change.

Floods and droughts

Floods and droughts have a severe impact on the lives of the interviewees. The major flood of 2020 devastated the residents of Naivasha, particularly those living in Kihoto, a district next to the lake. This flood was the most impactful and large flood in years. The initial interviews were conducted in Kihoto, an area that bore the burden of the flood's impact. During one of these first interviews, a farmer shared a heart-wracking story about the immense devastation caused by the flood. He described that many people lost their homes, food supplies, land, and even family members. The extent to which the water invaded the land can still be seen; the trees remain dead up to the high-water mark.

“On houses are still some lines visible where you can see how far the water had risen. Thereby, small children became sick because of the dirty water and there were more cases of malaria than we had seen in a very long time. Normally, malaria is not a hazard in the area, but after the flood we saw more cases and more people needed medical attention, as well for other diseases” (Interview 4, 22-3-2023).

The causes of floods and droughts led to different opinions among the interviewees. Some acknowledged that the climate is changing but found it challenging to grasp the underlying reasons for these changes. *“I know that climate change exists, but I also think it is a way how nature behaves”* (Interview 28, 8-5-2023). This supports the statement made by Leal Filho et al. (2022) who argue that local communities have been living with and adapting to a changing climate for decades. Initially, I assumed that rainmaking ceremonies and weather gods still played a significant role in the lives of farmers in Naivasha. However, the interviews revealed that this is no longer the case; the farmers no longer believe in these gods.

Numerous interviewees, including farmers and local inhabitants, expressed the view that both droughts and floods happen due to the effects of land degradation and land alteration. These interviewees pointed out that increased rainfall, driven by climate change, is the primary cause of the floods. Additionally, human activities such as deforestation have led to landslides and increased water runoff, further contributing to the rising water levels (Baraka C., 2022). Residents often use wood for cooking and heating their homes, but these trees have not been replaced. Instead, the cleared land is frequently changed into farmland or new housing developments where contractors invest.

Droughts are more common in Naivasha; they occur annually unlike floods and become more severe each year. The farmers and residents of Naivasha suffer more from the droughts than from the floods, as the dry conditions increasingly impact their daily lives and agricultural productivity.

Consequences of droughts and floods

The most observed impacts were noticeable in the challenges faced by people concerning their livestock, fields, and crops. When floods occur, the shift and substantial increase in water levels leads to the rapid covering of the (farming) land, especially impacting areas like Kihoto, where many farmers have their farming fields located next to the lake. Consequently, this results in the destruction and rotting of crops due to the high-water levels.

In regions further from the lake the direct impact of high-water levels is less severe, but other challenges will appear. These areas are more vulnerable to damage caused by wildlife, such as hippopotamuses or insects, which eat the plants and disrupt agricultural activities. Furthermore, heavy rainfall also affects the fields and the lake's rising water levels. An excess of water in the soil makes it infertile and inhibits root growth, ultimately resulting in rot. Additionally, the high precipitation can result in siltation, where essential nutrients and fertility from the topsoil are washed away to deeper layers or even other parts of the lake. This process may unwillingly lead to the transfer of manure and topsoil to neighboring fields, creating an imbalance of nutrients and infertility in the soil. Eventually, most of the fertilizers are washed into the lake, further disrupting the ecological balance.

Over a year, the constant wet soil poses challenges for farmers attempting to cultivate grass and worsen the scarcity of food and space for their livestock. As a consequence of these unfortunate conditions, many farmers find themselves compelled to sell off their livestock to cope with the environmental challenges (Interview 3, 22-3-2023).

Many farmers living farther from the lake have also resorted to selling their livestock for similar reasons. The scarcity of grass and water holes is primarily attributed to the severe droughts experienced in the region. As a result, the livestock remain undernourished, which forces them to walk long distances in search of sufficient food, which unfortunately results in the loss of some young animals.

Throughout the year, there is only a brief period when there is enough grass for all the animals, and during this time, they must share it with wild animals. If the livestock consume all the grass and flora, wild animals such as zebras and giraffes are forced to graze from their fields. Regardless of the consequences of floods and droughts, farmers are driven to continue cultivating "*we remain farmers because farming is in my blood*" (interview 9, 27-3-2023).

Hunger and financial constraints emerged as significant consequences of floods and droughts. While floods intensify the issue, it is during droughts that the effect of food scarcity and resulting

financial pressure becomes incredibly noticeable. Many interviewees expressed the struggle to afford basic needs like food, especially when their crops fail due to droughts. This economic strain often extends to education, with families finding it increasingly difficult to cover school fees.

This struggle is particularly acute in the Delamere area which was formerly a slum. When harvests are destroyed, children suffer from malnutrition, with some even developing conditions like 'Kwashiorkor'. During droughts, the focus shifts from development to sheer survival in this area as residents cope with the challenges of finding alternative sources of income. The lack of employment opportunities further compounds the difficulty of earning a livelihood. *"People in this area will do everything to survive, when crops won't grow and they have no other option they would sell everything they could if you know what I mean"* (Helper 2, 8-5-2023).

Throughout the interviews, the significance of the area and its natural vegetation became visible. Trees were consistently viewed as crucial in tackling a range of challenges, a sentiment often expressed in the phrase: "Trees are the solution to our problems."

There is a widespread belief among the interviewees that an abundance of trees could alleviate issues such as droughts, as they associate rainfall with areas with plentiful tree cover. Observations of regions higher up in the mountains, where rainfall is more common due to the presence of a large number of trees, reinforce this belief. Interviewees recognize that the shade trees provide slows down the evaporation process, contributing to moisture retention in the soil. Despite this understanding, none of the interviewees could pinpoint the exact cause of the dry soil. However, they observe a decline in grass growth, and they connect animals' intrusion into their crops for water and nutrition to the disappearance of plants in the lake.

The difference then and now of people's perception of the changing climate

Interviewees observe and experience changes in the weather and environment, which is how they perceive climate change. The interviews revealed that floods and droughts have always been part of the region's climate, but the severity has evolved over time. Many interviewees shared that weather events are becoming more severe and hazardous with each passing year. There is a noticeable trend in the worsening severity of droughts, which seem to be prolonging each year (Kipkemboi Kogo et al., 2020).

With their lifetime of farming and living in the area, the older generation can offer comparisons to the past. In contrast, the younger generation often draws upon the experiences of their

(grand)parents and notes changes they observe in their own lives. Not every interviewee has been a farmer for an extended period, which may limit their perspective on changes in farming practices. However, all interviewees acknowledge the changing climate around them.



FIGURE 4 FARM PLOT NEXT TO LAKE

Source: Author

Farmers know that floods cause a constant risk when farming near the lake. Unfortunately, in recent decades, there has been an increase in the frequency of these floods, which are occurring more rapidly than before. Despite floods, droughts remain the primary challenge for farmers in the Naivasha area. While droughts have been a longstanding issue, they have become increasingly severe and prolonged in recent years.

An elderly female farmer noted that weather patterns were more predictable in her youth. There used to be a reliable cycle of three months of rain followed by a few months of drought. However, the rainy seasons are becoming shorter nowadays, and droughts are lasting longer.

In 2022, there was almost no rainfall at all. Additionally, temperatures are rising, resulting in less rain and increased heat, which is catastrophic for crops (Interview 5, 22-3-2023).

“But still these droughts that we are having are way more severe than they used to. There is not a lot of knowledge how to cope with the droughts. People just put more fertilizer on top of their soil and hope for the best.” (Interview 2, 22-3-2023)

Even during droughts, farmers once possessed the ability to indicate coming rainfall by observing cloud formations. However, the presence of clouds during a drought no longer guarantees precipitation. Rainfall has become erratic, with prolonged periods of absence being observed. This issue of inconsistent rainfall is a recurring theme in the interviews. Traditionally, the raining season extended from February until June. However, this year, the start of the raining season was delayed until early April, and interviewees speculated that it would be shorter than usual. Unfortunately, this pattern is becoming more and more common. The rain season starts later in the year, lasts for a shorter period, and is characterized by more intense and sporadic heavy rainfall events.

During drought, farmers typically resorted to digging waterholes to irrigate their crops (see Appendix 2 for more LK). However, in recent years, they have found that the depth of these waterholes needs to be substantially increased to access groundwater effectively and throughout the year (Interview 4, 22-3-2023).

One farmer moved to Naivasha to be closer to a water source. He originated from around 60 km north-east of Naivasha where there used to be 7 rivers full of water when he grew up there. Nowadays, there are only 2 rivers that have water the whole year round and the water levels continue to drop (Interview 1, 22-3-2023).

The involvement of NGOs and the government was highlighted regarding this issue. Interviewees emphasized the importance of government assistance in addressing their needs, particularly given the significant problem of food insecurity. Furthermore, they noted the considerable changes in the market dynamics for selling their products. Therefore, Chapter: *Institutional support for strengthening local knowledge and practices* delves deeper into this transformation and underscores the necessity for assistance.

Local adaptation practices

This section illustrates an in-depth exploration of small-scale farmers' adaptation and survival strategies containing local knowledge, in Naivasha. It dives into their practices that are specifically adapted to cope with the increasing frequency of droughts, which have become a focus point of concern for these small-scale farmers. Moreover, this section explores the local

knowledge of small-scale farmers, including their experiences and insights into struggling with droughts, understanding weather patterns, and their local knowledge and management techniques related to crops (Appendix 2). Finally, it examines the role and input of the government in addressing these challenges faced by local small-scale farmers.

The traditional methods of agricultural cultivation are experiencing significant changes due to increasing pressures from limited water availability and the demands of water-intensive crops. Typically, when faced with drought conditions, farmers would change to planting seeds and crops more resilient to water scarcity. However, even these drought-tolerant species struggle to grow during long periods of intense heat. Consequently, when confronted with suboptimal harvests, farmers need to explore alternative ways to generate income. One alternative strategy involves expanding their livestock holdings. However, this option presents numerous financial hurdles, including significant investment costs and securing enough land for their livestock to graze. Despite these dreadful challenges, a sense of optimism persists among most interviewees regarding the future of farming. This optimism is supported by their passion for the craft and persistence in not wanting to quit. For instance, an elderly female farmer spoke of her aspirations of building up savings to invest in bricks, she sees it as a promising opportunity to diversify her income streams and tackle the uncertainties of agricultural livelihoods.

“I’ve seen so much change; the wetter is unpredictable and with no help from no one it is impossible to live a good life in my final years. That is why I am using farming to finally invest in some bricks” (Interviewee 4, 22-3-2023).

Unfortunately, the area has limited alternative income opportunities or job prospects. The need for more employment opportunities and better wages is pressing. Most of the interviewees and the other inhabitants I spoke with often need to work two jobs just to afford their basic needs like rent and groceries. Ultimately, this means that adapting to the changing climate becomes the primary tool for survival. Fortunately, these farmers are no strangers to adjusting their methods and coping with difficult circumstances. This adaptability shows the extent to which their Local Knowledge is applied, and it also highlights areas where additional information and strategies could be beneficial.

Despite being a tight-knit community, when the farmers are asked if they helped each other during floods or droughts, many responded, “Yes, but...” Initially, the priority is to support your family and ensure they are fed first. They consider assisting their neighbors and other farmers only after securing their family’s well-being. Most interviewees identify as Christian, and they

strongly believe in the importance of helping those in need, which is a core value in their community.

Helping others is an integral part of their farming practice, but they emphasize that one's own family must come first. They believe that if they cannot support their own family, it is impossible to help others. This belief underscores their sense of responsibility and the practical realities they face daily. It reflects a balance between community solidarity and the practical need to ensure their immediate family's survival before extending aid to others.

Three main practices

To understand how farmers are trying to cope with the changing climate, it is crucial to understand their local knowledge and how they manage their farming strategies. In the discussion, I will delve deeper into the nature of local knowledge, distinguishing between what defines local knowledge and what does not. Specifically, I will explore the knowledge farmers use to adapt to climate change, expressing what practices are practical and which ones fall short. For clarity, their knowledge is categorized into three main sections: weather forecasting, water preservation, and farmland management.

Starting with weather forecasting, it is essential to understand that before coming to Kenya, I was aware of different ways local communities used to predict the weather, such as observing the sky and animal behavior. During the interviews, I directly asked about farmers' methods to predict the weather and how they incorporate that knowledge into their daily lives.

Water preservation covers farmer's conservation techniques during prolonged droughts and erratic rainfall patterns. This includes their local knowledge, which is passed down through generations and any new practices they have adopted in response to changing environmental conditions.

Finally, the section on farmland management will explain how farmers adjust their agricultural practices to maintain soil fertility, manage crop rotations, and mitigate the effects of extreme weather events. This part will highlight farmers' challenges and the innovative solutions they are implementing to sustain their livelihoods.

Through this detailed examination of local knowledge in these three areas, it is possible to gain a comprehensive understanding of how farmers in Naivasha are navigating the complexities of climate change and aiming to sustain their agricultural practices.

Weather forecast

Most interviewees rely on their local knowledge, including observing animals and the sky, to predict the weather. This traditional approach has been passed down through generations and remains a fundamental part of their daily lives. These farmers have learned these techniques from their parents and grandparents, gaining these insights through living in close contact with nature. Their extensive time spent in natural environments has allowed them to observe changes and patterns, such as animal and insect behavior, and meteorological signs, to forecast weather changes and explain temperature variations. These indicators help them to predict events like upcoming rainfall (up to ten days in advance), droughts, and heat waves.

Interestingly, a few interviewees use modern methods, such as weather apps and news reports, in addition to traditional practices. Although these tools are not considered local knowledge because it is not knowledge passed on by locals, they provide additional information that some farmers find helpful. One participant, in particular, does not use traditional methods at all, relying solely on news and internet forecasts because he believes these sources are more accurate (interview 23, 8-5-2023).

Despite the availability of modern technology, most participants continue to depend on their local knowledge to predict the weather. This dependence traditional methods and their local knowledge highlights their deep connection with their environment and their trust in the wisdom passed down through generations. The traditional indicators remain invaluable for anticipating and preparing for rainfall, droughts, and heat waves, to ensure their resilience to changing climate conditions (Appendix 2).

Indicators that are frequently used are:

- **Red ants** appearing in surface of soil = Rain
“When red ants start appearing in surface of the soil, it means it will rain within 10-20 minutes. These creatures feel the shift in the air, even underground” (Interview 2, 22-3-2023).
“Red ants are the most accurate insects when it comes to predicting rain. Luckily, we can still rely on these little insects” (interview 24, 8-5,2023).
- Many **pigeons** in the sky at high speed = Rain
“Pigeons are often flying around you, but when you see them flying really fast and in a group it is definitely going to rain” (Interview 1, 22-3-2023)

“The fun thing about pigeons, they do not fly fast very often. This is an easy way to predict rain when they do fly fast” (Interview 11, 29-3-2023).

- **Sparrows chirping** in time of drought = rain within 10 days

“During droughts, I do not hear sparrows often. When they start making sounds and chirping together it will rain in 10 days” (Interview 12, 12-4-2023).

“Sparrows and pigeons are the only birds you can trust if you want to predict rain” (Interview 3, 22-3,2023).

- **Dragonfly’s** flying at high speed = rain

“Normal behavior if dragonfly’s is flying around or from plant to plant. But it will rain when they fly fast higher up in the air” (Interview 13, 12-4-2023).

“Dragonfly’s predict rain in a short time frame before it will rain, maybe an hour after they fly around it is going to rain” (Interview 14, 12-4-2023).

- **Butterfly migration** = long drought with high temperatures

“Butterfly’s like flowers, but flowers are not much around during droughts. When you see more butterfly’s around, it will rain in a few days” (Interview 1, 22-3-2023).

“Butterfly’s are a bit like the wildebeest migration, they follow rain” (Interview 16, 12-4-2023).

All these indicators have been validated by generations of farmers who have observed the same patterns and occurrences over decades, so became their local knowledge. Farmers also observe the sky and clouds to predict rainfall, a practice beneficial during the rainy season. When they see clouds approaching from the southeast over the mountain, they know rain will likely fall within a few hours. However, if the clouds come from other directions, the rain is less predictable and may only fall in a few places or bypass Naivasha entirely.

In past decades, these types of weather predictions were entirely accurate. These predictions have been refined and passed down through generations. Each generation closely observes the behavior of animals and insects and adjusts their findings to improve accuracy. However, almost 50% of the interviewees no longer rely solely on these traditional methods. Many farmers now use the internet or television weather forecasts to supplement their predictions. This shift is necessary because they find it increasingly difficult to rely entirely on their traditional ways in the face of changing climate patterns.

“The climate is changing so fast and intense that the animals don’t know how to behave anymore” (Interviewee 1, 22-3-2023).

This means that if the animals and insects behave differently than they used to, it is hard to follow their patterns and predict the weather via the traditional local ways.

“Dragonfly’s and birds are flying more at high speed, when it is not going to rain” (Interviewee 25, 8-5-2023).

Luckily, the forecast from the television combined with their local knowledge is quite accurate, at least accurate enough for now. Farmers will need to adjust their ways of following the animals in the future.

“Animals can feel the patterns of rain and droughts again when the climate isn’t changing each year so much. Only when animals are in sync with weather patterns again, they can predict the climate” (Interviewee 2, 22-3-2023).

The interviewees believe that as animals adapt to the changing climate, they will revert to their old patterns, allowing farmers to rely on them again in the future. Alternatively, animals and insects may develop new patterns that farmers can observe and follow.

Water

Most of the farmers have acquired their farming knowledge from their parents, other family members, or close friends who have been farming for an extended period which makes it local knowledge. Farming presents numerous challenges, the most significant one being water scarcity. Farmers use their local knowledge to cope with water scarcity and adapt to the changing climate.

“It is great to be a farmer, I am able to follow the passion that my whole family has over generations. The main struggle these days is lack of water” (Interview 1, 22-3-2023).

Water supply

This research involved interviews with individuals from various areas of Naivasha, each with distinct access to water resources. It is divided into four parts, each with different availability and accessibility of water.

Kihoto area – located next to the lake

To begin with, farmers from the Kihoto area, whose agricultural plots are located next to the lake, were selected for this study. These farms are positioned so close to the lake that even minor increases in water levels or storms can lead to their fields being flooded. Despite existing regulations that prohibit farming in such proximity to the lake, enforcement is lacking, this allows farmers to continue their practices without any interference (Municipality interview 1,

24-3-2023). Despite the occasional flooding of their fields, these farmers prioritize cultivating fertile soil often found near the lake. Despite the periodic floods, these fields do not encounter other water issues, as the soil retains moisture even during droughts. In contrast, fields located just 30 meters further away struggle with water shortages during periods of drought (Interviewee 3, 22-3-2023).

Kihoto area – located farther from the lake

Beneath the expansive farmlands lie an exciting network of water pipes, offering farmers a vital resource for irrigation. However, accessing this resource is costly because farmers must pay for gasoline and usage fees. These usage costs are directly paid to the respective authorities. Municipalities or landowners usually install pipes and have connection points where farmers can attach hoses to pump water into their fields (Interview 5, 22-3-2023).

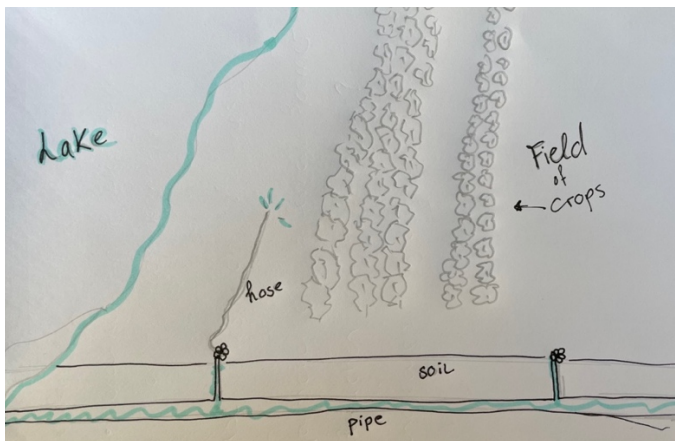


FIGURE 5 PIPE DRAWING UNDERNEATH SOIL

Source: Author's illustration

While the availability of these pipes ensures every farmer has access to water, coordination is essential to optimize their usage. Unfortunately, due to limitations in capacity, farmers cannot irrigate their fields at the same time. Consequently, some farmers must resort to watering their crops at night, risking encounters with aggressive hippos from the water in search of food. Conversely, others are compelled to irrigate during the scorching heat of the day, which can adversely affect their crop health (Interview 2, 22-3-2023).

Although the current infrastructure provides a valuable resource for water, there remains a pressing need to explore more efficient irrigation methods that enable simultaneous watering of fields. Furthermore, the financial burden due to gasoline and pipe usage fees can be prohibitive, particularly during prolonged droughts, where profits are significantly diminished (Interview 9, 27-3-2023).

Farmers resort to traditional methods such as waterholes to supplement their water supply during these challenging times. These excavated holes fill up with water during the rainy season, serving as an essential source for crop irrigation. Farmers must dig deeper to tap into groundwater reserves in the event of water shortages. Additionally, larger-scale farmers may invest in water tanks that collect rainwater during the rainy season, providing a reliable reserve for irrigation during drier periods.



FIGURE 6 WATERHOLE ON THE FIELD

Source: Author

Delamere area - located close to the river

Two additional areas located further away from the lake are also explored. Both of these locations are in the Delamere region. Historically, Delamere has been characterized by poverty and was once a sprawling slum. However, the municipality has demolished most of it for safety reasons. Nowadays, the area is undergoing extensive redevelopment, with a renewed focus on agriculture (Municipality interview 2, 24-3-2023).

The first location is where farmers live next to the river. Like Kihoto, farmers in this part Delamere rely on an underground network of water pipes, associated usage, and gasoline fees. However, this pipe network's efficacy depends upon the water availability in the river. Unfortunately, the time during which water levels remain sufficient for this network has been decreasing each year. Consequently, when water levels are insufficient, farmers must resort to either traveling to the river with buckets or utilizing waterholes as an alternative water source.

Delamere Area – located farther from the river

In contrast, there is no river or lake in this area, causing farmers to rely solely on water from waterholes and water tanks to irrigate their crops. One farmer expressed, *“I try so hard to collect and save water, but even with a 20000 liter tank, I am far from managing to get through*

the drought.” (Interview 10, 29-3-2023) Through observations and interviews, it becomes evident that irrigation remains the most pressing concern for these farmers.

Evaporation

In light of the recurrent droughts, farmers need to adjust to the water sources surrounding them. While some have embraced drip irrigation methods, not all farmers are using this water system right. Drip irrigation entails the precise delivery of water to the roots of plants, minimizing water waste by targeting the base of each plant below the foliage. However, a notable observation from interviews reveals that certain farmers lack the necessary knowledge to implement drip irrigation effectively. Consequently, instead of feeding water directly to the plant roots, some use excessive water pressure, resulting in a scattered spray across the plants.

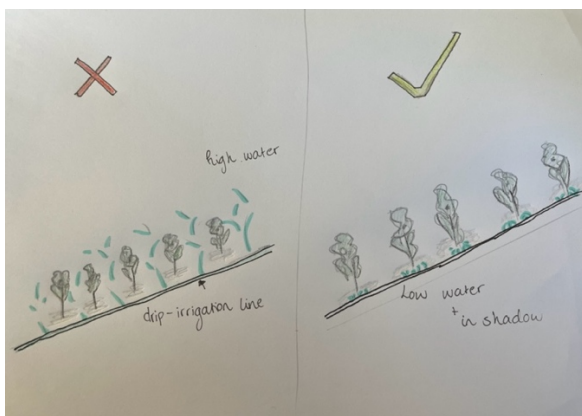


FIGURE 7 HOW TO USE DRIP-IRRIGATION SYSTEMS

Source: Author

When water comes into contact with plants while the sun is shining, it evaporates rapidly, providing minimal benefit to the plant. Moreover, in some cases, this can exacerbate issues as the leaves may scorch more quickly, further compromising the plant's health (Carter, A., 2000).

Farmers use diverse methods to adapt to the changing climate conditions, including mitigation of water loss through evaporation. A traditional strategy as such involves utilizing various types of manure, which not only enriches the soil but also helps to minimize the evaporation. Furthermore, farmers scatter organic materials such as leaves and old plants around their crops to conserve water. This organic material also promotes decomposition into compost which enriches the soil. Even during the initial stages of planting, a little layer of these materials is delicately spread over the seedlings, enriching the soil and providing a protective shelter to shield against excessive sunlight (Interview 11, 29-3-2023). During a prolonged drought and high temperatures, farmers cover their fields with cloths to create cooling shade, while still

permitting essential sunlight to filter through small holes in the fabric. Additionally, farmers often construct plastic barriers around their plants to combat water seepage and runoff. These barriers prevent moisture loss and promote efficient water usage. In certain circumstances, particularly during the vulnerable early growth stages, plants are sheltered within sawed-off plastic bottles, which provides a protective microclimate to support optimal development (Interview 12, 12-4-2023).



FIGURE 8 PLANT REMAINS ON THE CROPS TO REDUCE EVAPORATION.

Source: Author

Farmland management

Among the interviewed farmers, most of the methods and strategies are employed to cultivate crops, tailored to the distinct seasonal conditions of rainfall and drought. Farmers often alter their crop selection in response to occurring climatic challenges, such as changing from native species to more heat-resistant variations like chili peppers (Appendix 1). In addition to this diversity, several standard practices emerged, including the precise removal of roots and plants before sowing new seeds, the application of fertilizer (both chemical and organic), and the practice of planting multiple seeds in each hole (Appendix 2). Many farmers utilize a simple yet effective method of seed distribution using plastic bottles with perforated caps. All agricultural tasks, from planting to harvesting, are performed manually, with hand hoes employed to loosen the topsoil.

The careful plucking of leaves to ensure continued growth and productivity is critical to the harvesting process, particularly with spinach (known locally as collard greens). All farmers unanimously agree on the effectiveness of this careful harvesting method, which enhances plant vigor while reducing the necessity for excessive seed usage.

Regarding fertilization practices, responses among farmers were varied, with some opting for chemical fertilizers while others prefer organic alternatives. While acknowledging the soil's inherent fertility, farmers recognize the necessity of supplementary nutrients to support crop growth under these challenging conditions. However, there is a notable lack of awareness among farmers regarding the potential consequences of chemical fertilizer usage. This was evident during interviews, wherein farmers expressed uncertainty regarding the long-term impacts of different fertilization methods. Chemical fertilizers, while promoting robust plant growth, pose risks of soil exhaustion when used excessively and environmental hazards when the runoff enters nearby water bodies, leading to adverse ecological effects such as diminished fish populations and the distribution of invasive species like water hyacinth. Additionally, unlike their European counterparts who practice fallow periods to allow land to recover, local farmers often overlook this practice, worsening soil degradation and fertility loss over time. In addition, chemical fertilizer when it washes into the lake also reduces fish, which means fewer hippos and mega growth of water hyacinth (Otieno, P et al., 2014).

In contrast, water hyacinth is terrible for the flora and fauna in the lake, but it can be harvested and used as a biological fertilizer for the fields (interview 10, 29-3-2023).

Another technique employed involves utilizing rabbit urine as a source of ammonium nitrate fertilizer. If farmers have sufficient space in their fields, some produce their own compost by combining animal feces with decomposed plants. However, biological fertilizers are prohibitively expensive if farmers cannot make them independently. This financial constraint is one of the primary factors driving the widespread use of chemical fertilizers. Another contributing factor is farmers' lack of knowledge regarding producing sufficiently fertile homemade manure (Interview 14, 12-4-2023).

"I use fertilizer to help my plants to grow. I want to use only organic ones, which is very expensive. There is also one from the government, that one is way more cheap but worse for the environment" (Interview 3, 22-3-2023)

Farmers were inquired about the proactive and reactive measures they undertake to prepare their fields in anticipation of, and in response to, floods or droughts. Concerning floods, they expressed the logistical challenge of pre-flood preparations due to the unpredictable nature of flooding. Post-flood, their approach typically involves starting over on fertile land. In contrast,

they change to crops less reliant on rainfall when facing droughts. Embracing techniques like crop rotation and diversification enhances their resilience against harvest failures. This diversified approach helps them adapt to evolving weather patterns and serves as an experimental platform for identifying drought-tolerant crops that are suitable for the changing climate.

Furthermore, a significant challenge farmers face is the protection of their fields from animals. During droughts, insects pose a particularly formidable threat to crops due to their moisture content. However, devising effective strategies for insect management remains a persistent struggle. Moreover, larger animals such as hippos or giraffes are deterred with fences, sometimes electric, to save crops. In a collaborative effort, farmers work together to develop humane and non-lethal methods for scaring animals, adhering to regulations prohibiting harm to animals.

Transformed knowledge in present days

Nowadays, children often learn about household or backyard farming techniques at school or youth gatherings to ensure their families always have enough to eat. This educational approach follows the principles of permaculture, which involves designing farming systems with the integration of crops and animals and promoting high levels of habitat diversity (Morel et al., 2019). A comprehensive study is underway at the YMCA, a community center and NGO, to motivate young individuals to pursue farming and cultivate new crop varieties. This initiative represents an important step towards greater food security. According to one interviewee, this approach represents a new and modern farming strategy. It exemplifies how globalization and scientific insights can impact and advance knowledge systems in Naivasha, including their local knowledge base.

“The youth is our future, we need to teach them as much as we can to be able to build a sustainable way of living. That is why at YCMA we focus on new and innovative ways to farm” (Interview 4, 22-3-2023).

Furthermore, due to this newfound knowledge, a young female farmer has emerged as a central figure in advancing agricultural practices within the Naivasha region. Initially, amidst the challenges posed by the Covid pandemic, she embarked on a journey of entrepreneurship by selling chicken eggs from her humble one-bedroom apartment. Over time, her enterprise flourished and evolved into a thriving business model that involved at-home deliveries of eggs to customers.

As demand increased, she expanded her operations by buying a larger plot of land, where she delved into farming with remarkable success. She saw that she needed a more prominent place to multiply her innovative farming methods and invested in an even larger piece of land to establish her own small institution. Here, individuals from different areas of Kenya and even the world can gain insights into her pioneering agricultural techniques as she explains them to fellow farmers.

The facilities at her institution are comprehensive, encompassing accommodations for visitors journeying from distant locations and a purpose-built classroom for educational lectures. She also plunged into selling rabbit urine as an organic fertilizer and adapted her livestock choices to comply with regulations while maximizing the profits. Starting with poultry farming, she now oversees the breeding and management of various species for egg production and reproduction.

Remarkably, her entire agricultural enterprise is underpinned by a commitment to sustainability, serving as a beacon of inspiration for others in the community. Beyond traditional farming practices, she experiments with diverse crops to examine their resilience of the changing climate. For instances, where indigenous crops struggle to thrive, she diligently investigates the underlying factors and tries to devise strategies to improve them. Furthermore, she explores innovative techniques to extend the durability of food products, such as through drying or processing them into value-added items like chili powder. Perhaps most impressively, she accomplishes all of this through self-directed learning, utilizing the vast resources available on the internet to continually refine her agricultural understanding and drive positive change within her community.

“This is all possible because I have passion for what I do. Thereby, I started searching for new ways of farming on the internet. That is how I find new information.” (Interview 12, 12-4-2023).



FIGURE 9 THE FARM, WITH LOCAL AND MODERN KNOWLEDGE MIXED

Source: Author

Institutional support for strengthening local knowledge and practices

Starting the interviews, a recurring theme emerged regarding the significance of government support for farmers' future expectations. While most farmers express confidence in their ability to persevere and sustain their livelihoods even without government help, there is a selection of farmers who doubt the long-term viability of farming as a profitable endeavor.

Each farmer was asked two fundamental questions throughout the interviews: Does the government provide adequate assistance? And, what measures would you like the government to implement to support you further? These questions were posed to assess the potential impact of governmental intervention on the preservation and utilization of local knowledge among farmers.

Beginning with the first question, the unanimous response from all interviewees was 'no'- the government does not provide adequate assistance. According to their mutual perspective, the government's efforts to assist them are perceived as nonexistent. Despite promises made during flood events, wherein official announcements mentioned financial aid and support, the reality tells a different story. Disappointingly, there was no tangible assistance, with only the Red Cross making a brief appearance to photograph the situation, hardly offering any aid (Baraka, C., 2022).

Government support to farmers is mainly reflected in the supply of fertilizers and seeds, often at reduced rates or subsidies. However, these inexpensive fertilizers are mostly chemical-based and can have detrimental long-term effects on soil health and the surrounding environment. Additionally, the distribution of free seeds leads to a circulation of identical crops across farms, resulting in a saturation of the market and subsequent plunging prices for farmers' produce. This uniformity in crop cultivation not only diminishes profitability but also undermines the application of local agricultural knowledge. Consequently, farmers adapt their crop choices and fertilization methods in response to the availability of these government-subsidized inputs, potentially compromising the sustainability of their farming practices in the long run. As a result, the reliance on such assistance from the government asks for a significant shift in farming techniques and challenges the preservation of traditional agricultural wisdom (Interview 24, 8-5-2023).

“Because of the climate change not only people but also plants and trees are becoming sick with diseases we haven’t seen before. People can definitely stay farmers if they have education and resources from the government, like better fertilizer” (Interview 4, 22-3-2023)

Furthermore, significant shifts have occurred in the agricultural market landscape over the past few decades. During the 1980s, government assistance played a vital role in supporting farmers. Agricultural experts were dispatched to fields to assess fertilizer requirements, and the government facilitated fair pricing mechanisms by purchasing crops directly from farmers and selling them to markets. However, nowadays, market dynamics have evolved, with brokers dominating the agricultural trade. Farmers are compelled to sell their produce to these brokers due to logistical constraints or interference from middlemen, which prevent direct access to larger markets. Regrettably, governmental intervention to reverse this trend has been lacking, allowing intermediaries to amass wealth at the expense of farmers, who often receive minimal compensation for their crops.

“Farming has become a headache; the market is ruining the whole system” (Interview 6, 23-3,2023).

A valuable opportunity presented itself to interview three individuals representing the municipality. Emerging from these interviews was a profound acknowledgment of the multifaceted challenges faced by farmers, encompassing their struggles to meet educational expenses and secure adequate nutrition. At the governmental and municipal departments, efforts are being made to develop new technologies to help farmers. Plans are being carefully crafted for comprehensive training initiatives to fortify sales strategies and furnish farmers with indispensable insights to navigate the intricate landscape of climate change in agriculture.

Notably, a representative from the municipality underscored the existence of preexisting informative sessions, emphasizing the accessibility of municipal resources for farmers seeking guidance or further help (Interview Government 1, 24-3-2023). However, it is intriguing that farmers themselves confessed to being largely unaware of these available resources.

Nonetheless, farmers and municipal representatives agree on the vital role of information, recognizing it as an indispensable source of empowerment, using the dignified saying: "Information = power". Despite these efforts, there's still a noticeable lack of support from both governments and NGOs, emphasizing the need for more comprehensive assistance. The only NGO's I found that was helping the farmers in the area was Muungano (SDI Kenya) and WWF (Imarisha, 2015). WWF Kenya is trying to enhance water security and Muungano are giving classes for different ways to farm and try to help the farmers as well as they can.

5. Discussion

This discussion explores the significant influence of local knowledge on climate change adaptation among small-scale farmers in Kenya. Examining the resilience of local farmers, the adaptation practices they employ, and the interaction between local and scientific knowledge helps in understanding the strategies that contribute to sustainable agricultural practices.

Local Knowledge versus Scientific Knowledge

Scientific research indicates that Kenya faces increasing temperatures, heavier and irregular rainfall, and more frequent extreme weather events due to climate change. Farmers and residents of Naivasha are acutely aware of these changes, as they witness them firsthand. However, not all farmers fully understand the concept of climate change. However, they recognize the impacts of prolonged droughts, high temperatures, and reduced rainfall on their harvests and food security. *Farmers are trying more to adapt to their changing environment, but they struggling to understand why the weather is so unpredictable which makes it difficult for them to adjust* (Helper 3, 8-5-2023).

To address these challenges, farmers rely sincerely on their local knowledge. They use techniques such as water conservation, creating shade for crops, and experimenting with different crop varieties. Its contextual specificity and practical applicability characterize local knowledge. It is derived from long-term observations and experiences within a particular environment, often passed down through generations. This knowledge is holistic, incorporating cultural, social, and ecological dimensions, and deeply embedded in local communities' daily lives and practices as seen in the field. While practical and effective in their context, this local knowledge raises questions about its scientific validity and broader applicability as a climate change adaptation strategy. Nonetheless, local knowledge can offer valuable insights and perspectives that enhance scientific understanding of climate adaptation.

Adaptation Practices and Changing Knowledge

Farmers in Naivasha have adapted to the changing climate by combining traditional practices with new techniques. Permaculture, for example, has gained popularity as an approach that integrates traditional and modern agricultural methods. Farmers use chemical and organic fertilizers, diversify crops, and implement water conservation strategies (Interview 10, 29-3-2023).

Farmers primarily learn through practical experience and intergenerational knowledge transfer, despite these advancements, rather than formal education. They often cite family members and community elders as their primary sources of agricultural knowledge, learning what works through repeated practice over generations. This approach contrasts with the Western scientific research and formal education model but remains highly effective in their specific context.

While local knowledge is invaluable, it is not without limitations. The increasing unpredictability of weather patterns due to climate change poses new challenges that traditional practices may not fully address. Additionally, the lack of access to modern technology and resources can hinder the effectiveness of local adaptation strategies. This can be seen by the many crop failures and difficulty to harvest enough to make profit. Farmers lack the knowledge to adapt their farming strategies quickly enough to cope the changing weather conditions (Helper 2, 8-5-2023). Furthermore, the pressure on available land due to population growth and other socio-economic factors worsens the vulnerability of small-scale farmers (Interview 5, 22-3-2023). Areas that were once used for farming are now being developed or purchased by large flower farms, resulting in a scarcity of fertile fields near water sources.

Adaptation Strategies Employed by Small-Scale Farmers

1. **Water Conservation Techniques:** Given the recurrent droughts and unpredictable rainfall, farmers have developed various methods to conserve water. These include harvesting rainwater, building small holes, and creating shaded areas to reduce evaporation. Such techniques are vital in ensuring water availability during dry spells.
2. **Crop Diversification and Rotation:** Farmers practice crop diversification and rotation to mitigate the risk of crop failure. This not only improves soil fertility but also reduces the occurrence of pest infestations and disease outbreaks. Farmers can ensure some harvest by growing various crops even under unfavorable conditions.
3. **Use of Organic Fertilizers:** Many farmers prefer organic fertilizers, such as compost and animal manure, over chemical alternatives. This practice enhances soil health and reduces environmental degradation. Organic fertilizers are more sustainable and contribute to the long-term fertility of the soil.

4. **Weather prediction:** Farmers traditionally predict the weather by observing signs in the environment, such as animal behavior and cloud formations, to anticipate rain or droughts. However, these methods have become less reliable over time. Consequently, some farmers now rely on weather apps or forecasts from the news for more accurate predictions.
5. **Community-Based Resource Management:** Local communities often manage natural resources collectively. This includes communal grazing lands, water sources, and forests. Such practices ensure sustainable resource use and foster social cohesion, vital for community resilience in the face of climate change. This social cohesion is essential for transferring local knowledge to fellow farmers and future generations.

Defining whether all these strategies constitute local knowledge is challenging due to the complexity of the concept itself. Repeating, the definition of local knowledge used in this thesis is: *local knowledge is acquired over generations through living in contact with nature*. All the strategies will be addressed separately.

Beginning with water conservation techniques. Waterholes and creating shade to reduce evaporation are traditional ways, while water tanks and drip irrigation represent newer methods. They too can be seen as rooted in local practices. Water tanks resemble modern-day equivalents of traditional water holes, while drip irrigation mirrors an evolved watering can. These techniques are adopted through learning from preceding generations and neighboring farmers.

Crop rotation is a longstanding practice that varies throughout the year. Crop diversification relies on the availability of seeds and the local knowledge of farmers regarding which crops thrive under specific conditions. This local knowledge is applied in selecting the crop. The traditional knowledge of making compost and animal manure has been largely forgotten, but due to the increasing costs of chemical fertilizers, farmers are rediscovering and utilizing this knowledge once again. Chemical fertilizer can also be considered local knowledge because it has been passed down through generations and is widely adopted. However, the resurgence in the use of compost and animal manure faces challenges. While some farmers possess the skills to produce this type of fertilizer, many opt to purchase chemical alternatives due to the time-consuming nature of composting. Nonetheless, those who employ animal manure and compost can be regarded as guardians of local knowledge, having inherited these practices from previous generations. Today, they continue to pass on this knowledge to fellow farmers as a sustainable alternative to chemical fertilizers.

Using animals and environmental cues to predict weather changes illustrates local knowledge. This experiential learning and adaptation process highlights the dynamic nature of local knowledge, which evolves in response to new challenges and incorporates elements of scientific knowledge as they become available. Farmers gradually blend traditional practices with new techniques. They can learn from each other, creating a hybrid approach that uses both strengths.

The Value of Local Knowledge

Its contextual specificity and practical applicability characterize local knowledge. It is derived from long-term observations and experiences within a particular environment, often passed down through generations. This knowledge is holistic, incorporating cultural, social, and ecological dimensions, and deeply embedded in local communities' daily lives and practices.

Strengths:

- **Contextual Relevance:** Local knowledge is highly relevant to the specific environmental and cultural context in which it is applied. Farmers understand the nuances of their local environment better than external experts. They possess the ability to interpret the environment and adjust to upcoming weather conditions.
- **Sustainability:** Practices based on local knowledge are often sustainable and environmentally friendly, having evolved to work harmoniously with local ecosystems. For instance, the usage of plant remains reduces evaporation and enriches the soil.
- **Community Engagement:** Local knowledge fosters community cohesion and collaboration, which is critical for collective action in climate adaptation. Farmers are actively engaged in exchanging strategies and evaluating effective methods to adapt to climate change.

Weaknesses:

- **Dependency:** Local knowledge is not as reliable as it used to be. Farmers can no longer rely entirely on their environment. Weather patterns are shifting, animal behaviors are changing, and crops are not growing as effectively as they did in the past.
- **Sustainability:** When farmers no longer work in harmony with their surroundings, adaptation strategies can be disastrous for the environment due to a lack of knowledge of the consequences. For instance, the application of chemical fertilizer as a quick

solution often leads to accelerated soil depletion rather than sustainable long-term improvement.

Integration with Scientific Knowledge

Scientific research on climate change shows that Kenya is increasingly facing higher temperatures, irregular rainfall, and extreme weather events. While local farmers are aware of these changes, not all are familiar with the broader concept of climate change. With its empirical and systematic approach, scientific knowledge can provide valuable insights into these phenomena and offer innovative solutions (Gentles et al., 2015).

Benefits of Integration:

- **Enhanced Adaptation Strategies:** Farmers can develop more effective and comprehensive adaptation strategies by combining local knowledge with scientific research. For instance, scientific insights into climate patterns can help optimize traditional water conservation techniques.
- **Innovative Solutions:** Scientific advancements can introduce new technologies and practices, such as drought-resistant crop varieties and efficient irrigation systems, which can be integrated with traditional methods.
- **Capacity Building:** Training and educational programs can help farmers understand and implement scientific knowledge, thereby improving their adaptive capacity.

Challenges in integration

Despite the potential benefits, integrating local and scientific knowledge is challenging. One major issue is the difference in epistemologies – how knowledge is acquired and validated. Local knowledge is often experiential and qualitative, while scientific knowledge is empirical and quantitative. Bridging this gap requires mutual respect and understanding between local communities and scientists (Chalmers & Fabricius, 2007).

Another challenge is the accessibility of scientific knowledge. Many small-scale farmers lack the resources and infrastructure to access and implement advanced scientific techniques (Interview 12, 12-4-2023). Ensuring that scientific knowledge is distributed in an accessible and practical manner is crucial for successful integration.

Institutional Support: Bridging the Gap

Institutional support is crucial for enhancing the resilience of small-scale farmers. However, there is a significant gap in the assistance provided by governmental bodies and NGOs. Historically, the government offered substantial support to farmers, including field visits to assess fertilizer needs and they purchased the farmers' crops at fair prices. Today, however, the role of brokers in the agricultural market has marginalized farmers, reduced their profits and increased their vulnerability.

Interviews with municipal officials reveal that they know the farmers' struggles and are working on new technologies to assist them. These efforts include training programs to help farmers market their products better and cope with climate change. However, there is a disconnect, as many farmers are unaware of these resources. The phrase "information is power" resonates here, underscoring the need for better communication and accessibility of information.

Moreover, the current government support, primarily in the form of cheaper chemical fertilizers and free seeds, has mixed impacts. While these inputs can boost crop yields temporarily, they also lead to long-term soil degradation and market saturation which causes reduced profitability. This situation forces farmers to adapt their practices, sometimes at the expense of traditional methods that have sustained them for generations.

Local knowledge remains a vital component of resilience for small-scale farmers in Naivasha. Their deep-rooted understanding of the land, weather patterns, and effective farming practices, passed down through generations, remains relevant. However, integrating scientific knowledge and improved institutional support could be essential to enhance their adaptation strategies in the face of escalating climate challenges.

In the next chapter, I will conclude how a collaborative approach integrating both local and scientific knowledge can lead to more sustainable farming practices. The importance of institutional support in providing accessible information, training, and resources that complement the farmers' existing knowledge and practices is mentioned. By leveraging local knowledge, it could significantly enhance climate change adaptation efforts, ensuring a more secure and resilient future for the farming communities in Naivasha.

6. Conclusion

This thesis aimed to explore the influence of the local knowledge of local communities on climate change adaptation. This section will come back to the main research question and findings. First, the limitation of this study will be discussed.

Limitations of the study

Considering the conditions during which this study was executed, it is crucial to recognize the notable limitations, considering the particular period and setting of the research. This research's first and most important limitation is the depth and breadth of the collected data. Theoretical saturation was not achieved during fieldwork, weakening the theory construction due to limited time and respondents. Consequently, further research is necessary to investigate more thoroughly and substantiate the results better.

Another limitation is the narrow focus of the study. Social and natural phenomena are constantly changing, so it's essential to understand the bigger picture. However, as a researcher, my ability to move around and my resources were limited, making it hard to get that broader view.

Social implications

The limitations of this study have social implications, such as a biased perception of respondents. Moreover, the challenging process of accessing farmers in Naivasha and our limited time in the community, combined with the absence of follow-up support and information, may have led to differing expectations among community members during the study.

Method limitations

Initially, this research aimed to investigate various communities around Lake Naivasha to understand their challenges and local knowledge comprehensively. However, financial limitations, time constraints, poor road conditions, and difficult access to certain areas made it impossible to reach all targeted communities. Consequently, the interviews were conducted primarily closely to the city of Naivasha.

Once in the field, it became clear that walking around town independently was impractical. Prospective interviewees frequently demanded money/payment before engaging in discussions, and certain areas needed safety concerns for solo travel. Consequently, attending interviews and moving to urban areas or other destinations needed alternative logistical arrangements.

In addition, there was a limited time frame available for conducting interviews due to weather constraints. Every day around 14.00, it started pouring rain. It was not possible to take shelter

in the open fields, and the farmers were going home at that time. Because of the heat in the late morning and early afternoon, maintaining focus during interviews was challenging for me, my Muungano contacts, and the interviewees. Consequently, we had limited time each day to conduct interviews. Combined with the packed agenda of the contact of Muungano and the cultural differences, it was hard to make appointments to conduct interviews. Fortunately, after a few weeks, two additional individuals were able to assist, enabling us to complete all interviews together. Regrettably, most participants once again requested compensation, a common practice in Kenyan culture (Helper 2, 29- 3-2023) that was not anticipated before fieldwork. However, interviews were eventually conducted by exchanging valuable farming information, thus benefiting both parties.

Lastly, another limitation arose from the language barrier. While many of the younger farmers were comfortable enough to share their experiences in English. The elderly could answer the questions, but it was felt that their stories felt behind. To bridge this gap, the contact person from Muungano asked most of the questions in Swahili, facilitating a more nuanced exchange. The farmers told their stories to the contact person, who then translated and relayed them to me. However, the risk of misinterpretation and loss of information in translation exists using this method. Throughout the research endeavor, we remained aware of this potential, recognizing that information loss was an ongoing concern.

Potential research topics

Future research topics could include small-scale farmers in different areas dealing with the same circumstances to compare local knowledge and adaptation strategies. Farmers with different circumstances could be researched as well to define how local knowledge is implemented. Additional research may seek new information about small-scale farmers and their adaptation strategies to compare and define the needed knowledge.

Additionally future research could implement a case study approach with the influence of the government and other development organizations. Do these organizations have the needed knowledge and resources to help small-scale farmers adapt to the changing climate.

Conclusion

This thesis answers the three questions leading to the final question with a conclusion on how local knowledge of local communities influences their climate change adaptation strategies.

What diverse experiences and perceptions do small-scale farmers in Naivasha have regarding floods, droughts, and their effects?

The farmers of Naivasha are currently struggling with the concrete consequences of climate

change in their day-to-day agricultural life. This is shown through various challenges, including decreasing water resources, abnormal precipitation patterns characterized by increasingly severe droughts and floods, and a noticeable decline in the frequency of favorable harvests. To be able to survive as a farmer under these circumstances is becoming harder and harder. They need to adjust to the quickly changing climate and build their resilience.

Within the farming community, there are different beliefs regarding the severity of climate change. While some farmers associate recent misfortunes with short-term fluctuations in weather patterns, others have deep concerns about the long-term sustainability of agriculture due to climatic changes. These varying perspectives are shaped by multiple influences, including individual experiences and cultural beliefs, such as faith in God, which influences environmental outcomes. Consequently, this community's interpretation of climate change is complex and varied. Showing how personal beliefs interact with outside environmental factors is quite complex.

What strategies do small-scale farmers in Naivasha employ to adapt to and survive extreme weather events?

Small-scale farmers lack a defined strategy for adapting to and surviving extreme weather events. Instead, they rely on their indigenous knowledge to anticipate weather patterns and adjust their practices accordingly in response to changing conditions. Some adapting strategies farmers use during a drought are:

- less evaporation
 - o drip-irrigation
 - o shade, made by nets
 - o different crops, with big leaves to create more shade
- crop differentiation
 - o plant indigenous species
 - o plant exotic species like chili pepper
 - o species who need less water and are better adapted to the heat waves
- man-made manure
 - o if possible, stay away from chemical fertilizer because of expenses
 - o better for soil and insects
- last resort
 - o changing to livestock
 - o work for a boss (bigger company)

For other extreme events, they do not have strategies. Despite facing challenges such as heavy rainfall that leads to seed loss due to prolonged dry spells they express gratitude when rainfall occurs. However, adapting to floods in recent years has proven difficult due to their unpredictability. Nonetheless, they continue farming near the lake, drawn by the fertile land and access to (clean)water, even though the risks involved.

Can the local knowledge of small-scale farmers in Naivasha enhance their resilience to climate change? If yes, how?

The small-scale local farmers in Naivasha use diverse forms of local knowledge in their agricultural practices. Some farmers rely on their environment, such as observing animal behavior, monitoring insect activity, interpreting cloud movements, and studying patterns like stars and the moon to forecast weather patterns. Unfortunately, the reliability of these traditional methods has reduced due to the changing climate, affecting the long-standing predictive patterns that these farmers have inherited from previous generations.

Additionally, farmers utilize various techniques for water conservation, crop selection, and fertilizer application, often passed down through family, friends and neighbors. Despite limited access to formal education and scientific resources, their deep engagement with the natural environment enables them to feel and answer to the needs of their crops and fields.

However, the rapid pace of climate change necessitates further adaptation of their local knowledge systems. While their local practices enhance resilience to environmental changes, additional research is needed to examine the effectiveness of these methods in response to changing climatic conditions. Thus, the role of local knowledge in resilience to climate change needs additional research for conclusive assessment.

How does knowledge of local communities in Kenya influence climate change adaptation?

To answer my final question, it becomes clear that local knowledge plays a central role in shaping adaptation strategies. While local knowledge remains foundational for farmers, it is increasingly influenced by other forms of knowledge. A domain of new knowledge emerges, where the future landscape is envisioned as a combination of local wisdom and modern methodologies put together to tackle the challenges cause by climate change effectively.

The local knowledge could be transformed to other locales by NGO's, the government, and donors. As the water is becoming less available and farmers can't survive with 20000L tanks combined with local knowledge, it becomes a problem when droughts get more severe.

Therefore, it has been said that it is crucial to spread knowledge regarding the adverse effects of chemical fertilizers to mitigate further deterioration in the fields. Additionally, enhancing understanding of the proper utilization of drip-irrigation systems will lead to their more effective implementation. Ultimately, increased knowledge will boost farmers' resilience to the impacts of climate change.

Further research should focus on the needs of farmers. How different types of knowledge could make them more resilient to climate change. What kind of knowledge do the farmers use, and how can they implement it daily.

7. Reflection

This chapter aims to analyze and verify the successes and shortcomings of the research methodology and execution. Working in the field has provided an excellent opportunity to explore the beautiful area and its diverse inhabitants. Building connections with the local community has been memorable, and it has allowed me to understand their challenges, way of life, culture, and adaptation strategies.

Successes

Methodology

It was the right decision to use the ethnographic theory approach during this research. This approach allowed us to study a cultural group in its natural setting over a long period. This method mainly uses observations and interviews, which enables the researcher to stay flexible and adjust to real-life situations in the field. This allowed me to switch from interviews to observations and follow farmers' daily lives. Therefore, my interview guide needed to be flexible and adaptable throughout the process, which enabled me to conduct future interviews more effectively and thoroughly.

Conducting research

While conducting this research, I learned many valuable lessons that helped me grow as a field researcher. These lessons were essential for the study and helped me understand and follow the local cultural norms in their daily life.

One of the first lessons learned was to live by the day and not to expect or plan too much for the day; just let's see how far we can come in one day. This lesson contributed to understanding Kenya's culture and how people fill in their days. As a result, most of our meetings were held before noon because of the heat, and after the midday rain, I met with people at the YMCA or another get-together place.

Furthermore, deciphering the meaning and importance of how younger people address older adults in the culture and knowing what is essential was very important in executing this research. With the proper knowledge and words in Swahili interviewees are more open and willing to tell their story. To do this, the boundary between being seen as the white girl or 'Mzungu' and becoming just someone interested in their side of the story is very important.

Next to the lessons I have learned, what went particularly well was the immersion in the residents' daily lives in Naivasha. The kind ladies I met at a hotel showed me around various neighborhoods and popular spots, allowing me to explore the area and meet different people.

A small-scale farmer invited me to her local church, allowing me to experience and understand her beliefs more deeply.

Challenges faced

Methodological approach

The ethnographic theory approach fits the base of this research and the information collected before the fieldwork. Unfortunately, the ability to conduct multiple interviews with Naivasha's small-scale farmers and inhabitants was hampered by a language barrier, distance, transport, limited resources, cultural differences, and safety concerns. In the methodological approach developed before the field experience, significant factors were not identified as difficulties in conducting the study. Fortunately, everything was resolved through the helpfulness and input of all the backers, and the interviews could take place.

Conducting research

Initially, there was a significant deviation between the anticipated information gathered from the interviews that formed the basis of the research proposal and design and the actual interviews conducted in the field. This mismatch led to the need to develop a new approach and adjust the interview guide to ensure the collection of accurate and relevant answers.

Moreover, the region's host organization (or a local partner organization) proved essential and advantageous. This partnership was crucial in making proper arrangements with the intended interviewees, facilitating smoother communication and coordination.

The misalignment of expectations and information led to several challenges and difficulties during the study. These challenges included issues with interview scheduling, distance, language barrier, limited resources, and safety issues. The following sections will provide a detailed account of these difficulties.

Interview scheduling

The communication between the small-scale farmers had to go through my contact person in the Muungano organization. He knew where we could conduct the interviews and if people would speak to us. The first two weeks went well; we conducted several interviews and planned to visit different areas in the coming weeks. However, I soon realized I needed to adjust to the Kenyan culture, where appointments seldom happen at the agreed time. This meant that some days we had interviews scheduled, they did not occur because my contact did not show up. After a few weeks, I understood this was part of Kenyan culture. It was summed up by the phrase: 'hakuna matata', which means no worries and no rush. Due to my limited time in the area, two other men from Muugano helped me conduct additional interviews.

Distance

The village of Naivasha is a short two-hour drive from the capital Nairobi. It is possible to go here by bus or taxi. The area is relatively large, and walking everywhere on foot is impossible. I did not have a vehicle license, which made me dependent on others, such as a driver or local taxi-scooter drivers, who could take me somewhere. The distance had a tremendous impact on the execution of this research as it constrained me to go often to places further from the city center. This hindered the collection of data from communities living in areas further from the lake and the river.

Language barrier

Another challenge that occurred during the field of research was the language barrier. Luckily, it was not difficult to find a translator because my contacts from Muugano could all speak Swahili and translate during the interviews. Most of the interviews were conducted in English except a few words, and these are indigenous species that the small-scale farmers grow.

Interviews that did take place in Swahili were more challenging to conduct in the research because of the loss of information during translation. Therefore, having an easy conversation with farmers is more difficult when we need to translate every sentence.

Limited resources

To overcome these difficulties, resources are required. To be able to go to different places, it was necessary to go by scooter or even rent a car. This needed to be paid for, and the researcher has done it. Unfortunately, due to limited resources and no additional resources from the organization it was not possible to go often or to places any further. Some small-scale farmers requested payment for participating in the interviews, as they had to stop working to provide their answers. After many discussions and consultations with my contacts, we agreed with the farmers to exchange information for information. Providing money for their responses would not be ethically justified, as it might lead them to alter their answers to what they thought I would want to hear.

Instead, we organized an information evening where the farmers could share their local knowledge and climate change adaptation strategies with experts from the Muugano organization. This arrangement allowed for a fair exchange of valuable information without compromising the integrity of the research.

Safety issues

Despite the help from my contacts at Muugano, it wasn't easy to travel to other places on my own. My contact advised me that I could safely walk a few streets around my address, but I needed to take a scooter taxi if I wanted to go further. We had to rent a car for distances beyond what was possible by scooter because the local buses were very dangerous. During my stay, there were three fatal accidents involving these buses due to reckless driving.

The travel limitations made it challenging to meet new people. Fortunately, I met four women who showed me different regions and attractions in the area. Because of the restricted mobility, it could sometimes feel lonely, and there were days when I spoke to no one. These women, however, brightened my days by taking me in as part of their family, ensuring I had a great time and immersing me in the local culture. These experiences added significant value to the information I gathered from my interviews.

Recommendations

When considering an alternative approach to recommendations for further research, more time and resources must be included. The ability to go to other areas could add more information and show different adaptation strategies. With more time, it is possible to experience the changing climate and the farming strategies that change. To fully understand the concept of local knowledge, it is essential to dive into the culture of small-scale farmers. Farming together will help them understand the choices they make. This adds to the reliability of the research.

Besides this reflection, I stand by my choice of an ethnographic study because of my ability to adapt during the research. This approach makes it possible to live and experience with the participants, adding value to the study's background.

Harambee – Spirit of cooperation

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Appendix 1

Grow well during droughts

- *Chili*
- *“Managu” - Black knight shades*
- *Spider plant*
- *Green capsicum*
- *Unions*
- *Potatoes*
- *Cabbages*
- *Beans*

Plant mostly during rain season

- *Tomatoes*
- *Cales*

Appendix 2

Local knowledge used in Naivasha area:

- *Weather prediction*
 - o *Animals*
 - *Red ants appear at topsoil = rain within 10-20 minutes*
 - *Pigeons together in a big group = rain*
 - *Sparrow's chirping = rain*
 - *Dragonfly's flying at high speed = rain within 10 days*
 - *Butterfly migration = drought*
 - o *Environment*
 - *Clouds move from the mountain to the lake = it will rain today*
 - *Cycle of three months of rain followed by a few months of drought*
- *Crop diversification*
 - o *Spinach, collard, tomatoes, potatoes, cabbage and unions during raining season*
 - o *Chili's and beans in dry season*
- *Farming techniques*
 - o *Harvesting collard from the side of the plant so it continues to grow*
 - o *Harvesting Black Shades (Managu) from the joints so it continues to grow*
 - o *Using bottle with a cap that has holes to spread speeds around the field easily*
- *Organic fertilizer*
 - o *Nitrogen from rabbits' urine*
 - o *Lemon mixt with goat and chicken feces for better soil*
 - o *Water hyacinth from the lake*
 - o *Manure*
- *Water conservation*
 - o *Waterholes (and watertanks)*
 - o *Drip-irrigation*
 - o *Covering seeds and small plants with plant remains to reduce evaporation*
 - o *Covering the fields with clothes with holes that allow some sunlight to filter through and reduce evaporation*
 - o *Using plastic edges/trays so that water cannot flow away*

