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Analysis of Climate Change Adaptive Capacity among Landowners in Mara Siana in Kenya and Identification of appropriate Measures

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Declaration in lieu of oath

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Abstract

Due to the global phenomenon of climate change the region of Mara Siana is projected to increasingly face extreme weather events that particularly comprise prolonged droughts and heavier rainfalls. To be able to adequately adapt to these changing circumstances and maintain their livelihoods communities need to build respective capacities. As the main objective, this research aims at determining landowners' climate change adaptative capacity (CCAC) across different villages in Mara Siana. Accordingly, a semi-quantitative approach was carried out including qualitative interviews and the subsequent quantitative calculation of CCAC based on a multidimensional indicator set and a respective coding system. In addition to predominantly positive results of socio-cultural characteristics and the quality of natural resources, this work reveals clear weaknesses and potential for improvement in the areas of income security and financial stability, the expansion and resilience of infrastructure, and the relationship between communities and local authorities. Moreover, differences in capacity results are not only identified between the investigated villages as well as between individual households but also systemic disadvantage in capacity building affecting female landowners and community members can be indicated from the obtained interview data. Therefore, this research gives concrete recommendations for the implementation and verification of suitable adaptive measures that are particularly tailored for the improvement of low-performance indicators while following a gender-transformative approach and thus hold the potential to increase CCAC in the long-term.

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List of Abbreviations

ACW	Adaptive Capacity Wheel
ASAR	Arid and Semi-Arid Regions
CCA	Climate Change Adaptation
CCAC	Climate Change Adaptive Capacity
CIDP	County Integrated Development Plans
CMIP	Coupled Model Inter-comparison Projects
COP	Conference of the Parties
ENSO	El Niño Southern Oscillation
EWS	Early Warning System
GHG	Greenhouse Gases
GIS	Geographic Information Systems
HWC	Human Wildlife Conflict
IOD	Indian Ocean Dipole
IPCC	Intergovernmental Panel on Climate Change
MMNR	Maasai Mara National Reserve
MSC	Mara Siana Conservancy
MTP	Medium-Term Plans
NDC	Nationally Determined Contributions
ND-Gain	Notre Dame-Global Adaptation Index
NGO	Non-Governmental Organization
PV	Photovoltaic
UN	United Nations
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
WASH	Water, Sanitation, and Hygiene
WFP	World Food Programme
WWF	World Wide Fund for Nature

1) Introduction

In 2022 the Intergovernmental Panel on Climate Change (IPCC) released the sixth assessment report on climate change comprising a comprehensive overview about the current state of knowledge including impacts and risks as well as mitigation and adaptation aspects (IPCC 2023). In that regard, the United Nations Framework Convention on Climate Change (UNFCCC) defines 'climate change' as 'a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods' (United Nations 1992). As atmospheric greenhouse gas concentrations present a balance between human-caused emissions and natural sources and sinks, an increase of greenhouse gases due to human activities reflects a main driver of climate change (World Meteorological Organization 2022). To reduce human-related climate change and its impacts world leaders met at the UN Climate Change Conference (COP21) in Paris on 12 December 2015 to jointly adopt the Paris Agreement. The agreement defines long-term goals to which all nations may adhere with the main objective to significantly reduce global greenhouse gas emissions to limit the global temperature rise to 2 degrees Celsius within this century, while making efforts to limit this increase even to 1.5 degrees Celsius (United Nations 2015). To achieve this, a reduction of GHG emissions by 43% by 2030 and 60% by 2035 compared with 2019 levels is required with eventually reaching net zero emissions globally by 2050 (UNFCCC 2023). However, as the Emissions Gap Report 2022 issued by the United Nations Environment Programme (UNEP) concludes, humankind is far from achieving the Paris Agreement and its main objective since current policies indicate a temperature increase that is exceeding the suggested levels by the end of the century (UNEP 2022). These findings are particularly worrisome since impacts of global climate change are already reported in a wide range on a global scale. Accordingly, the intensity and frequency of extreme weather events such as hot extremes on land and in the ocean, heavy precipitation, and drought as major consequences of altering the atmospheric greenhouse gas balance are detected to cause widespread, detrimental impacts beyond natural climate variability. The assumption is that with high confidence climate change led to fundamental damages and already irreversible losses in especially terrestrial and marine ecosystems with a magnitude that is larger than previous IPCC reports had estimated. As a result, increased weather and climate extremes resulted in an enhanced exposure of many communities across different continents and particularly in the global South subsequently leading to a reduction of food and water security. Further impacts include implications on human health such as elevated levels of malnutrition and an increased occurrence of diarrheal diseases and other gastrointestinal infections. Furthermore, consequences of climate change also comprise economic damage with regional effects in areas such as agriculture, forestry, or tourism as well as the contribution to humanitarian crisis when climatic events interact with the high vulnerability of exposed communities. Future projections of climate change forecast that key risks and mid- and long-term impacts are multiple times higher beyond the year 2040 than currently. Thereby the exact magnitude strongly depends on mitigation and adaptation actions that are taken. Accordingly, near-term mitigation measures that limit the global warming to close to 1.5 degrees Celsius would very likely reduce losses and damages on human systems and ecosystems substantially compared to a greater warming (Lee et al. 2023).

In the context of strategies for mitigation respective system transformations across all sectors are required including industry, transport, building and agriculture. Moreover, the expansion of renewable energy utilization, the abolishment of fossil fuels, and a stop of deforestation are critical to reduce emissions and conserve and improve natural carbon sinks (UNFCCC 2023). To commit all member states of the Paris Agreement to a common reduction of GHG and to achieve the set emission reduction objectives so-called 'Nationally Determined Contributions' (NDC) are developed to realize and establish domestic mitigation measures (IPCC 2023). However, as climate change already leads to devastating impacts on a global scale and the success of mitigation measures with a subsequent reduction in GHG in the atmosphere are only recognizable in the long-term, increased adaptation actions are needed. In that regard, through enhancing adaptive capacity, strengthening resilience, and reducing vulnerability communities and the environment can be adequately prepared to minimize loss and damage. Thereby, when adaptation measures are especially driven by local populations the effectiveness of respective actions can be enhanced and transformative processes be promoted. Therefore, involving communities and local authorities and establishing partnerships with particularly marginalized groups including women, youth, or indigenous people remains of high importance for successful adaptation (UNFCCC 2023). Within recent years there were already efforts made to specifically analyze climate change adaptation (CCA) of communities and to determine their climate change adaptive capacity (CCAC). In that regard, approaches and methods to quantitatively as well as qualitatively assess CCAC are found to be highly fragmented and therefore prevent an overall holistic and comparable research in that field (Siders 2019). Additionally, the variety of aspects and factors attributed to CCAC analysis is large and basically comprises several spectrums from social and economic indicators (Panda et al. 2013; Thathsarani & Gunaratne 2018) to technological and institutional indicators (Matewos 2020; Wongbusarakum et al. 2021).

As also the region of East Africa is seen as being strongly impacted by climate change effects in recent decades involving especially intensified and prolonged droughts as well as shorter but heavier rainfall events (IPCC 2023) it is of high importance for local communities to build adaptive capacities towards climate change and sustainably increase their resilience. This master thesis deals with the determination of landowners' CCAC in the specific territory of Mara Siana located within the Maasai Mara ecosystem in the southwestern part of Kenya. The concrete study area of this research is presented by Mara Siana Conservancy (MSC), a large community-owned conservation area within the region of Mara Siana extending across several villages inhabiting landowners who lease their land to MSC for conservation activities. In Mara Siana particularly decisive weather and climate changes were already perceived by communities leading to an enhanced occurrence of extreme events including persistent droughts, heavy rainfalls, and subsequent flooding. These events already led to increased death rates of wild animals and livestock and a higher frequency of Human Wildlife Conflicts (HWCs) as space and resources are becoming scarce (see Annex IV). To adequately determine landowners' CCAC, a comprehensive indicator set is used which enables a respective semiquantitative assessment. Eventually, based on identified CCAC strengths and weaknesses appropriate measures are identified to improve CCAC of landowners and their households aiming to enhance resilience among communities and to reduce consequences of future climate change impacts.

1.1 Research Gaps

There is already research conducted within the wider geographic area of the Maasai Mara National Reserve (MMNR) that deals with weather events and variations in the context of climate change as well as with the interrelated socio-ecological impacts (Bartzke et al. 2018; Ogutu et al. 2014; Rotich et al. 2019). Furthermore, it is assumed that the resilience of people in the Mara region towards climate change effects is low due to different socio-political and socio-economic circumstances (Simotwo et al. 2018). However, comprehensive analysis of CCAC of local communities that especially involves aggregated, personal micro data has not been carried out for the wider geographic area including Mara Siana, the area of interest. Since there is no concrete research conducted for the time being that deals with CCAC of local communities in Mara Siana, there is a clear research gap occurring. The master thesis aims at closing this research gap by applying a semiquantitative research approach comprising the detailed determination of CCAC that is comprehensively introduced in the following sections.

1.2 Research Questions and Objectives

In general, the first objective of this master thesis is to identify those impacts of climate change that apply under the area of study. Furthermore, by answering to what extent communities in the Mara Siana region are able to adapt to the identified climate change effects, the main objective of adequately determining and calculating their CCAC is achieved. Eventually, through complementing the obtained findings from the previous research objectives including identified climate change effects and respective CCAC results, the final objective of this work is to derive appropriate adaptation measures recommended for implementation with the local communities. The detailed research approach including the utilized methods is illustrated in Figure 13 on page 28.

1.3 Justification

To date, such comprehensive assessment of CCAC within different communities on a household level as proposed by this work has not been conducted in the wider area of Mara Siana, respectively was not found in scientific databases. Furthermore, whereas over-regional and national adaptation data and calculations of CCAC, as they are determined by different institutions and initiatives such as ND-Gain (2023) and WeltRisikoBericht (2023), rather base on macro data of more basic and superficial key figures to inform about the development of institutional policies on a national scale the relevance of the information generated through this research arises from particular micro data about households' abilities to adapt to the changing climate in a specific setting. Accordingly, this work identifies weaknesses, strengths, and potential improvements serving as concrete entry points for regional policy makers, authorities, and institutions to implement specific measures for strengthening CCAC and reducing future vulnerability in the respective local setting and beyond. Thereby, findings are not only aggregated for individual landowners and their households but are also differentiated among various communities within Mara Siana which allows further conclusions to be drawn about geographical and demographic factors that influence socio-economic developments. Finally, the underlying methodological approach that is designed in this work may therefore also be applied and modified by other researchers who investigate CCAC in similar contexts.

2) Study Area

The following chapter aims at providing a general overview of the area of study that was selected to conduct this research. Firstly, a geographical localization as well as classification of the climate and landscape of the greater Maasai Mara is carried out followed by an extensive introduction into Mara Siana Conservancy (MSC) including its structure, conducted activities and societal characteristics. Figure 1 provides a first overview of the wider geographical region around the Maasai Mara National Reserve (MMNR), which is located in the southern part of Narok county in the south-west of Kenya. Along its southwestern border MMNR is directly adjoining Tanzania and the Serengeti National Park. MSC is especially highlighted within the map and is located in the southeastern part of the community-owned conservation areas and borders MMNR to the southeast.

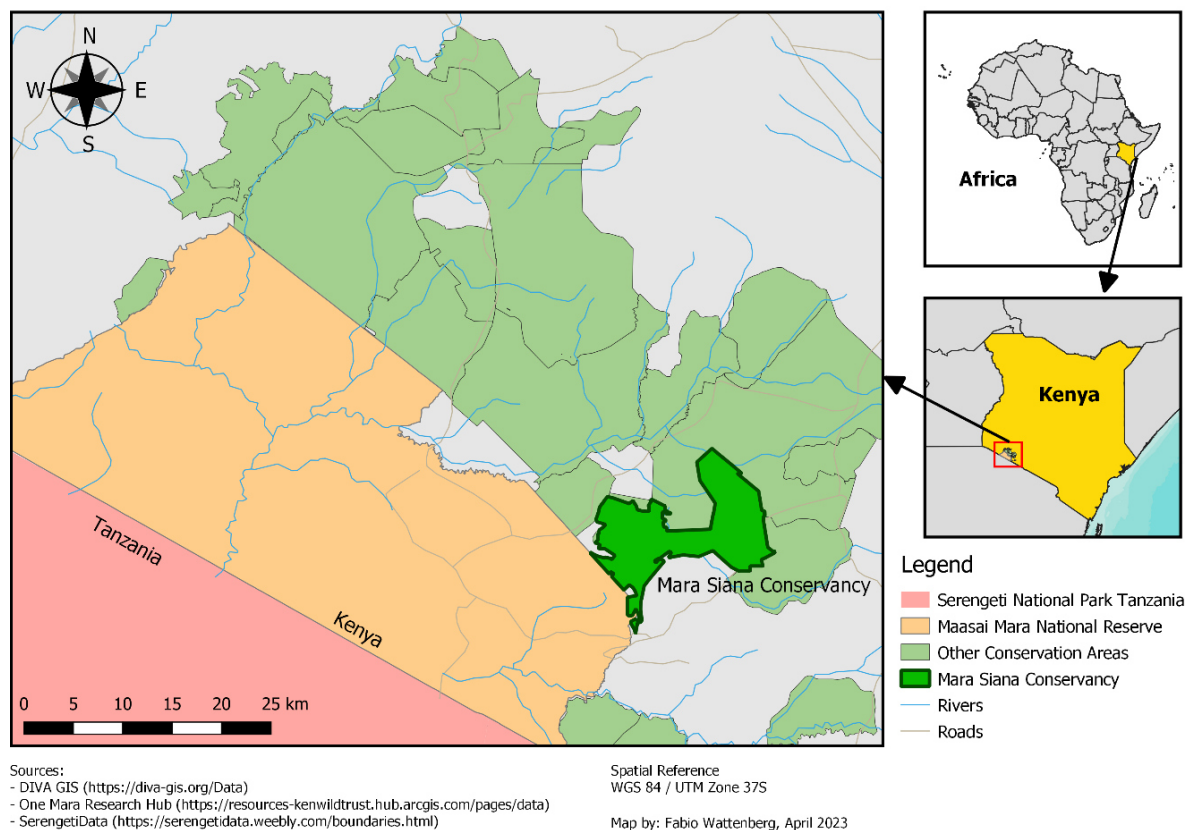


Figure 1: Map of the Maasai Mara Ecosystem and Parts of the Tanzania National Serengeti Park with highlighted Mara Siana Conservancy

2.1 Climate and Landscape

The landscape in the Maasai Mara is predominantly characterized by a semi-arid climate with a prevailing proportion of grassland at an altitude of around 1,500 to 1,900 meters above sea level (Dodd 2021). Due to the close proximity to the equator, temperatures are very constant throughout the year with two rainy seasons between November and December and from March to May while average daytime temperature ranges between 23 degrees Celsius in dry seasons and 27 degrees Celsius in rainy seasons. (Ross 2019). Precipitation is around 1.400 mm per year with particular rainfalls during the rainy seasons followed by regularly occurring floodings (MasaiMara.com n.d.). Figure 2 presents detailed

climate data from the village of Oololaimutia which is located within Mara Siana including precipitation and average temperature per month.

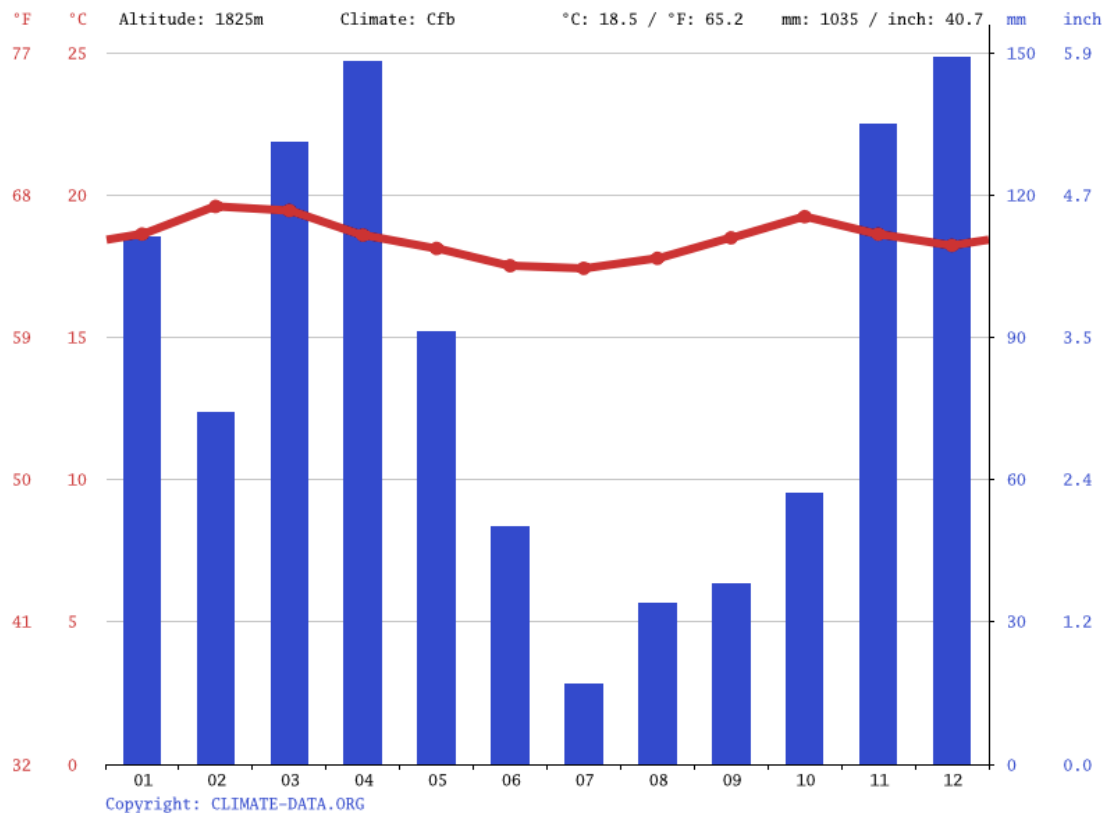


Figure 2: Climate Data of Oololaimutia based on the Period 1991-2021 (Source: Climate Data n.d.)

Those parts of the Maasai Mara ecosystem that are under conservation amount to nearly 3,000 km², an area almost equally divided between MMNR and several community-owned conservancies with unfenced boundaries to allow wildlife migration (Africa Geographic Stories 2020). As one of a total of 17 community-owned conservancies surrounding MMNR, the area of MSC is approximately 20,000 hectares. The vegetation types in this rather hilly landscape include various forest types and scrubland with African sage and acacia, but also plains and open grasslands. In addition, the conservancy inhabits marshes and riverbanks with appropriate riparian vegetation, gallery forests and a permanent watercourse (WWF 2021). Generally, within recent years land use and vegetation cover in the Maasai Mara as well as in Mara Siana has undergone phases of transition. In that regard, particularly grassland, forestland, and shrubland were found to decreased within the period between 1984 and 2016 whereas built-up areas slightly and cropland sharply increased indicating implications for livelihoods and biodiversity (Ongong'a et al. 2020). In addition to respective mechanized cultivation activities, the diversified land use systems of the Maasai communities also comprise an increase in tourism operations while livestock keeping still remains as a major land use strategy (Thompson et al. 2002). The significance of ecosystem conservation in the Maasai Mara lies therefore in counteracting negative land use developments and the accelerated degradation of natural vegetation as well as the expansion of bare ground as it was discovered in unprotected areas in the region. Moreover, the resistance of vegetation cover to droughts is especially affected on unprotected land

and respectively lower as in community-owned conservation projects and particularly fully protected areas. Additionally, community-owned conservation is also seen to have a special ability to ensure successful buffering against environmental degradation (Li et al. 2020).

Figure 3 shows the change in land cover around MSC from 2018 to 2020 and 2022. Accordingly, tree cover has increased sharply from 2018 to 2020 whereas from 2020 to 2022 it moderately decreased again. To this circumstance there are different aspects that need to be considered and which might be inter-related and decisive for this development. As Li et al. (2020) have concluded from their vegetation densification mapping, greening and woody densification in the greater Maasai Mara is both positively correlating with mean annual precipitation as well as negatively correlating with anthropogenic pressure (Li et al. 2020). Accordingly, one major argument to this land cover change and particularly the increased vegetation densification in Mara Siana is represented by the extraordinary wet season with heavy rains from October to December 2019. The furthermore resulting localized crop damage for farmers through floodings and increased swarms of locusts may as well be indicated from figure 3 as the area of cropland has been sharply reduced in 2020 compared to 2018 and 2022. The reason for such an unusual weather was a positive Indian Ocean Dipole (IOD) following a shift in sea surface temperatures with higher values in the Western Indian Ocean and the opposite in the Eastern Indian Ocean. The warmer water at the western side of the Indian Ocean has then likely contributed to the strongly intensified rainfalls across the Horn of Africa (Russel 2020). Another explanation for the sharp reduction in tree cover from 2020 to 2022 is given by a possible increase in deforestation and poaching activities as a consequence of COVID-19 and an increase of economic pressure and financial losses that communities experienced, leading to individuals trying to collect resources such as firewood by themselves in protected areas (see Annex IV).

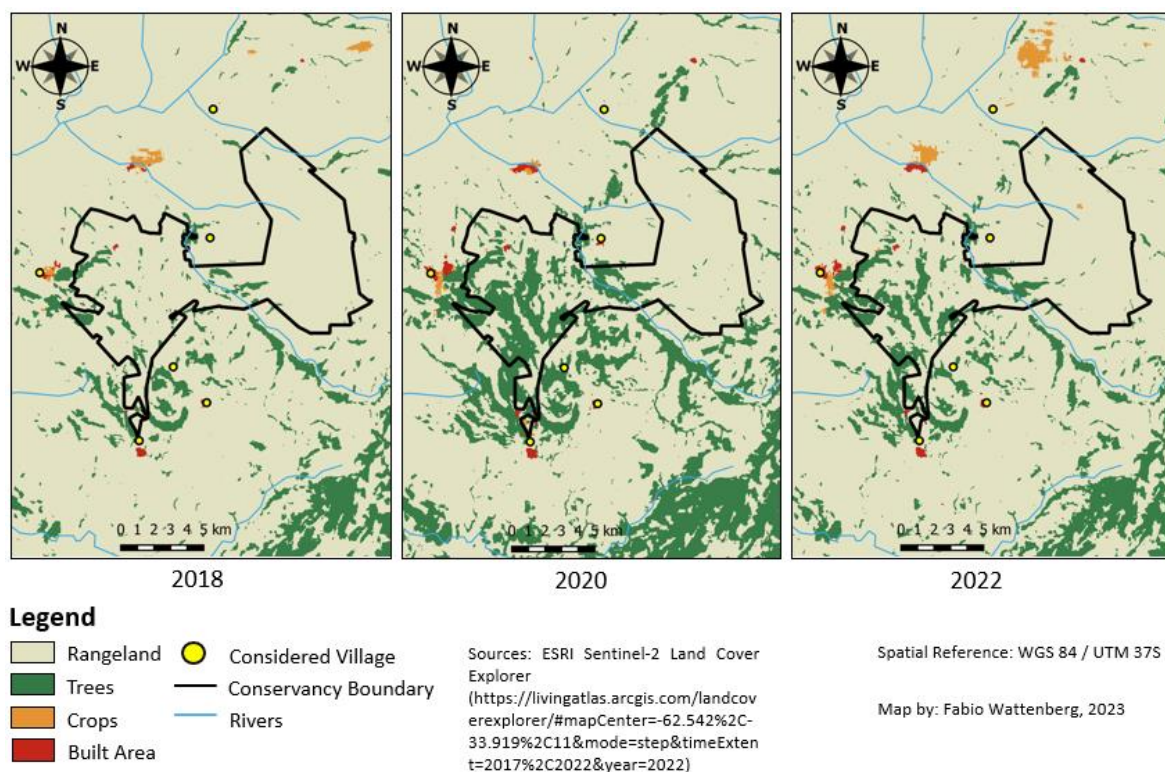


Figure 3: Land Cover Changes from 2018 to 2020 and 2022 around MSC

2.2 Mara Siana Conservancy

In the following chapters MSC is introduced in more detail comprising its foundation and structure as well as conducted conservation activities, resulting trade-offs, and societal aspects combined with infrastructural factors. Accordingly, it is essential to provide a comprehensive compendium of the conservancy system and the relationship between MSC and the involved landowners as a crucial foundation before introducing the research process. The main part of this chapter is based on the statements of the MSC manager, who was interviewed separately to obtain general information about the development of the conservancy within the context of the local Maasai communities (see Annex IV).

Figure 4 shows the area of MSC from a closer perspective including the locations of the conservancy office and the six villages that were visited for interviews to obtain CCAC data to be analyzed within this research. The conservancy stretches from the border to MMNR towards the North-East and is located in the midst of a popular elephant migratory corridor.

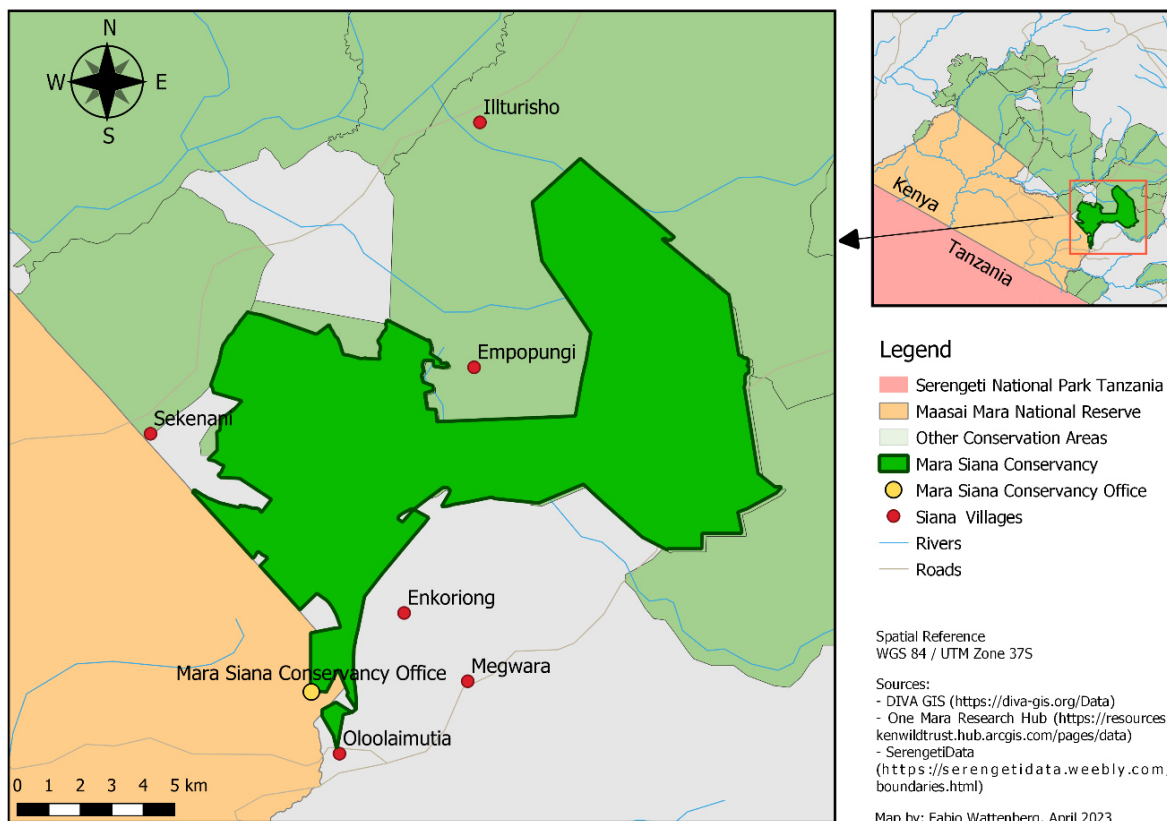


Figure 4: Map of the MSC including the Locations of the investigated Villages within this Research as well as the Conservancy Office

2.2.1 Foundation and Structure

The conservancy initially was established in 2009 with actively starting conservation activities in 2016 upon requests by the community with the aim to gain resources and financial benefits from conservation activities. In that regard, it was aimed to enhancing the tourism sector, increasing employment opportunities for local Maasai, providing the landowners with a steady income in form of a conservation lease, as well as using the conservancy area as a drying grazing zone. Thus, herders are enabled to get access to the grass especially in times of droughts when it becomes scarce (see Annex IV). With WWF

as co-initiator and funding agency of the project, the goal of securing additional habitats and migration corridors for wildlife, restoring ecosystems, and preventing poaching and illegal grazing as well as reducing HWCs was also proclaimed (WWF 2021). In the following, it was decided to demarcate the conservancy boundaries dedicating every legitimate landowner a fixed portion of 35 acres land outside the conservancy and 6.5 acres inside. The purpose of the land portions outside the conservancy was to provide a space for landowners and their families to settle down. (see Annex IV)

Generally, the conservation area in Mara Siana consists of land parcels owned by Maasai landowners that are leased by the conservancy. It is not mandatory to the people to lease their land for this purpose, however the wide majority of landowners cooperate and recognize the overall benefits of the conservancy activities. Accordingly, lease agreements between the landowners and the MSC board are signed and valid for a period of fifteen years. The board is firstly consisting of three representatives from Siana villages that are elected from a total of twelve representatives from all relevant villages with additionally four women that are integrated into the process due to gender representation purposes. The roles of the three elected representatives are including a chairman, a treasurer, and a secretary. These board members then approach the local tourism operators to find three of these willing to join the final MSC board.



Figure 5: Process of signing the Lease Agreement by Landowners and MSC Representatives in February 2023

Apart from the mentioned benefits that the Maasai landowners receive from the conservation activities there are also landowners who refuse to lease their land to the respective conditions as they are either not satisfied with the amount of payment as they are comparably wealthier than others or they rather see the opportunity to reach higher revenues when individually leasing the land to tourism operators. However, they are obliged

to follow the rules and regulations from MSC particularly as they are not allowed to impair the conservation activities through actions happening on their land. (see Annex IV)

2.2.2 Activities of the Conservancy

The main responsibility of the rangers working in the conservancy is to enforce law and order for people as well as for wildlife with the aim to reduce encroachment of people particularly herders with their livestock into wildlife areas and to minimize HWCs. Popular activities that are carried out involve the observation and monitoring of species inside the conservancy to track their movements and the controlling of trespassing of livestock especially through the wildlife corridors. However, ideally MSC staff is not supposed to remove livestock as a regular routine since the responsible landowners and herders should respect the lease agreement. As a reaction to these circumstances the conservancy management seeks for efficient and digital technologies to enhance the monitoring and observation activities to also reduce the own efforts inside the conservancy comprising vehicle movements and ranger patrols. Further important activities that are followed by the conservancy staff include the maintenance of visitor security and their safeguarding as well as awareness creation campaigns in communities and schools. In this regard, they are supposed to take up the role of conservation ambassadors towards the local people enhancing their understanding for MSC activities (see Annex IV). MSC management also increasingly hires female rangers who are equal to their male counterparts and perform the same duties. In this way, women who are generally considered weaker and more vulnerable than men are specifically promoted and enabled to increase the standard of living of their families through their own income which as well favors their reputation within the community (WWF 2022).



Figure 6: Illegal Cattle grazing within the Conservancy Area in February 2023

Before the conservancy was established the land was heavily degraded due to a high pressure on grass and ecosystem resources inside and around the conservancy including MMNR. This was especially relevant during dry season when the Maasai bring their livestock to graze in the area. After the conservation activities started a significant recovery of biomass and trees and formerly heavily degraded areas took place. Additionally, wetland ecosystems inside the conservancy did fully recover and increased in volume of water. In this regard, three main areas have been determined that function as water access points for livestock when grazing around or inside the conservancy. Since the wetland area inside the conservancy is recognized as a core area for wildlife it was aimed to minimize human and livestock movements distinctively (see Annex IV).

2.2.3 Trade-Offs related to Community-owned Conservancies

Conservation activities do not only focus on ecosystem and wildlife conservation but additionally aim at contributing to strengthening the coping capacity and risk mitigation factors for pastoral communities as lease payments target on buffering the fluctuating livestock income. To date, it has been observed that respective payments already led to both arising synergies as well as trade-offs depending on land use restrictions (Osano et al. 2013). Bedelian & Ogutu (2017) are giving a comprehensive overview about investigated trade-offs of conservancy interventions that are accompanied by both advantages and disadvantages especially for the local communities. On the one hand, conservation-based payments for land leases represent a steady and reliable income source for local people as well as the protection of grass areas that can be used as fodder banks providing local pastoralists with fodder in times of droughts with a lower availability of resources. On the other hand, land assigned to conservancy activities affects the accessibility of land and raise mobility restrictions for pastoralists reducing their ability to make use of seasonally available resources. Furthermore, the social and inclusive aspect of handing over lease payments to pastoralists is questionable as mainly male landowners are paid and women or other marginalized groups may not directly benefit (Bedelian & Ogutu 2017).

After subdividing and demarcating the land parcels in Mara Siana landowners started to fence their land blocking some of the avenues that different species used to access resources such as salt lakes, pasture, and water. This was because of their fear of land grabbing and the competition for grass between livestock and wild animals. As a negative repercussion, through such fencing activities HWCs were found to increase in the time after. Consequently, many incidents were reported where wild animals such as giraffes, zebras or impalas were entangled into the fences and elephants were pulling them down in order to access fodder resources.

One negative coping mechanism of Maasai herders during times of prolonged droughts is to bring their livestock into the conservancy to access grass and water resources although exceeding the areas and time periods of the provided grass banks, given by the conservancy. The overgrazing by the Maasai livestock then creates a high pressure on the ecosystem and leads to competition with wild animals that also rely on these resources. Another consequence of the increased livestock grazing on the ecosystem is that soil is exposed to the sun and becomes dry leading to increased run-off and a higher risk for flooding as the soils' capacity to hold water decreases. Moreover, HWCs have specifically increased due to the sharp growth of Maasai population in combination with the

establishment of several safari lodges in the area that occupy large spaces formerly belonging to wildlife habitat. Finally, in times of elevated poverty with higher unemployment and a lack of income, caused for example by the COVID-19 pandemic, it was discovered that poaching increased as people were aiming to access wild meat by using animal traps. These circumstances not only negatively affected the population of wildlife but also the security of people and rangers. (see Annex IV)

2.2.4 Societal Aspects and communal Infrastructure in Mara Siana

With the beginning of land demarcation and changes in land tenure as well as the establishment of MSC and other conservancies in the wider area the way of living has been changed drastically for the local Maasai population as they were transitioning from a nomadic and freely moving lifestyle towards a sedentary way of living with setting up homesteads and villages. This transition from traditional pastoralist communities (Kariuki et al. 2021) towards permanent settlements is linked with and induced by land fragmentation and privatization as well as population growth (Nkedianye et al. 2020).



Figure 7: The typical Structure of a so-called 'Boma', the traditional Maasai Residence, here reconstructed by Children using different Kinds of Stones (February 2023)

As the Maasai were traditionally nomadic people their houses are constructed by readily available materials and remain very impermanent in nature with either circular or loaf-shape designs built by the women. To protect their livestock from wild animals the men build a circular fence that envelopes their homesteads. Within the culturally patriarchal Maasai society particularly elder men are the decision-makers and determine most of the main matters for the community (Masai Mara.Travel n.d.). Major income source for the Maasai is

the selling and trading of livestock such as cattle, sheep, and goats for cash or other livestock products for instance milk. Further entrepreneurial and business activities carried out are including the production and selling of artwork and jewelry (Maimai n.d.). Also the tourism industry has become an essential pillar of the regional economy as Maasai communities are enabled to generate a variety of benefits. In that regard, it was found that tourism strengthened the preservation of Maasai culture, enabled the development of public infrastructure, and improved livelihoods by creating job and income opportunities (Rotich et al. 2019). Figure 7 shows the typical structure of a Maasai homestead replicated by children using stones, in this case, consisting of two houses and a few enclosures for the livestock in the middle and with a circular fence surrounding the whole construction.

The circumstance that infrastructure like road systems and facilities such as schools and hospitals were very limited and poorly developed when land demarcation and establishment of conservation areas started is related to the fact that these arid and semi-arid regions (ASAR) were highly neglected by governments even though they were hosting a large number of people. The shift of Maasai population from a nomadic to a sedentary lifestyle then triggered government efforts in developing infrastructure to serve people's needs such as public transport, medical treatments, and education. Accordingly, the first tarmacked road has been built connecting the village of Sekenani to the next bigger town of Narok in the North-East. While demarcating the land parcels in Mara Siana it has been decided that every village is dedicated a designated public land area meant to develop public utilities and infrastructure such as schools and hospitals. Except from this regulation are smaller settlements of a few homesteads as the village of Enkoring.



Figure 8: Figure 8: So-called 'Predator-proof Light' or 'Lion Light' utilized by a Landowner in the Village of Illturisho in March 2023

As the Maasai are still in a process of accustoming to the new sedentary lifestyle, water and sanitation habits and infrastructure are still poorly developed. A significant proportion of people does not use any latrines and practices open defecation which leads together with a lack of hygiene practices and water treatment to fecal infections and disease outbreaks. However, there are initiatives and awareness raising actions encouraging people to build and use latrines under the responsibility of the respective area chiefs. Additionally, there are other NGOs active that carry out education and awareness programs in villages and even issue medicines such as chlorine tabs to enable people purifying water by their own.

In terms of energy supply, the Maasai population in Mara Siana mostly relies on firewood as their main energy source for cooking and heating whereas many are provided with solar energy either in the form of a PV panel on the roof or with so-called 'predator prove lights' (see figure 8) that were giving out from MSC in cooperation with other NGOs and which help to keep predators away from livestock. Since the governmental elections in 2017, a basic connection to the national electricity grid has been established only to the urban centers in the wider Mara region but not to the smaller Maasai villages. Installing solar systems in Mara Siana is either carried out by a service provider who is installing the solar panels in exchange for a monthly payment or by MSC who supply people with subsidized solar panels or predator proof lights for which the ownership is handed over to the people. The former option is accompanied by the possible disconnection of energy supply if payments are not made (see Annex IV).

3) Conceptual Framework

In this chapter the general concepts and terminology on which the research is based on are examined in detail. Accordingly, it is aimed to define and distinguish interrelated and different terminologies in the context of climate change and its impacts. In the following, the term of 'climate change adaptation' (CCA) is firstly explained before a general definition and further elaboration of the concept of 'climate change adaptive capacity' (CCAC) is provided representing the most important part of this research. To enable an adequate understanding of CCAC it is moreover essential to shed light on the meaning and relevance of the concepts of 'resilience' and 'vulnerability' as well as the enabling tools of 'determinants' and 'indicators', which are the main component to a proper analysis and calculation of capacities.

Transcending the general terminology of 'adaptation' IPCC's Sixth Assessment Report uses the term exclusively in direct relation to climate change and its effects. In that regard, it is distinguished between adaptation of natural systems and human systems towards these effects. As this research particularly deals with CCAC of individual humans on a household level by collecting precise micro data, the latter concept is therefore further examined in the following. Accordingly, IPCC defines CCA as 'the process of adjustment to actual or expected climate and its effects in order to moderate harm or exploit beneficial opportunities' (IPCC (2023)). The idea of adaptation planning within social systems therefore involves the practice of repetitive risk management whereas adaptation is categorized into different constellations comprising 'anticipatory versus reactive', 'incremental versus transformational', and 'autonomous versus planned'. The process of adaptation facilitation

is thereby usually divided into the five phases of awareness, assessment, planning, implementation, and monitoring and evaluation (IPCC 2023).

Building on the adaptation definition already given, the term of adaptive capacity which will be continued in the following chapters mainly as CCAC explicitly refers to the ability of a system to perform appropriate processes for adaptation. Accordingly, ND-Gain defines CCAC as ‘the ability of society and its supporting sectors to adjust to reduce potential damage and to respond to the negative consequences of climate events’ (University of Notre Dame 2023). As previously mentioned, the scope as well as the scale of definition is also important for the overall understanding of the concept of CCAC as either social or ecological systems may be addressed whereas this research focuses on the determination of CCAC from a social perspective.

In general, the classification of the concept of CCAC is also of importance in the interplay with other terminologies in this field such as ‘resilience’ and ‘vulnerability’. Accordingly, the term of resilience is a commonly used entry point with a large spectrum of meanings and is defined by IPCC (2023, p.43) as ‘the capacity of social, economic and environmental systems to cope with a hazardous event or trend or disturbance, responding or reorganizing in ways that maintain their essential function, identity and structure while also maintaining the capacity for adaptation, learning and transformation’. An alternative and commonly cited definition of resilience is also provided by Béné et al. (2012) particularly mentioning the ability to respond to shocks at different scales and under consideration of absorptive, adaptive, and transformative capacities. Accordingly, while the component of transformative capacity presents the occurrence of transformational responses by the creation of fundamentally new systems through the increasing extent of change across the three different components the term of ‘absorptive capacity’ is defined by Cutter et al. (2008, p.663) as ‘the ability of the community to absorb event impacts using predetermined coping responses’. Moreover, it is emphasized that resilience is not only generated through these individual pillars but also emerges from the interactions between them which results in the fact that corresponding overlaps exist that are additionally shown in the conceptual framework of this research in figure 9 (Béné et al. 2012). Further overlaps of resilience are also recognized by IPCC (2023) that additionally points out the aspect of ‘vulnerability’. Contrary to resilience, vulnerability is considered as a component of risk which is defined as a ‘predisposition to be adversely affected’ (IPCC 2023, p.43) and which comprises elements of susceptibility and the lack of capacity to adapt and to cope. Mechanisms to analyze vulnerability include top-down approaches incorporating the exposure to climate hazards as well as bottom-up approaches considering social and contextual determinants. In the common understanding, aspects of vulnerability change over time and differ within and between communities while ‘exposure’ in a social context refers to the presence of people, livelihoods, economic, or social assets in locations potentially affected (IPCC 2023).

Figure 9 shows the emerging conceptual framework comprising the previously introduced characteristics of resilience with its three different significant components of absorptive, adaptive, and transformative capacity. Accordingly, through strengthening those capacities individually or simultaneously the resilience of communities can be enhanced. In addition to the common understanding of this resilience approach, absorptive capacity is shown as strongly linked to the aspect of ‘coping capacity’ which is among others used by

WeltRisikoBericht (2023) to explain the similar principle of communities' ability to deal with societal shocks including political and economic instability and resources insecurity. In the respective WeltRisikoBericht (2023) that is annually published by the German non-profit registered association 'Bündnis Entwicklung Hilft', the authors present their calculation method for determining the overall country risk which comprises the exposition of people towards natural disasters as well as their vulnerability. In that regard, the vulnerability is composed of the lack of coping capacity, the lack of adaptive capacity, and the susceptibility of the investigated social system (WeltRisikoBericht 2023). Figure 9 therefore conclusively shows that a correspondingly low adaptive capacity, just like coping capacity, increases people's overall vulnerability, which at the same time implies a low resilience level. Differently to the definition of 'adaptive capacity' by the IPCC (2023) who directly relate the term to climate change, WeltRisikoBericht (2023) defines 'adaptive capacity' as reflected through long-term processes that achieve anticipatory changes in social structures and systems. Thereby, adaptive capacity is perceived on a more general level as they eventually refer to the calculation of disaster risk, although within this understanding a certain interrelation with climate change and its effects is given (WeltRisikoBericht 2023). Consequently, both perspectives as well as the overall understanding of the resilience concept with its three components together form the final conceptual framework of this research.

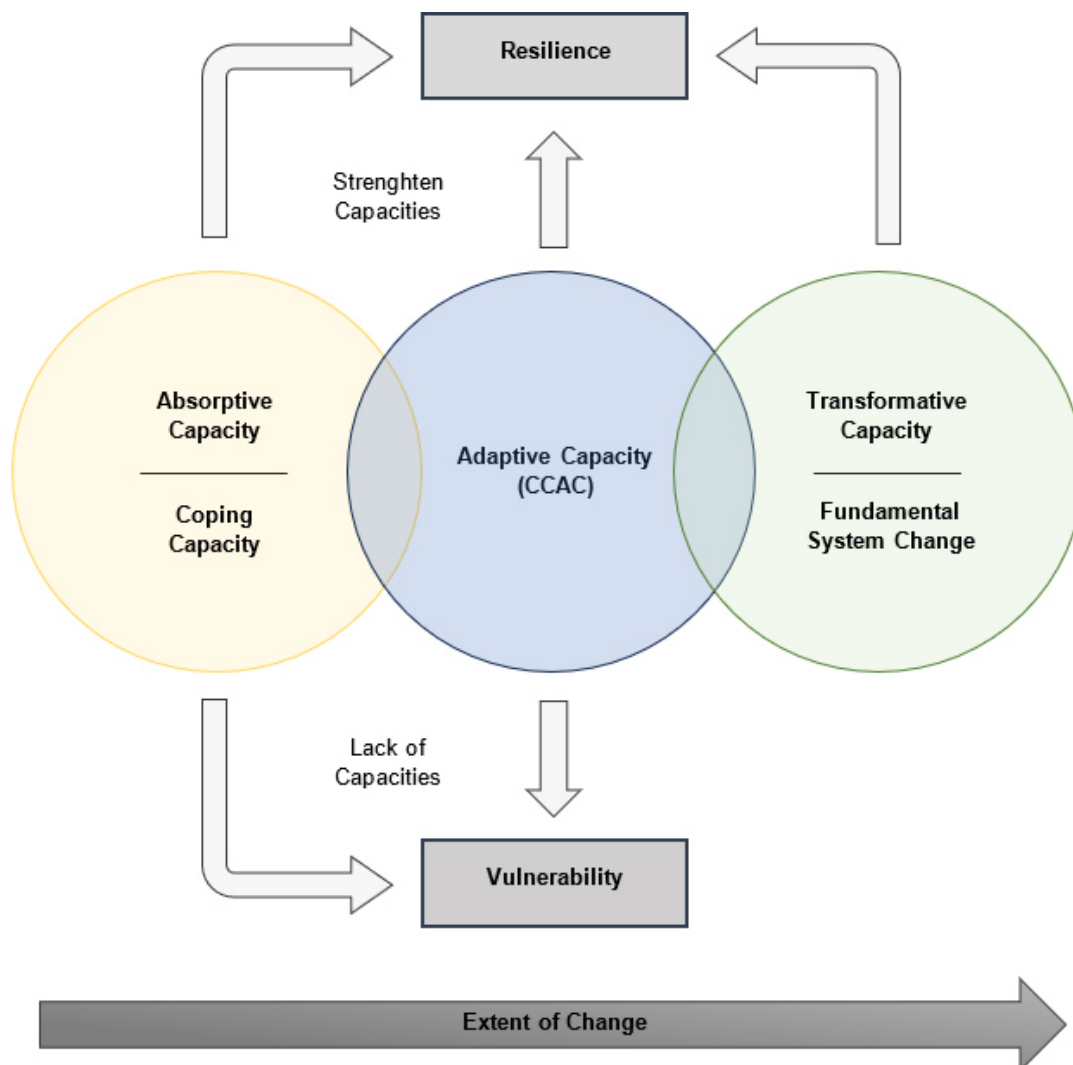


Figure 9: Conceptual Framework (in accordance with Béné et al. (2012) and WRB (2023))

As the structure of the conceptual framework is partly adapted by Béné et al. (2012), beside absorptive and adaptive capacity the third component of transformative capacity is additionally integrated; however, within this work aspects of especially transformative capacity are not further considered. Nevertheless, through comprehensively analyzing the component of CCAC certain similarities and overlaps to the dimension of absorptive capacity and respectively emerging coping mechanisms of households appear throughout this work. Furthermore, the common term of 'maladaptation' which directly refers to unintended negative outcomes of certain adaptation practices comprising inappropriate counter measures to climate change impacts leading to lock-in effects of vulnerability (WeltRisikoBericht 2023) is not particularly considered within this research. Accordingly, current adaptation measures taken by households are not assessed in according to their effectiveness, but instead existing CCAC aspects are examined and analyzed.

Based on the introduced conceptual framework and the respective terminology, this research focuses specifically on the determination of CCAC within a social system and thus identifies adaptation weaknesses that negatively impact households' vulnerability and adaptation strengths that contribute to enhanced resilience. To properly carry out the CCAC analysis the categorization of CCAC into different determinants and the assignment of respective indicators to each of the determinants are of essential significance as they allow for a structured and comprehensive semi-quantitative assessment. In that regard, for the term of 'determinant' that describes the five utilized superordinate topic categories to which respective CCAC indicators are assigned within this work, different definitions and terms of use are identified in research dealing with CCA. Accordingly, whereas Siders (2019) considers all CCA relevant aspects as determinants, for example Abdul-Razak & Kruse (2017) and Williges et al. (2017) rather perceive those as direct indicators and sort them to respective overarching topic categories. The ladder approach has been adopted for this research comprising the determinants of socio-cultural capacity, natural resources capacity, economic capacity, infrastructural and technological capacity, and institutional capacity.

4) State of the Art

4.1 Climate Change in the Region

Generally, there are different naturally occurring weather events and disasters that are characterizing the wider continental region of East Africa. The Kenya National Adaptation Plan 2015-2030 (2016) specifically identified droughts as the prime natural disaster in Kenya that causes not only severe losses in crop production and livestock but additionally impacts water availability eventually leading to famine and increased population displacement. Another main vulnerability that the Ministry of Environment and Natural Resources points out is excessive flooding that particularly refers to riverine floods occurring three to four times a year and which lead to flood-related fatalities, an increase in water and sanitation-related diseases, as well as the damage of critical infrastructure (Government of Kenya 2016). Generally, symptoms of climate change in the wider region of the Maasai Mara ecosystem stretching from Kenya to Tanzania have already been identified and investigated through various research. A major effect of climate change that has been reported are rising temperatures which are mentioned in several studies (Nnko et al. 2021; Ogutu et al. 2008; Ogutu et al. 2011; Simotwo et al. 2018).

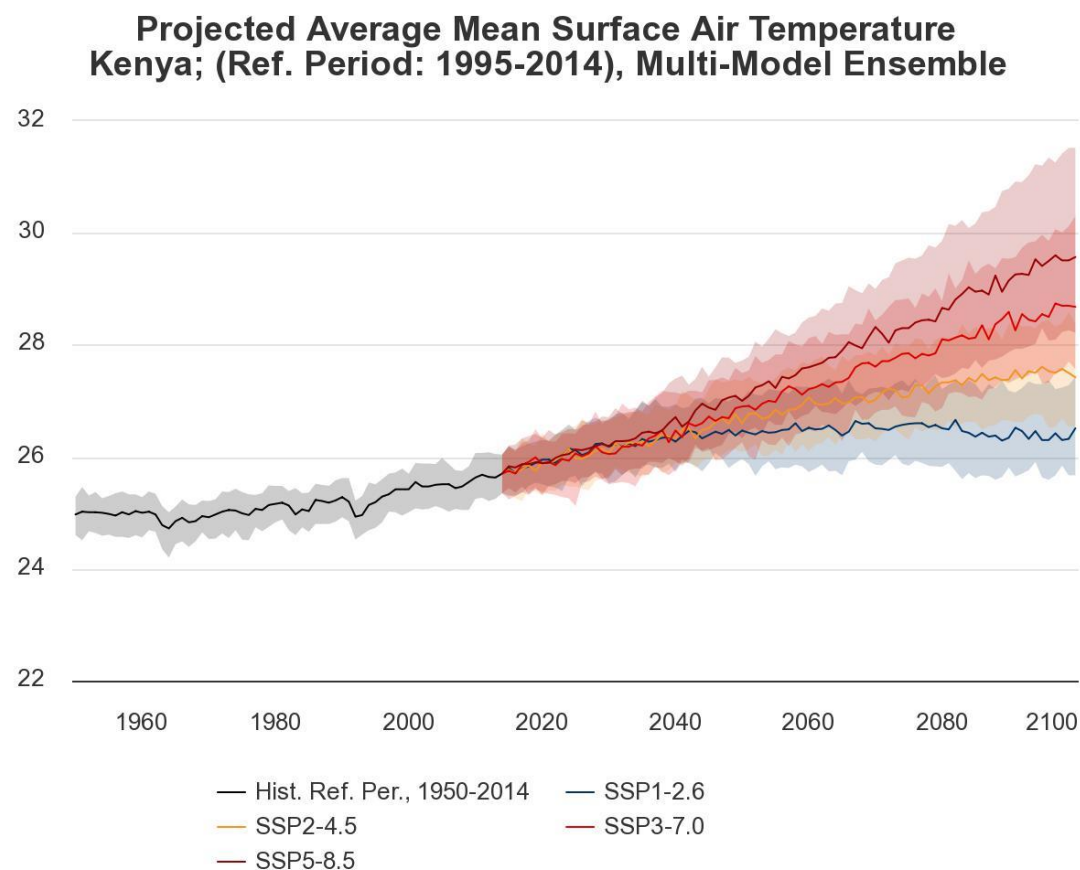


Figure 10: Projected Average Mean Surface Air Temperature for Kenya (Source: CMIPs6)

Also, Nnko et al. (2020) who particularly dealt with adaptation capacities of investigated households in the Maasai steppe in Tanzania reported increasing temperature, insufficient rainfall, and spatial-temporal variations as major symptoms of climate change. Resulting consequences for local communities were identified as a reduction in livestock productivity, perishing of livestock and social conflicts among the pastoralists. The authors attributed the investigated trekking of livestock and the receiving of livestock-based donations from relatives to commonly used strategies to cope with adverse drought impacts (Nnko et al. 2021).

Investigating climate changes over a long period from 1965 to 2015 in the particular region of Maasai Mara, Bartzke et al. (2018) focused specifically on rainfall variations and their impacts on biodiversity and animal population dynamics. While arguing that the Mara region is characterized by persistent inter-annual cycles and seasonally stable rainfall oscillations the researchers detected an increase in the frequency of severe droughts and the intensity of floodings. However, as with regards to the intensification of droughts contrary results for the nearby area of Narok Town were observed for the same period coinciding with the periodicity in rainfall oscillations, it was concluded that regional rainfall variability is strongly influenced by atmospheric and oceanic circulation patterns. Through the identified substantial variation in rainfall patterns on a spatial and temporal scale within the Maasai Mara ecosystem differing from predicted regional and continental patterns, Bartzke et al. (2018) moreover critically question IPCC's large-scale predictions for rainfall increases across East Africa.

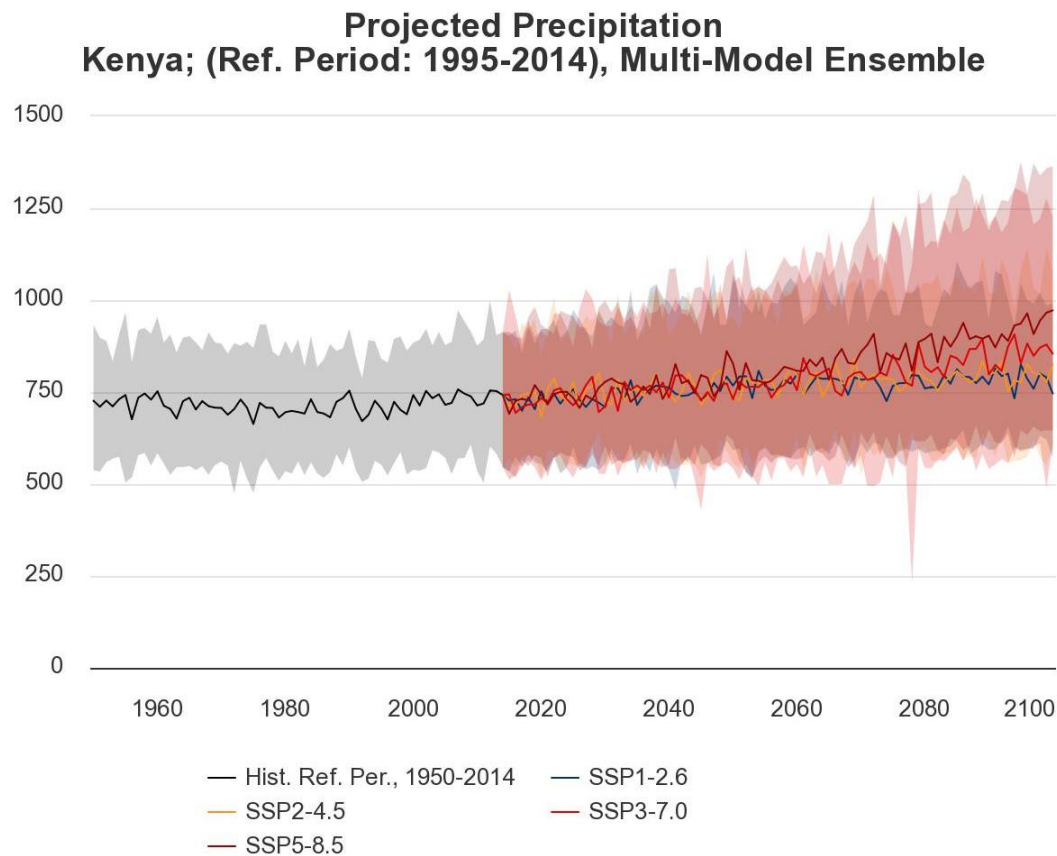


Figure 11: Projected Precipitation for Kenya (Source: CMIPs6)

However, the multi-model ensembles of projected precipitation and mean surface air temperature in Kenya in figures 10 and 11 support the previously introduced state of various research indicating intensified droughts and heavier rainfall extremes by presenting an overall increase in temperature as well as precipitation until the end of the century across different scenarios. The respective data is retrieved from the World Bank's Climate Change Knowledge Portal and is based on the Sixth phase of the Coupled Model Inter-comparison Projects (CMIPs) which also provides as a foundation for IPCC's Sixth Assessment Report. Accordingly, a highly variable precipitation with an expected increase in average rainfall can be expected by mid-century while extreme rainfalls likely increase in frequency, intensity, and duration; however, with projected extended periods between heavy rainfall events (Climate Change Knowledge Portal n.d.). From Kenya's Common Programme Framework for Ending Drought Emergencies, expected rainfall changes coupled with severe droughts are estimated to additionally increase existing vulnerabilities across economic and natural sectors such as agriculture, livestock, and water management likely leading to increased conflicts about limited water resources in arid and semi-arid areas (Republic of Kenya 2014).

Intensified droughts and increasing rainfall extremes may also induce conditions that support animal disease outbreaks and reduced vegetation quality for herbivores potentially impacting their migration patterns (Bartzke et al. 2018). Further research identified a potential impairment of crop productivity and livestock performance, moreover guided by food security decrease and a decline in income stability of communities (Simotwo et al. 2018).

Another relevant aspect is the anthropogenic transformation from forest lands with higher vegetation towards grasslands and agriculture which is impacting water flows and availability and that is expected to exacerbate water scarcity and erosion when being accompanied by critical climate variations. Accordingly, the response of runoff simulations for respective water basins towards climate change scenarios already indicated a high vulnerability to rainfall extremes with very intense and very low rainfall amounts. Mango et al. (2011) therefore support the undertaken efforts in water resources management and recommend to implement comprehensive CCA measures through which land use practices as well as aquifer infiltration and recharge can be improved.

Moreover, a factor that certainly contributes to the emerging weather and climate changes in the region is the El Niño effect. This phenomenon is characterized by an irregular and recurring climate pattern that features the warming of surface waters in the eastern Pacific Ocean impacting weather from Australia to South America and beyond (National Geographic Society 2023). In that regard, Ogutu et al. (2020) are claiming that droughts in the Mara-Serengeti ecosystem triggered by El Niño leading subsequently to habitat drying and arising food shortage. The El Niño effect is also known as one significant component of the so called El Niño Southern Oscillation (ENSO) while many scientists use both terms interchangeably (Ogutu et al. 2008). Accordingly, El Niño and the Southern Oscillation are determined by climatologists to occur simultaneously while the latter refers to an air pressure change over the tropical Pacific Ocean (National Geographic Society 2023). As it has been observed for the period of the 1990s and 2000s strong ENSO episodes may exacerbate extreme weather events such as intensifying droughts when they appear simultaneously to rising temperatures and rainfall decline. Consequences may comprise a reduction of vegetation production as well as habitat drying (Ogutu et al. 2008).

Also in Mara Siana decisive weather and climate changes as well as resulting consequences for the environment have already been perceived. Within recent years persistent and prolonged droughts were recognized in a frame of overall changing weather patterns enhancing the occurrence of extreme weather events including heavy rainfalls and subsequent floodings. Consequences of drought periods are comprising increased death rates of wild animals such as buffalos, giraffes, and elephants, but also cattle that are dying from more widely spread diseases as well as an increase in still births especially among elephants and buffalos. Another aspect of the changing climate is the spill over of cyclones from Tanzania to Mara causing an increase in floodings. Indirect consequences of the changing weather patterns are predominantly including an increase in HWCs for example due to a higher number of wild animals particularly elephants posing a threat as they enter human settlements when searching for water. Additionally, predators such as lions are pushed out of the national reserve into the surrounding conservancy areas when grass has grown too high so that hunting becomes more difficult (see Annex IV).

4.2 Climate Change Adaptation in the Region

In this section recent adaptation approaches of social systems and communities towards the already identified climate change impacts within the Mara region as well as the state of respective policy implementation at a national scale are presented. Accordingly, research has already been conducted dealing with CCA from various perspectives.

While investigating climate change, variability, and the adaptation of pastoralist communities in the Maasai Steppe in Tanzania researchers identified experience about climate change as of great potential to initiate fast risk mitigation actions to counterbalance climate change impacts. Accordingly, education as well as encouragement of social and financial livelihood assets by providing information access to communities was found to have a significant influence on CCA (Nnko et al. 2021). Also, Aryal et al. (2021) who dealt with climate risks and adaptation strategies of farmers across East Africa support this hypothesis as they argue that inadequate governance and institutions as well as the existence of significant differences between male and female headed households constrain CCAC and impact the choice of respective adaptation strategies. Simotwo et al. (2018) who dealt with CCAC in Trans-Mara East sub-County also indirectly underpin this argumentation and highlight the meaning of climate change knowledge as they identified an only vague channel through which communities and smallholders can access climate change relevant information, which in according to the authors would even intensify externalities including land use transformations, environmental degradation, and social conflict. They particularly found that adaptation capacities of local farmers and smallholders were mainly constrained through actual governmental policies and their respective implementation, additionally exacerbated through low education levels and livelihoods (Simotwo et al. 2018). For pastoral communities in the wider Maasai land, it was furthermore investigated that distinct disparities exist between rich and poor households as well as between male and female headed households in terms of livestock wealth. Those differences combined with a growing restriction in livestock mobility, land fragmentation, and other factors likely reduce communities' resilience to climate variability and intensified droughts indicating a respectively lower CCA (Nkedianye et al. 2019).

Research that is dealing with the potential of ecosystem-based adaptation in the wider Maasai area with an increasing frequency and intensity of droughts also analyzed the contribution of community-owned conservancies especially to risk management strategies with additionally calculating CCA potential of the respective pastoral communities. Similar to the approach of MSC and the payments of conservancy leases to landowners, Osano et al. (2013) analyzed the impacts of applied payments for ecosystem services dedicated to farm households. Results from this research revealed that those payments do firstly provide a critical financial buffer for pastoralist families with fluctuating livestock income supporting them to cope with drought-related liquidity constraints. However, both synergies as well as trade-offs related to land use restrictions were found to be created by this approach (Osano et al. 2013). As the economic sector of tourism is playing an increasingly important part for income generation within the Mara region, Rotich et al. (2019) investigated the impact of climate change on natural resources and respectively tourism sustainability. They concluded that the tourism product which is mainly based on wildlife and nature should be more diversified given climate change threats on natural systems towards more non-nature-based tourism products involving national heritage and culture.

At a higher level, the ND-Gain Index which calculates a country's general vulnerability to climate change and other global challenges including the readiness to increase resilience ranks Kenya 150 out of a total of 185 investigated countries indicating a relatively high vulnerability in global comparison. The component of adaptive capacity which is as well

determined by ND-Gain ranks Kenya similarly low with place 133 out of 176 (University of Notre Dame 2023).

As a response to their vulnerability Kenya submitted an updated NDC to UNFCCC (in 2020) with increased support in adaptation and mitigation efforts as well as disaster preparedness and resilience to climate change while the country strives to become newly industrialized by 2030. Generally, Kenya's Ministry of Environment and Natural resources concentrate national adaptation efforts in the critical sectors of infrastructure, energy, land use and environment, agriculture, health, water and irrigation, and tourism. In their NDC the country of Kenya presents adaptation particularly as 'highest priority' for preventing losses and damage as well as for safeguarding lives, livelihoods, and further social development, as it is also the main focus of CCAC analysis of this work. Within the NDC update from 2020 Kenya additionally takes up the previously introduced suggestions of different researchers and commits itself to embed CCA in policy frameworks through mainstreaming Medium-Term Plans (MTPs) as well as County Integrated Development Plans (CIDPs) with the aim of achieving a climate resilient society towards 2030. Accordingly, the country presents its comprehensive adaptation ambitions including strengthening CCAC and climate resilience throughout the economy on both national as well as county governmental level, enhancing livelihood strategies and resilience of local communities, and improving information channels and uptake of information by targeted population and especially vulnerable groups (Republic of Kenya 2020). The Kenyan government furthermore aims to improve efficiencies in water use and strives to contribute to the restoration of critical regenerative ecological and physical functions of respective water bodies (Republic of Kenya 2014) as an improved water management is expected to provide a range of benefits for the various economic sectors and particularly agriculture while safeguarding food security and water access (Republic of Kenya 2015).

Through the National Environment Authority as a National Implementing Entity for the Adaptation Fund accredited by UNFCCC's Green Climate Fund, Kenya is enabled to access climate financing with the aim to support not only mitigation and resilience pathways but especially CCA efforts (USAID 2018).

4.3 Determination of Climate Change Adaptive Capacity

In the following chapter, popular concepts and methods that were already used in the literature to analyze and assess especially CCAC are briefly presented.

In her synthesis study about concepts, methods, and findings of CCAC, Siders (2019) argues that the field of CCAC in general is strongly interdisciplinary covering a wide range of sectors, geographic locations, and methods of analysis and therefore remains highly fragmented. Through her systemic review of CCAC relevant literature several different indicator-based indices as well as frameworks and outcome measures utilized to determine CCAC were identified. In according to the author, the lack of consensus about a common CCAC framework may constrain the ability of respective research to inform adaptation practice. The question forwarded by Siders (2019) asking whether CCAC is truly scale- and context dependent refers to several researchers individually designing CCAC frameworks in according to their specific study case and location (Siders 2019).

Several different approaches are carried out by researchers to determine CCAC. Accordingly, popular strategies involve the 'Five Capital Model', the 'Adaptive Capacity Wheel' (ACW), and the 'Sustainable Livelihood Framework' among others which are introduced in the following sequence. The concrete derivation of respective indicators however is not comprehensively presented as it is part of chapter 4.4 that precisely depicts the construction of the indicator set applied in this work.

Within the literature ACW is usually applied for assessing AC of institutions and not households however integrated indicators such as trust, access to information, responsiveness, and financial resources may also be applicable on a micro scale and household level (Bergsma et al. 2012). Leon-Camacho et al. (2014) who dealt with the evaluation of CCAC when using decentralized renewable energy also address different methodologies to properly adopt the ACW while adding a further dimension to their final wheel comprising access to basic services. Within the initial study of the ACW which is described by Gupta et al. (2010), the researchers deal with the question how characteristics of especially institutions to stimulate society's capacity to adapt to climate change can be assessed on a local and national level (Gupta et al. 2010). The final wheel contains six dimensions integrating a total of 22 criteria.

The original meaning of the so-called 'Five Capitals Model' was to provide a tool that enables the analysis and understanding of sustainability within the economic concept of wealth creation. Accordingly, the concept was firstly published in Jonathan Porritt's book 'Capitalism As If The World Matters'. It was intended to be used by organizations in order for them to get insights into how sustainability looks like in their own operations, products, and services comprising manufactured, social, human, natural, and financial capital (Porritt 2005). In recent literature the 'Five Capital Method' was also projected to be applied in terms of general adaptive capacity analysis (Brown et al. 2016; Thathsarani & Gunaratne 2018; Choden et al. 2020) for rural communities (Ellis 2000). Respective CCA research that is using the mentioned concepts also labelled 'manufactured capital' as 'physical capital' comprising for example infrastructure, machinery, shelter, and further assets (Habib et al. 2023). There are various approaches followed by researchers to determine CCAC and which are partly inspired by the 'Five Capital Model' meaning that for example one or more of the different capitals are investigated in more detail and respective indicators are defined individually. Brown et al. (2016) used the 'Five Capital Method' as foundation for their CCAC assessment including the identification of CCA constraints and opportunities with an additional component of self-definition of different indicators through workshops with farmers. Pike et al. (2022) assembled indicators by means of the common list provided by Sider (2019) and established their framework following the 'Five Capital Method'. In that regard, indicators were thematically categorized in different topics including a total of 23 indicators (Pike et al. 2022). D'agata et al. (2020) particularly concentrated their research in small-scale fishing communities in Kenya on multiscale determinants of social adaptive capacity including 'assets', 'learning', and 'social organization'. In according to the authors their research revealed specific mechanisms that stimulate conservation and development activities to eventually increase social adaptive capacity in the respective communities including market access and education, mitigation of climate exposure, and improved conservation efforts (D'agata et al. 2020). Omemo et al. (2017) determined CCAC in the Lake Victoria Basin in Kenya especially on the household's level arguing that capacity

characteristics mainly depend on the household head's potential to cope with climate change induced impacts effectively. Within their CCAC analysis the researchers focused on the determinants of 'knowledge', 'attitude', and 'practices' for which the obtained results were eventually interpreted concluding that CCAC was positively influenced by the performance of the household head (Omemo et al. 2017). Also Chepkoech et al. (2020) who dealt with CCAC analysis of smallholder farmers in different agro-climatic zones in Kenya applied the 'Five Capital Model' by using the sustainable livelihood framework. Accordingly, the obtained disparities in CCAC scores between the respondents comprising age, marital status, gender and location concluding that resilience interventions should specifically target those individuals with low CCAC (Chepkoech et al. 2020).

Other CCA research (Nelson et al. 2010; Williges et al. 2017) for example deals with the determination of CCAC in accordance with the principle of livelihood diversification that was introduced by Ellis (2000) and which comprises the factors of seasonality, labor markets, credit markets, risk, asset strategies, and coping strategies (Ellis 2000). Still other studies (Wu et al. 2023; Choden et al. 2020; Li et al. 2017) refer their determination of CCAC to the 'Sustainable Livelihoods Framework' that was introduced by Scoones (1998) and through which livelihoods can be analyzed in different contexts by investigating the access of communities to a variety of livelihood resources combined with adapted livelihood strategies influenced by institutional factors (Scoones 1998).

4.4 Identification of Climate Change Adaptive Capacity Indicators

After the current state of research regarding different techniques and methods of determining CCAC has been provided previously, this chapter deals with the identification of relevant CCAC indicators assembled by means of a separate and comprehensive literature review. This initially conducted literature review respectively presents the crucial foundation of this research and has been conducted through the scientific database 'ScienceDirect' in first place. Here, different search strings were utilized to gather any relevant research generally dealing with the assessment of people's adaptive capacity towards climate change. By doing so, it was specifically aimed to retrieve several perspectives and aspects of how CCAC can adequately and comprehensively be analyzed. Keywords that were used during multiple searches comprise the main words of 'Climate Change' and 'Adaptive Capacity' plus the selected additional words 'Indicator', '(Assess)ment', 'Characteristics', 'Criteria', 'Evaluation', and 'Analysis' that were individually combined. After proving and removing of duplications and inappropriate articles a final number of 59 results has been obtained. These relevant research articles were analyzed and respectively contributing aspects serving as input for the definition of the CCAC indicator set were identified. The methodological approach of the research including the respective research questions is additionally shown in figure 13 on page 28.

Within the process of identifying those essential indicators from the investigated literature five main determinants could be defined comprising 17 indicators in total. These main determinants are named as 'socio-cultural capacity', 'natural resources capacity', 'economic capacity', 'infrastructural and technological capacity' as well as 'institutional capacity'. The derivation of respective indicators for the different determinants from literature is presented in the following sequence separately for each of the determinants. An overview of the indicator set is additionally provided in figure 12 on page 27.

4.4.1 Socio-Cultural Capacity

The determinant of socio-cultural capacity is the most comprehensive one of this research comprising five indicators with a total of nine questions. The first indicator is defined as 'family and relatives environment' and particularly refers to the size of household as well as the age of the household head and the other members as being part of previous studies (Chepkoech et al. 2020; Li et al. 2017). This indicator is the only one of the whole set that is not quantitatively considered within the CCAC assessment meaning there are no defined codes determining the level of adaptive capacity resulting from the size and age of household. This circumstance is due to uncertainties in the way that there is no clarity to what extent a higher or lower age or number of children may affect the households CCAC. However, the obtained results to the respective questions will be recognized both qualitatively and as part of the final discussion aiming to identify appropriate measures. A further aspect that has been introduced to CCA analysis by Park et al. (2012) is about the participation of women and girls in decision-making processes. Thus, to what extent female household members are generally involved into decision-making is being investigated through the indicator of 'gender integration and participation'. The most significant indicator of the socio-cultural capacity dimension is represented as 'social network and community' and includes three questions that are dealing with different aspects. Firstly, it is investigated whether the interview participant is active in any kind of network which includes the participation and membership in cooperatives or associations with other farmers (Brown et al. 2016; Chepkoech et al. 2020; Choden et al. 2020; Freduah et al. 2019) as well as religion-based organizations (Abdul-Razak & Kruse 2017), and self-help groups (Panda et al. 2013). Moreover, the role that is taken by the interviewee inside the respective group and the participation in management decision as thematized by D'agata et al. (2020) and Matewos (2020) is part of the question. Secondly, the access to support services from NGOs and other networks before, during, and after crisis and disasters (Nhuan et al. 2016; Ofoegbu et al. 2016) is assessed. The third question of this indicator is referring to the interviewee's perception of the social bond inside their community and between its members (Williges et al. 2017; D'agata et al. 2020; Flórez Bossio et al. 2021) as well as the level of trust received and dedicated to others (Bergsma et al. 2012; Dressel et al. 2020). Because also the willingness and motivation to personally adapt to general changes is crucial in the field of CCAC (Lohmann 2016; Matewos 2020; Wongbusarakum et al. 2021), this aspect is as well represented within the indicator set and titled as 'attitude and social attributes'. It is therefore the aim to determine the very personal attitude of every individual towards changes and new developments possibly indicating about their success in adapting to changing climate conditions. The last indicator that is related to the first determinant is about 'skills and knowledge' and consists of three different questions to be asked. Firstly, the education level of the interviewee and the other household members is identified (Hogarth & Wójcik 2016; Li et al. 2017; Dafieta & Rapera 2014). In a next step the knowledge about and perception of local climate and weather changes is to be analyzed (Kuhl et al. 2020; Quiroga et al. 2015; van Gameren & Zaccai 2015). Thus, the awareness of the interviewee about the topic can be determined more concretely. Finally, it is of significant interest to whom the interviewee attributes the responsibility for solving climate change and adaptation issues (Omemo et al. 2017). Accordingly, within the interview there are four key stakeholders given that the participant can associate as responsible namely the government, NGOs, other organizations, and individuals. As all of them are crucial

stakeholders in that context it is analyzed whether the participant is able to grasp the scope of the climate change issue and involve several of them.

4.4.2 Natural Resources Capacity

The first indicator of the determinant of natural resources capacity refers to 'livestock and agriculture' and consists of two different questions. One is asking whether agriculture, or livestock keeping, or both is being practiced. Based on this result, the diversity of agricultural crops that are planted (Martin & Magne 2015; Omemo et al. 2017) as well as the diversification of livestock animals (Omemo et al. 2017; Williges et al. 2017) is analyzed. The second question is dealing with livestock and the appearance of pests and diseases, as investigated by Brown et al. (2016), and aims to figure out whether the livestock animals of the interviewees have been affected in the past already, and if so, to what extent the landowners were able to cope with the situation. The next indicator is about 'Land Usability' and incorporates aspects such as land productivity (Brown et al. 2016; Williges et al. 2017) and soil health (Brown et al. 2016). Accordingly, it is basically asked whether the interviewee is of the opinion that their land is providing a good quality either for agriculture or livestock keeping. The last indicator of the determinant is dealing with 'water resources' and mainly focuses on the quality of water (Park et al. 2012) that is being accessed by the interviewee. Sub-questions are not only addressing the perceived quality of drinking water but particularly whether the landowner's household members have been affected by diseases already that can be attributed to the respective water source and how reliable the water supply generally is.

4.4.3 Economic Capacity

The determinant of economic capacity comprises four different indicators. 'Income' as the first one focuses on the diversification of income (Brown et al. 2016; Mazhar et al. 2021; Nelson et al. 2010) and is asking the participant to name their respective sources to generate money including remittances from relatives (Park et al. 2012; Dafieta & Rapera 2014) as well as subsidies (Dafieta & Rapera 2014; van Gameren & Zaccai 2015) or further financial assistance (van Gameren & Zaccai 2015; Abdul-Razak & Kruse 2017) that can be received. Additionally, it is of interest whether these income sources rely on climate sensitive resources (Chepkoech et al. 2020). 'Costs' as the second indicator aims to determine the ability of the participant to cover their regular costs (Brown et al. 2016; Williams et al. 2019) related to possibly experienced financial losses through weather events and damages (Panda et al. 2013) as well as the opportunity to access external credit (Chepkoech et al. 2020; Dafieta & Rapera 2014) to buffer the damage. Another indicator of economic capacity is named as 'assets' and focuses on the participant's possessions such as machinery and tools (Chepkoech et al. 2020, Dafieta & Rapera 2014), for example for agricultural or livestock purposes, livestock animals (Dafieta & Rapera 2014; Pike et al. 2022), household savings (Williamson et al. 2012) and other livelihood assets (Matewos 2020; Nhuan et al. 2016; D'agata et al. 2020) to be identified and which embody an economic value that provides security in times of financial constraints. 'Insurance' represents the final indicator of this determinant and aims to identify whether the interviewee is possessing different kinds of insurances. Accordingly, it is asked about possible insurances for climate related damage (Hogarth & Wójcik 2016), agriculture including livestock and crops (Panda et al. 2013; Williges et al. 2017), health and social issues (Nhuan et al. 2016), as well as assets and furniture (Nhuan et al. 2016).

4.4.4 Infrastructural and Technological Capacity

The determinant of infrastructural and technological capacity consists of the three indicators 'connection', 'housing and living environment', and 'access to public housing services'. 'Connection' as the first one refers to the interviewee's accessibility to the road system (Angell & Stokke 2014; Clarvis & Allan 2014; Ofoegbu et al. 2016), markets (Brown et al. 2016; Hogarth & Wójcik 2016; Williamson et al. 2012), healthcare facilities (Choden et al. 2020, Nhuan et al. 2016), and education facilities (Park et al. 2012) as well as the respective resilience and preparedness towards extreme weather events and natural disasters (Hogarth & Wójcik 2016; Park et al. 2012) that these infrastructural systems embody. By analyzing the indicator of 'housing and living environment' it is the aim to firstly determine the quality of the interviewee's house and the utilized materials (Li et al. 2017) and furthermore investigating whether it is capable of resisting to extreme weather events (Hogarth & Wójcik 2016; Angell & Stokke 2014) particularly heavy rainfalls. Additionally, it is to be asked whether the interviewee even considered adaptation aspects already when building the house or components of it. The indicator of 'access to public housing services' is comprising the three aspects of 'sanitation and sewage', 'communication network', and 'energy system'. Accordingly, it firstly is of interest whether the interviewee is provided with a reliable sanitation or sewage system with particular interest towards the availability of latrines as well as possibly a drainage system to drain wastewater out of the property (Angell & Stokke 2014; Flórez Bossio et al. 2021). Analyzing the communication network is comprising the access to telephone network, mobile system, and internet at the place in which the interviewee is living (Brown et al. 2016; Park et al. 2012). Furthermore, to determine whether the interviewee is benefiting from the available technologies, it is asked through which channels they receive information and news (Bergsma et al. 2012; Ofoegbu et al. 2016). With regards to the aspect of the energy system it is analyzed whether the interviewee has access to energy and electricity (Hogarth & Wójcik 2016; León-Camacho et al. 2014), what the particular energy sources (Park et al. 2012; León-Camacho et al. 2014) are, and how reliable and stable the system is (Hogarth & Wójcik 2016; León-Camacho et al. 2014).

4.4.5 Institutional Capacity

Within the framework of institutional capacity there are two main indicators of interest namely 'relationship' and 'access to governmental support'. The first one aims at determining the level of relationship that the interviewee keeps with governmental or institutional authorities in the area (Freduah et al. 2019). The second one investigates the access of the interviewee to governmental support that has already been provided in the past. Main aspects to take into account are the provision of governmental support services and information channels or materials (Mandryk et al. 2015; Matewos 2020) as well as the especial support by the government to solve problems or conflicts the interviewee was already encountering (Quiroga et al. 2015; Park et al. 2012; Williams et al. 2019).

1 Socio-Cultural Capacity			
1.1 Family and Relatives Environment, → Size of Household → Age of Household Head and Members ➡ Question 1.1		1.2 Gender Integration and Participation → Participation from Women in Decision-Making ➡ Question 1.2	
1.4 Attitude and social Attributes → Motivation / Willingness / Openness to adapt to new Technology, Ability to plan, learn, recognize, adapt to Changes ➡ Question 1.6		1.3 Social Network and Community → Participation in Networks / Cooperatives / Associations / (informal) Networks → Membership in Religion-based Groups → Membership in Self-Help Groups → Participation in Management Decision ➡ Question 1.3	
		→ Social Support Networks (post - during - Disaster) → Affiliation to and Support from Organizations ➡ Question 1.4 → Social Bonds and Conflicts between Community Members → Trust (within Community, among and between local/external Actors) ➡ Question 1.5	
1.5 Skills and Knowledge → Education Level (primary, secondary, tertiary / College, University) ➡ Question 1.7		→ Climate Change and Adaptation Knowledge, Acceptance of Climate Change, Weather Forecast, Perceived Weather Changes. Events and Impacts ➡ Question 1.8	
		→ Perceived Responsibility for Climate Change issues (Government, NGOs, Organizations, Individuals) ➡ Question 1.9	
2 Natural Resources Capacity			
2.1 Livestock and Agriculture → Pests and Diseases ➡ Question 2.1		2.2 Land Usability → Land Quality → Land Capability, Land Productivity → Soil Health ➡ Question 2.3	
→ Biodiversity → Crop Diversification → Livestock Diversification → Agricultural Diversity ➡ Question 2.2		2.3 Water Resources → Water Quality ➡ Question 2.4	
3 Economic Capacity			
3.1 Income → Income Diversification → Receiving of Remittances → Climate Sensitivity → Disaster Relief → Subsidies / Assistance ➡ Question 3.1		3.2 Costs → Production and Labor → Costs of Living ➡ Question 3.2 → Access to Credit / Loans → Financial Losses due to Climate Change ➡ Question 3.3	
		3.3 Assets → Ownership of Tools and Machinery → Value of Animals → Livelihood Assets → Household Savings ➡ Question 3.4	
		3.4 Insurance → Climate related Damage → Agricultural Insurance → Social and Health → Assets and Furniture ➡ Question 3.5	
4 Infrastructural and Technological Capacity			
4.1 Connection → Road System → Healthcare Accessibility → Education Accessibility ➡ Question 4.1 → Preparedness ➡ Question 4.2		4.2 Housing and Living Environment → Type and Quality of Housing incl. Materials → Climate Change Adaptation Features ➡ Question 4.3	
		4.3 Access to Public Housing Services → Sanitation, Sewage and Drainage System ➡ Question 4.4 → Communication Network ➡ Question 4.5	
		→ Energy System Reliability and Accessibility → Diversification of Energy Sources ➡ Question 4.6	
5 Institutional Capacity			
5.1 Relationship → Relationship to Authorities, Institutions, Governmental Entities ➡ Question 5.1		5.2 Access of Governmental Support → Availability of formal and informal Institutions and their Functions → Accessibility of Governmental Information → Institutions and Entitlements → Perception of Governmental (Adaptation) Support ➡ Question 5.2 → Support from Government or NGOs	

Figure 12: Indicator set including relevant Aspects related to the Interview Questions

5) Methodology

5.1 Methodological Approach

The methodological approach of this work is presented in figure 13 comprising research questions, objectives, methods, as well as the respective research basis. Further different methodological components of this work are moreover explained in detail within the following chapters.

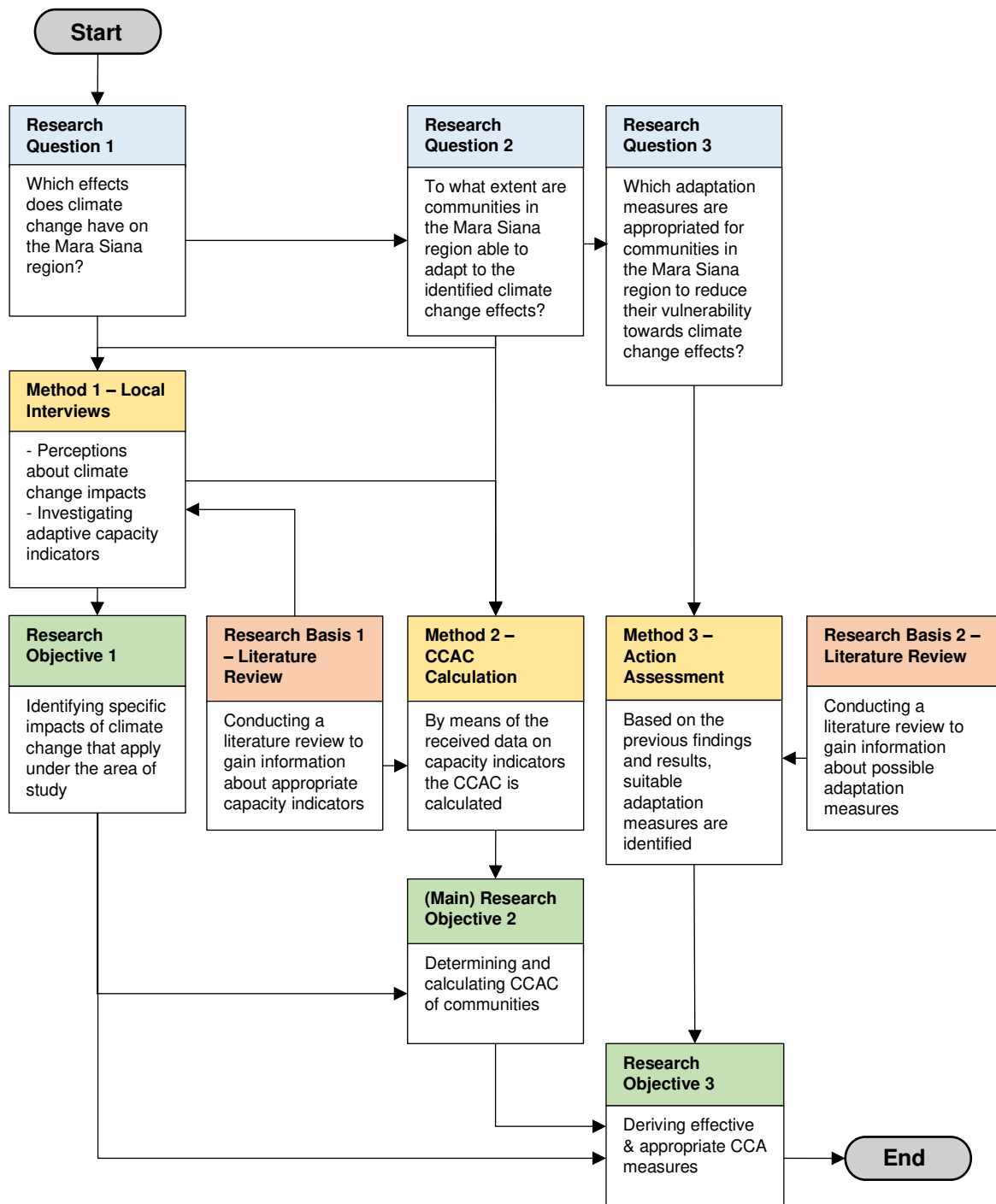


Figure 13: Methodological Approach

The main element of this research is represented by the conducting of qualitative interviews with the Maasai landowners from surrounding villages belonging to the Mara Siana territory. It is aimed to obtain essential insights about their CCAC; therefore, a comprehensive questionnaire (see Annex II) has been constructed that covers different topics and indicators that are derived from relevant literature and which were already examined in the previous chapter. Eventually, through applying a semi-quantitative approach not only qualitative information but also quantitative data which is used to determine the value of CCAC per indicator as well as for the overall performance of every landowner is being obtained. The final step of this work is represented by the elaboration of several measures that are recommended to reduce vulnerabilities and improve CCAC in the long-term.

5.2 Research Basis and Research Design

As it is visualized in figure 12 each indicator contains additional information which is derived from the analyzed research articles and that is furthermore being integrated into the final questionnaire. Accordingly, to adequately determine their fulfillment for each indicator between one and three questions are asked within the final interviews leading to 26 questions in total. These questions are designed as open questions giving the interviewee the opportunity to answer independently while providing individual information that is subsequently translated into codes. Retrospectively, the time effort for conducting the interviews was ranging between roughly 25 and 53 minutes. In that regard, a few interviews could be held in English as the interviewees were able to speak the language and were therefore much shorter in time. However, the majority of interviews was conducted with the help of an interpreter that was provided by MSC, translating English to Maasai and vice versa resulting in longer interview sequences. Accordingly, all interviews were recorded with a smartphone device and later transcribed and typewritten. These interview transcripts were exclusively written in English language after they were, in most cases, translated by the interpreter from original 'Maa'. The transcripts which are incorporated in the CCAC assessment table can be viewed in Annex III.

5.2.1 Selection of Interview Participants

Of the surrounding Maasai villages in Mara Siana six have been selected for conducting the interviews. Among these six villages are three big villages with more than 2000 residents and three smaller villages with less than 2000 residents. The aim is to ensure a proper basis to compare the obtained CCAC results not only between the different villages but also with special attention to their size and location. Accordingly, in each of the selected bigger villages six interviews with different landowners were conducted whereas in the smaller villages three landowners were respectively interviewed leading to 27 interviews in total. General population numbers from a recent census to define the village size have been provided through the conservancy staff members and particularly the responsible community liaison manager (see Annex V). The actual selection of landowners to be interviewed was based on a random sampling approach. In that regard, during community visits respective homesteads were approached randomly while always the landowner was interviewed who was found on the spot, whether it was the husband or a wife. Nonetheless, before starting an interview, it was crucial to confirm that the person to be interviewed is a legitimate landowner to maintain the consistent research base.

5.2.2 Definition of Codes

The coding system which has been set up within this research represents the crucial foundation not only to properly classify and categorize the different interview answers in a qualitative way but also as an essential prerequisite for the quantitative determination for any CCAC results as well as any further analysis of the collected data. The major part of the coding system consists of the definition of assessment codes which are integrated in the code manual that is being introduced in the following chapters. These codes are defined for and assigned to the respective questions and subsequently provide the basis for determining the level of CCAC for every answered question and indicator of any interview participant.

Furthermore, additional inductive codes are playing an important role within this research as they are obtained through the interview answers of all participants and consist of valuable information apart from the assessment codes. They are only used for qualitative purposes and provide a wider frame about CCAC aspects.

5.2.2.1 Assessment Codes

Most of the assessment codes were inductively defined meaning that directly during the collection of data through the interviews, information was obtained that provided the basis for dividing the answers into different codes. However, in some cases these assessment codes were deductively defined meaning they have been identified already before starting with the interviews as no additional impressions from the field were needed. Whether a specific code has been defined deductively or inductively can be seen in Annex I (Columns G;H). In some cases, more than one code per question could be selected and added up whereas in most questions only one code can be selected based on the participant's answer to the question. Moreover, interview questions are partly structured into multiple sub-questions which are not being assessed individually but as a whole. Their significance lies in the support of an even more precise answer while digging deeper into a respective aspect supporting the participants' understanding of the question.

5.2.2.2 Additional Inductive Codes

The additionally obtained inductive codes are providing more detailed information about the concrete circumstances and living conditions of the participants related to a specific question. The results of these inductive codes from the interviews are then used on a later stage to support and elaborate on the claims that can be made based on the data from the assessment codes. For demonstration purposes, an example of a finalized coding process including the selection of the correct assessment code for question 1.3 is given below.

Table 1: Coding Process including the Derivation of additional inductive Codes

Indicator	Question	Assessment Codes	Result	Further inductive Codes
Social Network and Community	a) Are you engaged / participating in any kind of social group, network or are you a member of cooperatives or associations? (e.g. self-help groups, religion-based organizations, NGOs, farmer association)? b) If yes, what is the focus of the respective network?	1 - Engaged as an active member in at least one group that is dealing with problem solutions to benefit the members	High	→ Contribution and saving of money as a simple form of insurance within the group → Buying utensils → Role as treasurer → Member in church

Indicator	Question	Assessment Codes	Result	Further inductive Codes
	c) How would you describe your position within the group? Are you participating in relevant decision-making processes? Are you rather active or passive?			

5.2.2.3 Code Manual

Within this chapter the code manual for assessing CCAC based on the defined codes assigned to all respective questions is being introduced. Generally, results for any question are being selected from the available options 'high', 'medium', and 'low' indicating the sub-level of CCAC. Further particularities of the code manual are described in the following sections.

D1 Code Manual – Socio-Cultural Capacity

Table 2 shows the defined code manual for socio-cultural capacity as the first determinant. Accordingly, there are no codes defined for question 1.1 as it was not clearly demonstrable what exact number of children would be suitable assessing CCAC differences expressed in levels and values. From a qualitative research perspective however, actual arguments such as a drastic increase in population, land and resources pressure as well as climate change effects are said to pose a threat on the Maasai landowners and their families. One major argument referring to this situation is the demarcated and assigned portions of land given to Maasai landowners that need to be shared by the descendants, additionally facing increased livestock pressure as people still concentrate on their pastoralist traditions (Bedelian & Ogutu 2017). Another special case for the first determinant can be seen in question 1.2 where the possibility is given that the final result may be assessed as 'not applicable' when the household of the participating interviewee is led by a woman only as this circumstance cannot provide any valuable information about gender integration.

Table 2: Coding Manual for the Determinant of Socio-Cultural Capacity

D1: Socio-Cultural Capacity				
Indicator		Question	Assessment Codes	Result
1.1	Family and Relatives Environment	a) How many people are living in the household?	No Codes defined	None
		b) How many children and how many adults?		
1.2	Gender Integration and Participation	a) To what extent are women in your household able to participate in decision-making processes?	1 - Women and men are equally participating in general household decision-making	High
			2 - Women are integrated in the majority of general household decisions but the man is the final decision-maker	Medium
			3 - Women are not recognized at all or only in the minority of general household decisions	Low
			4 - Not being considered when household is led by a woman only	None

D1: Socio-Cultural Capacity					
Indicator		Question	Assessment Codes	Result	
1.3	Social Network and Community	a) Are you engaged / participating in any kind of social group, network or are you a member of cooperatives or associations? (e.g. self-help groups, religion-based organizations, NGOs, farmer association)	1 - Engaged as an active member in at least one group that is dealing with problem solutions to benefit the members	High	
		b) If yes, what is the focus of the respective network?	2 - Engaged as an active member in at least one group that is not necessarily dealing with problem solutions to benefit the members	Medium	
			3 - Not engaged in any kind of group	Low	
		c) How would you describe your position within the group? Are you participating in relevant decision-making processes? Are you rather active or passive?			
		a) Have you already been provided in the past with support from organizations or can you rely on the support of certain supporting organizations in times of crisis or disasters?	1 - Yes, already experienced support from organizations during crisis and natural disasters (i.e. drought)	High	
			2 - Already experienced support from organizations during certain crisis (i.e. COVID) but not for natural disasters	Medium	
			3 - No support from organizations during any kind of crisis or natural disaster experienced	Low	
		a) How would you describe your social connection / binding to other members of your closer community / environment?	1 - Integrated within a close community with a low level of conflicts and a high level of trust	High	
2 - Integrated within a close community with possibly facing conflicts and disagreements and / or with a medium level of trust	Medium				
3 - Member of a community that is not close to each other with possibly facing conflicts and disagreements and with a medium level of trust	Low				
1.4	Attitude and social Attributes	a) How would you describe your behavior towards new technologies or developments? Are you rather passive or do you like it to try new things out?	1 - General attitude towards new developments & technologies and a respective understanding can be estimated as high based on given examples and explanations	High	
			2 - Interviewee seems to lack of comprehensive understanding of the question and respectively addressed technologies and gives examples that are unprecise or seems to be moderately open to new technologies	Medium	
			3 - New technology generally is not very appreciated	Low	
1.5	Skills and Knowledge	a) What is your educational level?	1 - Household head has gone to school and the children are being sent to the school	High	
		b) What is the educational level of the other household members?	2 - Household head has gone to school and there are no children in the household (not old enough to go to school)	High	
			3 - Household head has not gone to school, but the children are being sent to the school	Medium	
			4 - Household head has not gone to school and does not send all the children to school (e.g. due to financial reasons)	Low	

D1: Socio-Cultural Capacity				
Indicator		Question	Assessment Codes	Result
			5 - Household head is not promoting the children going to school generally	Low
		a) Are you aware about the phenomenon of (global) climate change?	1 - Being aware about and believing in the (global) phenomenon of climate change plus having experienced effects and weather changes already by their own	High
		b) Do you believe in the circumstance that there is a climate change process with changing weather patterns?	2 - Being aware about and believing in the (global) phenomenon of climate change but not having experienced effects and weather changes already by their own	Medium
		c) Have you already personally recognized weather changes in the region?	3 - Being not aware about the (global) phenomenon of climate change but having experienced effects and weather changes already by their own	Medium
			4 - Being not aware about the (global) phenomenon of climate change and not having experienced effects and weather changes already by their own	Low
		a) Who do you think should care about the possibly changing climate in the region? (e.g. government, NGOs, organizations, individuals)	1 - Being of the opinion that with reasonable explanation at least two or all of the mentioned stakeholders including government, organizations and every individual are responsible	High
			2 - Being of the opinion that without reasonable explanation two or only one of these stakeholders are responsible	Medium
			3 - Mentioning none of these stakeholders	Low

D2 Code Manual – Natural Resources Capacity

Table 3 shows the defined code manual for natural resources capacity. A special case of assessment procedure can be seen in question 2.3. Here, it firstly is to be selected between two different levels that compute either a high or medium capacity result. Eventually, there are two further code options that may be selected simultaneously and which respectively subtract one level from the previously obtained result meaning that an initially assessed capacity of 'high' can even be downgraded to 'low' if both additional options are being selected. A further particularity is shown in question 2.3 where an additional option of 'no proper information concerning reliability provided' can be selected. The fact that such information has not been provided within the interview is being neglected in such a case as it does not necessarily mean that the interviewee is affected by a low water reliability especially because they did not mention any related information during the openly designed qualitative interview.

Table 3: Coding Manual for the Determinant of Natural Resources Capacity

D2: Natural Resources Capacity				
Indicator		Question	Assessment Codes	Result
2.1	Livestock and Agriculture	a) Do you deal with both livestock and agriculture?	1 - Keeping diversified livestock and doing agricultural farming	High
		b) If you deal with livestock: How diversified is your livestock? How many different farm animals are there?	2 - Keeping diversified livestock and not doing agricultural farming	Medium
			3 - Keeping livestock which is not diversified and not doing agricultural farming	Low

D2: Natural Resources Capacity				
Indicator		Question	Assessment Codes	Result
		c) If you deal with agriculture: How diversified is your cultivated area? Are you using single crop(s) and planting techniques or do u diversify the crop(s) you are using?		
		a) Have your farm animals / livestock been affected (seriously) by pests and diseases in the past?	1 - No, farm animals have not been affected (seriously) by pests and diseases	High
		b) Have you been able to improve the situation effectively by means available to you?	2 - Yes, farm animals have been affected (seriously) by pests and diseases, however, means to handle the situation were available	Medium
			3 - Yes, farm animals have been affected (seriously) by pests and diseases, means to handle the situation were not available	Low
2.2	Land Usability	a) Does your land provide good quality conditions either: a1: for your crops? a2: for your livestock?	1 - Yes, the conditions for agriculture and/or livestock are good	High
			2 - The conditions for either agriculture or livestock are not good but not bad	Medium
			3 - No, the conditions for agriculture and/or livestock are bad	Low
2.3	Water Resources	a) How would you assess the quality of water from your respective water source(s)?	1 - Seemingly good quality and no treatment steps applied or medium / low / unknown quality, but treatment steps applied	High
		b) Have you once been affected by a disease or sickness that was related to a water source you are accessing?	2 - Seemingly medium / low / unknown quality and no treatment steps applied	Medium
			3 - Affected by diseases related to the water in recent time	Minus 1 Level
		c) How reliable is the water supply system?	4 - Low reliability or regular water shortages	Minus 1 Level
			5 - No proper information concerning reliability provided	None

D3 Code Manual – Economic Capacity

Table 4 shows the defined code manual for economic capacity. Similar to the previous determinant there are defined codes for the questions 3.1 and 3.2 through which one or even two result levels may be subtracted from the initially assessed level when the respective criteria are met.

Table 4: Coding Manual for the Determinant of Economic Capacity

D3: Economic Capacity				
Indicator		Question	Assessment Codes	Result
3.1	Income	a) Through which activities do you generate income? (e.g. livestock, crop cultivation, remittances you receive from relatives, subsidies / financial assistance)	1 - More than one income source (beside conservancy lease)	High
			2 - One income source (beside conservancy lease)	Medium
			3 - Equal to or more than 50% of income sources directly climate sensitive	Minus 1 Level
			4 - No conservancy lease received	Minus 1 Level

D3: Economic Capacity				
Indicator		Question	Assessment Codes	Result
		b) Are there any of those mentioned income sources depending on climate sensitive resources?		
3.2	Costs	a) Can you usually cover the costs (production, living, labor etc.) through your income? To which percentage? b) Have there been any serious fluctuations and increases of costs within recent years that affected you especially?	1 - Yes, several costs can be covered simply	High
			2 - Costs that can usually be covered are particularly related to basic needs	Medium
			3 - Costs (for basic needs) can usually not be covered	Low
			4 - Fluctuations, cost increases	Minus 1 Level
		a) Did you experience any financial losses through weather events (climate change) within recent years? b) Do you have access to credit or other forms of financial assistance?	1 - No financial losses experienced + access to credit / financial assistance	High
			2 - Financial losses experienced + access to credit / financial assistance	Medium
			3 - No financial losses experienced + no proper access to credit / financial assistance	Medium
			4 - Financial losses experienced + no proper access to credit / financial assistance	Low
3.3	Assets	a) Which are the main assets (financial or physical) of higher value that you possess (e.g. animals, land, house savings)	1 - Being the owner of the land, the animals, and the farm (house) plus having household savings and / or further assets of value such as a car, a bike, a TV etc.	High
		b) Are you the legitimate owner of the following assets? To what extent? b1) Land b2) Livestock and farm animals b3) Assets and machinery	2 - Being the owner of the land, the animals, and the farm (house) but neither having household savings nor further assets of value such as a car, a bike, a TV etc.	Medium
			3 - Not being the owner of the land, the animals, and the farm (house) and neither having household savings nor further assets of value such as a car, a bike, a TV etc.	Low
3.4	Insurance	a) Do you have financial insurances for the following topics: - Climate related damage - Agriculture and crops - Social and health - Assets and furniture	1 - Having external insurances focusing on climate related damage or agriculture / livestock plus a social / health insurance	High
			2 - Having either an external insurance for health or assets for example or for climate related damage or agriculture and crops plus recognizing of or planning with assets such as livestock as financial insurance	High
			3 - Having either an external insurance for health or assets for example or for climate related damage or agriculture and crops	Medium
			4 - Recognizing of or planning with assets such as livestock as financial insurance	Medium
			5 - Having no kind of insurance	Low

D4 Code Manual – Infrastructural and Technological Capacity

Table 5 shows the defined code manual for infrastructural and technological capacity. A previously described particularity can be seen in question 4.3 where an additional option of 'no proper information concerning reliability provided' can be selected. This circumstance results in the fact that the information about energy reliability is not being considered as

contributing to the final score of the question assessment as no adequate answer has been provided by the participant.

Table 5: Coding Manual for the Determinant of Infrastructural and Technological Capacity

D4: Infrastructural and Technological Capacity				
Indicator		Question	Assessment Codes	Result
4.1	Connection	a) How would you describe your connection to and the quality of the road system that you are accessing? (road may be used also to drive a car, ride a bike, walk, or for livestock grazing purposes) b) How quickly accessible are the following services to you? - Market - School / education facility - Healthcare facility	1 - Road system is in a good shape and is reliable plus the majority of different facilities (market, school, healthcare) can be accessed in under 30 min.	High
			2 - Road system is not in a good shape and the majority of different facilities (market, school, healthcare) can be accessed in under 30 min.	Medium
			3 - Moderate road system plus the majority of different facilities (market, school, healthcare) can be accessed in under 30 min	Medium
			4 - Road system is in a good shape and is reliable and the majority of different facilities (market, school, healthcare) can be accessed in under 60 min.	Medium
			5 - Moderate road system plus the majority of different facilities (market, school, healthcare) can be accessed in under 60 min or even longer than 60 min	Low
			6 - Road system is not in a good shape and the majority of different facilities (market, school, healthcare) can be accessed in under 60 min or even longer than 60 min	Low
		a) Is there (communal) infrastructure provided to you that is especially prepared and equipped for extreme weather events or disasters?	1 - Yes, there is a clear trend of providing communal infrastructure within the surrounding / accessible that is especially equipped for extreme weather events and disasters	High
			2 - A little of communal infrastructure in the surrounding has been designed in a resilient way	Medium
			3 - There is nothing of this communal infrastructure especially equipped for resilience purposes	Low
4.2	Housing and Living Environment	a) Do you already build new or modify already existing components of your house / farm in a resilient and resistant way with regards to extreme weather and weather changes?	1 - Components of the farm / house have already been built actively considering climate changes and weather events	High
			2 - Building of components of the farm / house considering climate changes and weather events has not been actively considered but facilities are withstanding extreme weather	Medium
			3 - Components of the farm / house have already been built actively considering climate changes and weather events however facilities are not always withstanding extreme weather	Medium
			4 - Building of components of the farm / house considering climate changes and weather events has not been considered and facilities are not withstanding extreme weather	Low

D4: Infrastructural and Technological Capacity				
Indicator		Question	Assessment Codes	Result
4.3	Access to Public Housing Services	a) Are you provided with a reliable sanitation and sewage system? b) Are there any drainage systems or measures used on your property?	1 - Provided with all these systems and they are reliable	High
			2 - Provided with a sanitation and sewage system or with a drainage system	Medium
			3 - Neither provided with a sanitation and sewage system nor with a drainage system	Low
		a) Do you have access to telephone network, mobile system, or internet at your place?	1 - Access to internet and telephone and using them as a channel to receive news and information from outside	High
			2 - No access to internet / Having access to internet but using other means such as telephone, TV or radio to receive news and information from outside	Medium
			3 - No access to internet or telephone network, possibly only provided with a radio to receive news and information from outside	Low
		a) Do you have access to energy / electricity? b) What are the sources of energy? Are they diversified? c) How would you assess the reliability of the energy system? Is it stable or do you face disruptions / black outs frequently?	1 - Provided with electricity and energy through diversified sources with a high reliability and less shortages	High
			2 - Provided with electricity and energy through diversified sources but with a low reliability and more shortages	Medium
			3 - Not provided with electricity or only provided with energy through unreliable single source	Low
			4 - No proper information concerning reliability provided	None

D5 Code Manual – Institutional Capacity

Table 6 shows the defined code manual for institutional capacity. Apart from the usual scoring levels of 'high', 'medium', and 'low' that can be selected for each of the two questions, no particularity is present in the assessment scheme of this determinant.

Table 6: Coding Manual for the Determinant of Institutional Capacity

D5: Institutional Capacity				
Indicator		Question	Assessment Codes	Result
5.1	Relationship to Government & Authorities	a) How would you describe your relationship towards local and regional authorities, institutions, and governmental units?	1 - Local actors of respective authorities are known and access is possible and / or interviewee is satisfied with the relationship	High
			2 - Local actors are known but access is not possible and / or interviewee is not fully satisfied with the relationship	Medium
			3 - Local actors are not known and no relationship is possible and / or interviewee is not satisfied at all with the relationship	Low
5.2	Access to Governmental Support	a) Do you have access to governmental and institutional support services and provided information?	1 - Governmental support services are being accessed and further personal support from governmental institutions has already been received	High

D5: Institutional Capacity			
Indicator	Question	Assessment Codes	Result
	b) How would you describe the support from governmental side for general problems that you are encountering?	2 - Governmental support services are being accessed or further personal support from governmental institutions has been received	Medium
		3 - Neither provided information and governmental support services are being accessed nor has any personal support from governmental institutions been received	Low

5.3 Climate Change Adaptive Capacity Calculation

The obtained results from the defined codes are being translated into a quantitative scale where the level 'low' is equal to the value of '0', 'medium' is equal to '0.5', and 'high' is equal to '1'. This 3-level input is understood as the simple basis for the subsequent more complex calculation of the final CCAC output. For this CCAC output, a scale with five different levels is applied which ensures a more sophisticated and a more detailed subdivision of the results. Accordingly, a computed value below '0.2' equals the level 'very low', a value between '0.2' and '0.399' equals the level 'low', a value between '0.4' and '0.599' equals the level 'medium', a value between '0.6' and '0.799' equals the level 'high', and a value above '0.8' equals the level 'very high'.

Generally, there are two steps of handling the collected data. Displaying the results per question is predominantly essential for analyzing and understanding factual interrelations in according to the predefined assessment codes as well as the further inductive codes. Though it is moreover crucial in contributing to the subsequently retrieved results per indicator since a part of these research indicators involve more than one interview question as explained in previous chapters. The compilation of the results based on the indicator set, on the other hand, is of crucial importance, especially for the quantitative evaluation and comparability of the data for the final overview.

Results per determinant are calculated by adding up the obtained values for each question (Q) that are derived from the assessment codes taken the median as it can be seen in the following formula which is oriented on the first determinant (D1) 'socio-cultural capacity':

$$CCAC \text{ of } D1 = Median(Q1.1 - Q.1.9)$$

Every question that has been asked within the whole assessment is considered and weighed equally as no concrete difference in their contribution towards CCAC is quantified within this research. Nevertheless, with regards to the number of questions that are assigned to the respective indicators, the weight per Indicator is based on the number of questions being asked. The following formula gives an example for the calculation of indicator 1.3 'social network and community' that comprises the values from three different questions:

$$Indicator \ 1.3 = \frac{Q1.3 + Q1.4 + Q1.5}{3}$$

Related to the above formula the overall CCAC result for the first determinant 'socio-cultural capacity' as already shown in the first example can be alternatively calculated on the basis of the indicators alone through considering the number of questions per indicator which leads to the same result allowing for verification:

$$CCAC \text{ of } D1 = Median(Q1.1 + Q1.2 + \frac{Q1.3 + Q1.4 + Q1.5}{3} + Q1.6 + \frac{Q1.7 + Q1.8 + Q1.9}{3})$$

While the previous formulas are displaying the calculation per interview participant (P) the obtained results are furthermore being calculated and summarized for every village (V) as it is the aim to be able of comparing the obtained data from the different villages and drawing substantial conclusions. Thus, the following formula simply shows the summary for the six interview participants from the first village:

$$CCAC \text{ of } V1 = Median(P1 - P6)$$

The final results for Mara Siana landowners focusing on the average CCAC performance are aggregated through adding up the results of the respective villages considering the number of interviewees that have participated following the scheme:

$$\emptyset CCAC \text{ Total} = Median(V1 * 6; V2 * 6; V3 * 6; V4 * 3; V5 * 3; V6 * 3)$$

Additionally, the same way of calculating the total CCAC for the whole group of participants is also being used to compute any of the respective final indicator values that have previously been obtained for every village.

5.4 Identification of Measures

The final activity of this work is to derive appropriate counter measures which are suitable to improve the CCAC of the Maasai landowners in the long-term. The determination of these measures is being conducted in according to the respective indicator set and aims to assign them respectively to one or more particular indicators they are related to. Accordingly, it is aimed to especially address those indicators that achieved relatively poor performances during the CCAC assessment and therefore present respective weaknesses and potential for improvement. Furthermore, it is important to identify the concrete responsibility and focal point the measures will be taken by and aiming at. The identification of measures is among others based on literature references and is orientating on already established and common CCA knowledge that serves as crucial input for the adequate identification of measures. This research is mainly aiming at determining and calculating CCAC while the final derivation of measures can be understood as a general recommendation demanding for a proper and more sophisticated analysis through further research in the area that enables the investigation of the concrete feasibility and effectivity of the respective measures. Moreover, beside those main measure packages for CCAC improvement further activities that potentially benefit landowners' CCAC across the different villages, providing additional opportunities for capacity strengthening, are briefly examined. Finally, individual recommendations that are especially originating from the CCAC analysis in this specific area setting and that may be of high significance for future research are additionally defined and provided at the end of this work.

6) Results

As the number of interviews conducted per village is related to the respective size of the villages (see chapter 5.3.1), in the larger villages of Oololaimutia, Megwara, and Sekenani six interviews each were carried out whereas in the smaller villages of Empopungi, Enkoriong, and Illturisho only three interviews were conducted. Table 7 shows the number of interviews per village broken down by gender of the interview participant.

Table 7: Number of Interviews per Village segregated by Gender

Village	Oololaimutia	Megwara	Sekenani	Empopungi	Enkoriong	Illturisho
Male	4	1	3	0	0	0
Female	2	5	3	3	3	3

In the following, the CCAC results are firstly investigated following the structure of the indicator set comprising the final results of all villages combined per indicator. Afterwards, the individual results for each of the six investigated villages around MSC are presented. The analysis of CCAC in both ways is comprising not only qualitative codes and information but also quantitative data determining concrete levels of CCAC. Eventually, not only the total combined results are presented but also the results of the different villages are compared with each other with the aim of drawing meaningful conclusions on underlying causes.

6.1 Results in accordance with the CCAC Indicator Set

The overall results for the five determinants divided by the different villages are presented in table 8. Here, the calculated values are relatively wide-ranging generating capacity results between 'low' and 'high' with only one single 'very low' result obtained for the determinant of institutional capacity in the village of Empopungi and not one result that is reflecting a 'very high' capacity. Socio-cultural capacity reached the highest value among the determinants with an overall score of 0.69 whereas economic capacity only reached a value of 0.42 and infrastructural and technological capacity reflecting the lowest result with a value of 0.41. The overall average CCAC result amounts to 0.55 while Empopungi reached the lowest and Illturisho the highest score with 0.45 and 0.63 respectively.

Table 8: Overall Results for all Determinants across all Villages

Indicator		V1 - Oololaimutia		V2 - Megwara		V3 - Sekenani		V4 - Empopungi		V5 - Enkoriong		V6 - Illturisho		Average (Total)	
1	Socio-Cultural Capacity	H	0.68	H	0.67	H	0.71	H	0.67	H	0.75	H	0.71	H	0.69
2	Natural Resources Capacity	M	0.48	H	0.73	H	0.63	M	0.58	H	0.79	H	0.79	H	0.65
3	Economic Capacity	M	0.40	L	0.38	L	0.33	L	0.37	M	0.53	H	0.67	M	0.42
4	Infrastructural & Technological Capacity	M	0.49	M	0.42	M	0.43	L	0.25	L	0.39	L	0.36	M	0.41
5	Institutional Capacity	M	0.50	H	0.75	H	0.75	VL	0.17	M	0.42	H	0.75	M	0.59
Total		M	0.53	M	0.57	M	0.56	M	0.45	H	0.60	H	0.63	H	0.55

6.1.1 Socio-Cultural Capacity

Table 9 shows the results across all villages for the first determinant of socio-cultural capacity. It can directly be seen that the overall capacity results for all different villages are 'high' reflecting a generated value between 0.67 and 0.75 with Enkoring reaching the highest value of 0.75 and Megwara and Empopungi both achieving the lowest results with 0.67 each. The overall average for all villages and participants within socio-cultural capacity lies at 0.69 representing the highest overall result among the five different determinants. As in chapter three already mentioned, indicator 1.1 'family and relatives environment' reflects a unique particularity among all indicators as the obtained information about the number and age of household members have not been coded and assessed categorizing them into quantitative levels, therefore values are not available as table 9 shows. In the following, quantitative results as well as obtained qualitative information for each of the indicators of 'socio-cultural capacity' are discussed.

Table 9: Overall Results for the Determinant of Socio-Cultural Capacity

Indicator		V1 - Oololaimutia		V2 - Megwara		V3 - Sekenani		V4 - Empopungi		V5 - Enkoring		V6 - Illturisho		Average (Total)	
1	Socio-Cultural Capacity	H	0.68	H	0.67	H	0.71	H	0.67	H	0.75	H	0.71	H	0.69
1.1	Family & Relatives Environment	-	-	-	-	-	-	-	-	-	-	-	-	N.A	N.A
1.2	Gender Integration & Participation	M	0.50	M	0.42	M	0.58	M	0.50	L	0.33	M	0.50	M	0.48
1.3	Social Network & Community	H	0.72	H	0.72	VH	0.83	H	0.67	VH	0.89	H	0.72	H	0.76
1.4	Attitude & social Attributes	M	0.58	H	0.75	M	0.58	M	0.50	VH	0.83	VH	0.83	H	0.67
1.5	Skills & Knowledge	H	0.72	H	0.67	H	0.67	H	0.78	H	0.72	H	0.72	H	0.70

6.1.1.1 Family and Relatives Environment

Concrete codes leading to quantitative values for determining the capacity of landowners and their families with regards to the size of their household have not been defined due to the complexity of aspects. Accordingly, it was decided to just identify the number and age of household members for qualitative purposes arguing that there is no maximum, minimum, or optimum of the number of children with regards to CCAC. Nevertheless, a wide range of household size and constellations has been identified from households with only two adults and one child such as in the case of interviewee (7) from Megwara to households consisting of four adults including one husband, three wives, and fifteen children as in the case of interviewee (11) from Megwara. Information in that matter depends as well on the perspective of the respective interviewee. As in chapter three already mentioned a male landowner may tend to provide information related to the demographic structure of him and possibly several wives including their children whereas the definition of a household perceived by female interviewees may only include the husband and the own children but exclude other co-wives with their respective children. Furthermore, there are different constellations between adults and children in terms of the degree of relatedness as it must not always be parents and children but also grandparents living solely together with their

grandchildren as in the case of interviewee (1) from Oololaimutia or also other distant relatives or even not directly related people living in the same household as in the case of interviewee (19) from Empopungi in whose household an older man is accommodated in addition to both parents. Although quantitative information to assess CCAC with regard to the indicator of 'family and relatives environment' is not provided within this research, obtained qualitative data comprising interviewee's claims about the household size and composition will be integrated into the final analysis and recommendations for further adaptation in the face of the changing climate.

6.1.1.2 Gender Integration and Participation

The analysis of this indicator, particularly focusing on the position of female household members within decision-making processes and the extent of their integration, delivers distinct results as well as a deeper insight into the relationship between men and women at the household level. Accordingly, 21 of the 27 interviewed landowners stated that generally the man is the final decision-maker, although women are integrated in the majority of household decisions. Three interview participants even stated that women are not recognized at all or only in the minority of general household decisions. Just interviewee (8) from Megwara and interviewee (14) from Sekenani have indicated that in their respective households women and men are equally participating in general decision-making from which a higher level of gender equality can be assumed. A further particularity is reflected by the first interviewee (1) from Oololaimutia who specified that she is the only adult person in the household as her husband has died. Since it is not possible to obtain concrete information on female integration in this household as the children are still of a very young age and would not be able to take over decision-making responsibility, it was decided not to consider this household for a more detailed evaluation of the indicator. On the contrary, when a son is old enough and there is no father or mother's partner in the household, it seems to be a normal process for the son to take over decision-making and assume the role of head of the family. This circumstance is clearly described by the participants (15) from Sekenani and (21) from Empopungi. A major reason for this imbalanced and segregated gender-relation in decision-making is presumably a culture-based division of roles between women and men, which is also clearly communicated by interview participants (4) and (6) from Oololaimutia. On the whole, the indicator of 'family and relatives environment' therefore clearly shows the weakest result of all indicators in the area of socio-cultural capacity with an overall value of 0.48 and the lowest result generated in the village of Enkoriong with only 0.33.

Table 10: Inductive Codes from Indicator 1.2 'Gender Integration and Participation'

Indicator 1.2 - Gender Integration and Participation			
Question	Identified inductive Codes		
1.2	<ul style="list-style-type: none"> Elder son is the decision-maker (2) 	<ul style="list-style-type: none"> Husband has died (1) 	<ul style="list-style-type: none"> Cultural role distribution between men and women (2)

6.1.1.3 Social Network and Community

In the first of the following paragraphs the results for question 1.3 about engagement in any kind of group are analyzed, before the results for the questions 1.4 about perceived social

bonds within the community and 1.5 about experiences with social support services from governmental and non-governmental organizations are presented.

The overall result for the engagement of the interview participants in any kind of social group among all villages is calculated as 'very high' with a value of 0.80. Accordingly, 21 of 27 interviewees mentioned that they are engaged in a social group with the particular purpose of benefiting the members through the respective group activities. Advanced coding of their answers identified various types of such groups with different activities and ways of generating a common benefit. One popular mechanism is the contribution of money from the beneficiaries either to just put it aside in the form of a common saving which was stated by three landowners or to dedicate the contributed money particularly to the beneficiaries when school fees of children must be paid as mentioned by five participants. Accordingly, six interviewees stated that there was the distinct mechanism within their group to provide the saved money to alternating beneficiaries from their group. In this way, it has been argued that people would earlier be able to afford the payment for livestock such as a goat or a chicken which would increase their capability of self-providing themselves with food resources or obtaining benefit from trading the respective livestock after feeding it from a young to a grown stage selling it for a higher price. The different obtained codes from question 1.3 are as well of an interrelated character as four interviewees highlighted the shared procurements of diverse utensils in their self-help groups while seven other participants particularly mentioned the shared buying of livestock which as well implies individual financial contributions. Other forms of social groups that interviewees associated with the question were the membership in the church which was stated by two participants as well as a religion-based organization that one landowner (5) from Oololamutia was reporting about. The two participants (26) and (27) from the village of Illturisho also pointed out that their self-help groups, possibly one and the same, received facilitation support from MSC which has not been mentioned from landowners in the other villages. On the sub-question 1.3 (c) that asks whether the participant takes a specific responsibility within their group, two interviewees stated that they incorporate the role as a chair lady and two others are responsible for the treasure within their group. The rest of the interviewed landowners is thus expected to take the role as an active member inside the respective group. Beside the landowners who are participating in a self-help group there are also five interviewees that stated to not be part of such a group, among them interviewee (6) from Oololaimutia and interviewee (26) from Illturisho. The capacity of interviewee (5) from Oololaimutia, who noted that he is a member in a religion-based organization, has been assessed as 'medium' since the organization was still in an initial stage and at that point of time not benefiting the interviewee in terms of support with problem solutions.

The widespread presence and emerge of self-help groups does not only indicate a distinct economic pressure on the Maasai population in the different villages, which is furthermore investigated in the third determinant of economic capacity, but it also shows a very high level of community bonding and mutual support to overcome severe financial constraints. It has been identified that these self-help groups are seemingly of particular significance for women as 16 of 19 female participants (84 %) compared to four of eight male participants (50 %) who were interviewed stated to be part of an active self-help group.



Figure 14: Agnes Sasine (4th from the right) together with her Women Self-Help Group from Oloolaimutia presenting their self-made Items and Accessories (March, 2023)

Question 1.4 that represents the second part of indicator 1.3 'social network and community' is asking about how the interview participants perceive the social connection and integration within their community. In this regard, mainly positive results were obtained saying that 22 of the interviewees reported to be integrated within a close community of a low level of conflict whereas only four interviewees stated to be part of a community that possibly faces conflicts and disagreements or shows a medium level of trust. Only interviewee (14) from Sekenani was complaining sharply about the community he was part of, explaining it as not being close with a medium level of trust. Accordingly, in the interview he additionally argued that conflicts about land rights and fencing as well as a division between poor and richer people within the direct neighborhood have shaped his impression. Another different critic was stated by interviewee (7) from Megwara who is working in a program that supports girls yet facing challenges with parents about the respective support for their daughters. Although the reflected experience of interviewee (14) partly destructs the picture of a holistically integrative community to some extent, a wide majority of landowners were reporting about a very positive relationship within their community, generally indicating the impression of strong social bonds. A possible reason for these results is delivered by interviewee (6) from Oloolaimutia who noted that the close bond of the community is founding on the Maasai culture.

The third question of indicator 1.3 is focusing on organizational support that interview participants are regularly receiving or might have experienced in the past already to find out whether they can rely on such assistance in case of future shocks affecting them. To

investigate the presence of organizational support with direct relation to CCAC and therefore natural disasters in first place the question divides between explicit support during natural disasters or support for other crisis or shocks particularly taking into account the recent COVID-19 pandemic. Accordingly, 16 interview participants mentioned that they already experienced support from organizations during certain crisis and particularly COVID-19 whereas only eight interviewees stated to have even received organizational support also for natural disasters and particularly droughts. Additional inductive coding computed more distinct results about explicit reasons for support as well as the means by which the landowners have been assisted throughout the respective crisis. In this regard, seven participants stated that they have received support particularly during droughts, whereas 23 participants noted to have received assistance during COVID-19. Thus, it is indicated that seven of the eight landowners that were mentioning to receive support during droughts have as well received support during COVID-19 or another crisis already. Furthermore, the extended coding results compute that one interviewee (20) from Empopungi and the respective household have not at all been reached with support neither during droughts nor during other kinds of crisis. Another interview participant (8) from Megwara especially stated that their household has not received assistance during COVID-19. Concerning the means of support a wide variety and several different ways of provision were identified. Accordingly, the majority of 19 participants mentioned that they received assistance in form of foodstuffs throughout the respective crisis whereas six other interviewees claimed to have received financial support. For a deeper understanding of these results, it is crucial mentioning that the different means of support are not necessarily noted as single services that had been received but that it is also possible that multiple of the services registered as different codes have been received by one and the same interviewee. For example, participant (13) received support both in form of foodstuffs as well as through financial resources and interviewee (12) from Megwara stated to have received support with sanitary equipment and education especially for women as well as assistance in the provision of sanitation facilities in addition to provided foodstuffs. Another aspect of high significance for the analysis of question 1.3 is the variety of different sources through which respective support was provided to the landowners and their households. In this regard, the majority of seven interview participants mentioned different organizations that they were receiving respective assistance from while three others reported the government as the source of support. Moreover, interviewees (14) and (15) from Sekenani stated in the third question of 1.3 that they have been assisted by other conservancies in the area. In addition to that, interviewee (14) who was previously already complaining about a present division between rich and poor people in the neighborhood, highlighted that he and his family have not received any support during crisis or disasters from these rich people. Sources which have been mentioned only once by interviewees are comprising tourists, as well as other individuals which were more precisely described by interviewee (22) who explained that a so-called 'Mzungu' (meaning a 'white', wealthy person) has helped the community with foodstuffs that were distributed inside a church particularly during COVID-19.

Table 11 gives insights about further codes and information that has been derived from the interviewees with regards to indicator 1.3 and the three different questions. Summarizing, a high total result of 0.76 for indicator 1.3 'social network and community' could be

determined with the best capacity result of 0.89 calculated for the village of Empopungi and the worst result of 0.67 generated for the village of Enkoriong.

Table 11: Inductive Codes from Indicator 1.3 'Social Network and Community'

Indicator 1.3 - Social Network and Community				
Question	Identified inductive Codes			
1.3	<ul style="list-style-type: none"> Contribution and saving of money as a simple form of insurance within the group (3) Buying livestock together and share it (7) Selling bits together to the tourists (1) Member in church (2) Buying utensils (4) 	<ul style="list-style-type: none"> Contribution of money with alternating beneficiaries from the group (6) Self-help group was closed during COVID (1) Formerly engaged in a group (2) Role as chair lady (2) Member in church (2) 	<ul style="list-style-type: none"> Contribution and saving of money for school fees (5) Member in a religion-based organization (1) Support from Mara Siana Conservancy (2) Role as treasurer (2) 	
1.4	<ul style="list-style-type: none"> Conflicts about land rights and fencing (1) Facing challenges with parents about girls support (1) 	<ul style="list-style-type: none"> Division between rich and poor (1) Conflicts and disagreements occur but are being solved (1) 	<ul style="list-style-type: none"> Working to support girls (1) Culturally close community (1) 	
1.5	<ul style="list-style-type: none"> Support during COVID (23) Support with education (2) Support from nearby conservancy (2) Support from organizations (7) Support with building sanitation facilities (1) Provided with water (1) 	<ul style="list-style-type: none"> Provided with foodstuffs (19) Support during droughts (7) No help from the rich (1) Support with sanitary equipment for women (1) Support from 'Mzungu' (individual support) (1) Not been reached by support and aid (1) 	<ul style="list-style-type: none"> Financial support (6) Governmental support (3) Support from tourists (1) Support with education for women (1) Support provided in church (1) No support during COVID (2) 	

6.1.1.4 Attitude and Social Attributes

The capacity results for indicator 1.4 represent a distinct variety across the different villages. Accordingly, for the village of Empopungi a 'medium' value of 0.50 has been obtained whereas both Enkoriong as well as Illturisho reached a 'very high' result with 0.83. Indicator 1.4 mainly aims to identify the general attitude of the interviewees and their willingness to possibly adapt their way of living to a changing climate and weather conditions. In order to receive credible answers, it is asked how they would describe their behavior to new technologies or developments and whether they act rather passive or take the initiative. Furthermore, to be able to assess their level of understanding of the question context the interviewees are asked to back their answers with concrete examples that they relate to developments and technologies. Accordingly, out of the 27 interview participants 11 have been attributed with a generally positive attitude and behavior towards new developments and technologies with a seemingly well understanding of the context. Within their answers

they were often referring to the adoption of new livestock management techniques, in total mentioned by nine landowners, as well as the access to new education opportunities as children are being promoted and enabled to go to school, which was noted by 11 landowners. On the other side, there are 14 interviewees who showed a rather moderate attitude towards new technologies and developments or who were claiming to be open minded, although their answers have been assessed as lacking a comprehensive understanding of the question context including giving unprecise examples. In this regard, six landowners, including for example interviewees (3) and (6) from Oololaimutia predominantly stated their appreciation for communication technology yet this does not necessarily imply a general positive attitude towards lifestyle changes and adaptative behavior but also includes the aspect of self-entertainment through access to smartphones and internet. Accordingly, interviewee (12) is critically self-reflecting this circumstance by mentioning possible deterioration effects through an increased utilization of digital technology also on the culture. Other relevant aspects that interview participants related to new technologies and developments such as the wearing of modern clothes which has been mentioned by four different interviewees are presented in the form of codes in table 12. Finally, there are also two cases in which landowners argued that they do not appreciate new technologies or developments in general. Both interviewees (14) and (18) are from the village of Sekenani and respectively explained their attitude. Interviewee (14) stated that the adoption and acceptance of new developments such as the participation of children in schools is accompanied with high costs as particularly school fees are perceived as relatively expensive. Interviewee (18) just argued that he rather likes to stick to cultural traditions than to be open towards new things.

Table 12: Inductive Codes from Indicator 1.4 'Attitude and social Attributes'

Indicator 1.4 - Attitude and Social Attributes			
Question	Identified inductive Codes		
1.6	<ul style="list-style-type: none"> Becoming religious, believing in God (1) New livestock management (9) Communication technology dangerous (1) Sewing machine appreciated (1) Deterioration of cultural habits and traditions (1) 	<ul style="list-style-type: none"> Wearing modern clothes (4) Technology difficult and / or expensive (1) Communication technology appreciated (6) New energy sources (1) New agriculture technology (1) 	<ul style="list-style-type: none"> New education opportunities (13) School fees expensive (1) Environment conservation (1) New dietary patterns (1)

6.1.1.5 Skills and Knowledge

This indicator focuses on the three different aspects of the educational level of household members, the interviewee's knowledge about and perception of climate change, and the opinion on who is having the responsibility for tackling climate change issues. Therefore, in the following paragraphs, the results to the three different questions are presented in closer detail.

For the aspect of education, the interviewed landowners provided relatively balanced information about the respective household head and whether he has an educational background. In this regard, if a female landowner has been interviewed it was additionally asked to what extent the husband has been educated as he is mostly the one to be considered as the household head and the final-decision maker as already interpreted from indicator 1.2 'gender integration and participation'. The results reveal that 11 household heads have gone to school whereas 16 have not. However, the final outcome is very clear with regards to sending the own children to school. Accordingly, 25 of 26 interview participants who have at least one child stated that their children are visiting the school, whereas only one participant mentioned that she is not able to send all children to school due to financial constraints.

Similarly, the results for question 1.8 concerning the awareness and perception of climate change by the interview participants are very clear. While 25 of 27 interviewees stated that they are aware about the phenomenon of climate change in general and that they believe in its existence, all the 27 interviewees, even if not aware of that, have experienced effects and weather changes already by their own. Accordingly, 20 participants especially mentioned changing weather patterns of drought and rain that they were witnessing in recent years whereas intensified droughts have been noted 20 times as well among the landowners. Other observations that were made and which were mentioned only once each comprise erosion and environmental destruction as mentioned by interviewee (4) from Oololaimutia as well as temperature rise which was stated by interviewee (12) from Megwara.

Question 1.9 was aiming to analyze how and with whom the landowners relate the responsibility to tackle the respective effects of climate and weather changes. In this regard, they were given different stakeholders namely individuals, organizations, and the government with the intention to encourage the participants to connect the responsibility to each of them realizing the importance of this aspect of being a multi-stakeholder concern. For this reason, also the presence of a reasonable explanation to underline the landowner's opinion is of significance. In this context, six interview participants were assessed as recognizing at least two or all of the referenced stakeholders while providing a reasonable explanation for their opinion resulting in the achievement of a 'high' result. On the other hand, although 13 further interview participants mentioned two or all of the stakeholders as well, it has been decided to grade their capacity as 'medium' arguing that they could not provide a reasonable explanation, possibly indicating a simple reproduction of the given options. Overall, 13 interviewees said that the government would be responsible for climate protection, while five interviewees were given the concrete example of individuals that can help to fight climate change by planting trees. Moreover, the contribution by organizations has also been mentioned five times. Interviewees (5) from Oololaimutia and (12) from Megwara who were already mentioning several different stakeholder groups particularly brought up the narrative of a collective responsibility which would be of high significance to tackle climate change consequences and thus were also assessed with a 'high' capacity for this question. Eight interviewees were found to state none of the stakeholders resulting in a 'low' capacity assessment. These interview participants were often bringing up the name of God who can provide help to this situation or also referred to the 'white' (meaning 'wealthy') people who would have the knowledge and responsibility to help.

To sum up, the indicator of 'skills and knowledge' reaches relatively consistent results across the six villages with the minimum value of 0.67 obtained in Megwara and Sekenani and the maximum value of 0.78 generated in Empopungi. The overall indicator result including all villages amounts to 0.7 with the general attribute of 'high'.

Table 13: Inductive Codes from Indicator 1.4 'Skills and Knowledge'

Indicator 1.5 - Skills and Knowledge	
Question	Identified inductive Codes
1.7	<ul style="list-style-type: none"> Not enough money for paying school fees (1)
1.8	<ul style="list-style-type: none"> Changing weather patterns of drought and rain (20) Erosion (1) Intensified droughts (20) Temperature Rise (1) Destruction of environment (1)
1.9	<ul style="list-style-type: none"> God may help (11) Environment conservation (2) White people can bring change (2) Individuals can change by planting trees (5) Government responsible for climate protection (13) Organization's contribution (5) Collective responsibility (2)

6.1.2 Natural Resources Capacity

Table 14 shows the results across all villages for the second determinant of natural resources capacity for which a wide range of capacity results including the total values for the three relevant indicators has been computed. Accordingly, the indicator of 'livestock and agriculture' reaches the lowest result with a medium score of 0.53 whereas the indicator of 'Land Usability' achieves a 'very high' result of 0.93 which is also the highest among all investigated indicators within this work. The overall average for all villages and participants with regards to natural resources capacity lies at 0.65 representing the second-highest overall result among the five different determinants. In the following, quantitative results as well as obtained qualitative information for each of the indicators of 'natural resources capacity' are discussed.

Table 14: Overall Results for the Determinant of Natural Resources Capacity

Indicator		V1 - Oololaimutia		V2 - Megwara		V3 - Sekenani		V4 - Empopungi		V5 - Enkoriong		V6 - Illturisho		Average (Total)	
2	Natural Resources Capacity	M	0.48	H	0.73	H	0.63	M	0.58	H	0.79	H	0.79	H	0.65
2.1	Livestock & Agriculture	M	0.46	H	0.63	M	0.46	M	0.50	M	0.58	M	0.58	M	0.53
2.2	Land Usability	H	0.67	VH	1.00	VH	1.00	VH	1.00	VH	1.00	VH	1.00	VH	0.93
2.3	Water Resources	L	0.33	H	0.67	M	0.58	L	0.33	VH	1.00	VH	1.00	H	0.61

6.1.2.1 Livestock and Agriculture

Indicator 2.1 'livestock and agriculture' aims at identifying the concrete landowner's focus on agricultural crops or livestock animals first and moreover determining their capability to

carry out respective activities while possibly experiencing constraints through the appearance of pests and diseases affecting crops or livestock.

To begin with, by analyzing the results to question 2.1 it has been identified that all of the interviewed landowners are keeping livestock, however only four of them are carrying out agricultural activities at the same time. Accordingly, two interview participants from Megwara and respectively one from the villages of Enkoriong and Illturisho stated to grow agricultural crops. Both landowners explained to particularly utilize three acres of their land for agriculture, managing different kinds of crops and plants such as spinach, cabbage, and tomatoes in a system of paddocks with both interviewees mentioned that they even use a tractor for digging and preparing the soil. With regards to the aspect of diversification of agricultural production and self-sufficiency the focus on both agriculture as well as livestock is assessed with a 'high' capacity whereas the keeping of livestock only generates a 'medium' capacity. Several interview participants stated their personal reasons behind their decision to not carry out agricultural activities with a distinct majority of 10 interviewees arguing that properly maintaining agricultural activities is certainly difficult due to wildlife conflicts. Another landowner from Empopungi (21) stated not only the difficulty related to wildlife conflicts but also related to droughts.



Figure 15: Agricultural Farming Construction in the Village of Illturisho (March, 2023)

The results of question 2.2 that is dealing with the presence of diseases and pests affecting crops and livestock as well as the landowner's capability to cope with the situation reveals very consistent results. Accordingly, 26 of the 27 interviewed landowners said that either their crops or livestock had been affected already by pests or diseases, whereas 25 of the

26 stated to have access to appropriate means to handle the situation and only one landowner (1) from Oololaimutia noted that she had no means available to cope with the situation. For question 2.2 a particularity is presented by interview participant (9) from Megwara who explained that her livestock has not been affected seriously by pests and diseases to date. Overall, diseases and pests that were reported by the interview participants across the different villages were 'food and mouth' (12), 'tse-tse fly affecting livestock' (3), 'Malaria affecting livestock' (6), 'livestock cold' (2), and 'cham cham' (2) which refers to the disease 'blue tongue' affecting mainly sheep during cold seasons. Additionally, caterpillars affecting crops were mentioned by interviewee (7) from Megwara. Table 15 does not only provide the identified qualitative codes for the different kinds of diseases that interview participants were reporting but also sheds light on the coping strategies that landowners chose to handle the situation. The most popular ways of coping with the situation of mainly affected livestock were described as buying medicine from the retailer shop 'Agrovat' mentioned by 21 landowners and the consultation and seeking for support from a veterinary which has been stated by 13 landowners. Further coping strategies comprise the vaccination of livestock, mentioned by six interview participants and the spraying of pesticides for agricultural crops, mentioned by three interview participants. Countermeasures that were only stated once respectively were the covering of water sources to prevent transmission, stated by landowner (25) from Illturisho, putting livestock inside the house, stated by landowner (27) from Illturisho, deworming, stated by landowner (3) from Oololaimutia, and the application of antibiotics, stated by landowner (4) from Oololaimutia. In the case of interviewee (26) from Illturisho it has been reported that no countermeasures were carried out to prevent pests from affecting agricultural crops.

Table 15: Inductive Codes from Indicator 2.1 'Livestock and Agriculture'

Indicator 2.1 – Livestock and Agriculture			
Question	Identified inductive Codes		
2.1	<ul style="list-style-type: none"> Difficulty in doing agriculture due to wildlife conflicts (10) 	<ul style="list-style-type: none"> Planting different types of vegetables (4) 	<ul style="list-style-type: none"> Difficulty in doing agriculture due to droughts (1)
2.2	<ul style="list-style-type: none"> Food and Mouth (12) Putting livestock inside the house (1) No (prevention) measures for agriculture (1) Malaria for livestock (6) Deworming (1) 'Cham cham' (2) 	<ul style="list-style-type: none"> Buying medicine (from Agrovat) (21) Tse-tse fly affecting livestock (3) Wildebeests transmitting disease (1) Affected by droughts (2) Spraying pesticides (3) Pests (1) 	<ul style="list-style-type: none"> Seeking support from Veterinary (13) Vaccination of livestock (6) Covering water sources to prevent transmission (1) Cold for livestock (2) Applying antibiotics (1) Caterpillars affecting crops (1)

6.1.2.2 Land Usability

Overall, the assessment results for indicator 2.2 are relatively clear as 24 of the interview participants stated that they benefit from good conditions for agriculture and livestock. Both the two interview participants who noted the presence of medium land quality for livestock

and agriculture as well as the interviewee that reported bad conditions for his livestock are situated in the village of Oololaimutia.

Similar to the retrieved codes from indicator 2.1 and particularly question 2.1 two interview participants stated that they are facing a difficulty in doing agriculture due to wildlife conflicts, relating the abundance of wildlife and accompanied restrictions directly to the usability and quality of their land. Additionally, one landowner (6) from Oololaimutia yet connected the abundance of wildlife and especially elephants, that destroy fences and approach the farmland, to a restriction of livestock management. On the other hand, three landowners were focusing their argumentation about a present land pressure that was observed on the overload of livestock that they attribute to themselves and the whole community. As well related to a proper livestock management and the desired land conditions interview participant (4) from Oololaimutia argued that especially due to droughts the land does not have a sufficient fertility to support his livestock.

Table 16: Inductive Codes from Indicator 2.2 'Land Usability'

Indicator 2.2 – Land Usability			
Question	Identified inductive Codes		
2.3	<ul style="list-style-type: none"> • Difficulty in doing agriculture due to wildlife conflicts (3) • Land pressure by livestock overload (3) 	<ul style="list-style-type: none"> • Difficulty in livestock management due to wildlife conflicts (1) 	<ul style="list-style-type: none"> • Low fertility during droughts (1)

6.1.2.3 Water Resources

Indicator 2.3 focuses predominantly on the quality of drinking water that is being accessed by the landowners and their communities. Accordingly, the interview participants were firstly asked from which sources they access the drinking water, how they would assess its quality, and which measures they take to measure it. Furthermore, participants were asked whether they have already been affected by diseases which were attributed to the consumption of contaminated drinking water. Lastly, the interviewees should describe the reliability of their respective water sources meaning if the water is available for them at all times or if they possibly face certain shortages. The overall results for this indicator are very different across the villages. Both Oololaimutia and Empopungi only reached a score of 0.33 whereas Enkoriong and Illturisho received the highest possible value with 1.00 respectively. The total result including all villages is computed as 0.61 and the capacity level therefore recognized as 'high'.

Basically, the qualitatively defined codes to enable a proper assessment of the water quality are divided into two main cases. The first one represents a seemingly good water quality with no treatment steps applied or a perceived medium, low, or unknown water quality but with treatment steps respectively applied. This description matches the majority of 22 interview participants. The remaining five interviewees reported a seemingly medium, low, or unknown water quality while no treatments steps have been applied. The respective 'high' or 'medium' level that has been attributed to the landowners in according to the previously mentioned two cases furthermore takes into account whether the water source

is reliable and whether the landowners have already been affected by diseases due to the drinking water. If any of these conditions are reported with a negative result, this lowers the level of the grading as it is shown in the code manual for 'natural resources capacity' in chapter 5.3.2.3. In this regard, 10 interview participants stated that they have already been affected by diseases which they attribute to their drinking water, equaling 37% of all interviewed landowners whereas six interviewees especially noted a low reliability of the water source or regular water shortages. These information result in 13 interview participants being individually assessed with a 'high' capacity, eight participants with a 'medium' capacity, and seven with a 'low' capacity.



Figure 16: Constructed Water Tap close to the Village of Oololaimutia (March, 2023)



Figure 17: Digging water Technique at the Village of Oololaimutia (February, 2023)

The interviewed landowners provided different types of water sources that they are accessing their drinking water from. The majority of 12 landowners noted to access basic river water and directly catch it from the surface while five interview participants emphasized that they do not catch the water directly from the surface but dig the sand close to the water source as shown in figure 16. Catching the water by using this technique implies the particular consideration of natural water filtering mechanisms. Another seven interviewees, all of which are living in the three bigger villages Oololaimutia, Megwara, and Sekenani, mentioned to access tab stands providing drilled water as for example shown in figure 17. Moreover, interviewee (4) from Oololaimutia pointed out to prioritize rainwater harvesting as the preferred means of accessing drinking water and the two landowners (9) and (11) from Megwara stated to access their water from a stream that originates in nearby hills. Two landowners additionally noted that they have the opportunity to hire someone who is providing them with drinking water. With regards to water treatment, only three interview

participants reported to actively carry out water treatment measures before consumption. Accordingly, landowners (4) and (5) from Oololaimutia stated to boil their accessed water while interviewee (1) from Oololaimutia mentioned to apply sieving techniques. Landowner (23) from Enkoriong additionally noted to prevent water contamination by covering or fencing the water catchment so that it is not accessed by livestock and wildlife possibly transmitting diseases. The majority of 15 interview participants claimed to not know how to effectively measure the quality of their water source, however eight participants added to check the water quality by optical inspection and consume it if it appears to be clean.

Under consideration of the affectedness by water-related diseases ten landowners in total stated that they were affected by diseases related to drinking water. Of the 12 participants that are fetching river water were seven already affected by related diseases which equals a percentage of 58%. Additionally, interviewee (5), who reported to mainly fetch river water but also accesses tab water that is especially provided during droughts, has been affected by diseases. However, due to the different sources his case is not directly assigned to one of these water sources. Further, one landowner (3) from Oololaimutia who reported to dig sand at the water source but not directly fetch water from the surface, has been affected by water-related stomachs in the past. Also, one landowner (11), who mentioned the hill behind his land as the source of the stream where he accesses water from, reported that his children have already been affected by water related diseases. He attributes these incidents to activities of a school which has been built close to the stream and which causes pollution. Beside two interview participants who stated the occurrence of stomachs related to the consumption of water, five interviewees especially noted cases of diarrheal diseases such as Cholera. In comparison, none of the seven interview participants who stated to access drilled water from tabs reported cases of water-related diseases. Another disease-related aspect has been brought up by interviewees (2) and (3) from Oololaimutia who stated that they recognized their respective water sources as breeding sites for mosquitos which are the popular transmitters of Malaria. Further issues which have been brought up are arising conflicts for available water among neighbors as in the case of interviewee (14). Also, interview participants (4) from Oololaimutia and (21) from Empopungi mentioned that the accessibility of water is directly dependent on the climate.

Table 17: Inductive Codes from Indicator 2.3 'Water Resources'

Indicator 2.3 – Water Resources			
Question	Identified inductive Codes		
2.4	<ul style="list-style-type: none"> Digging sand at water source and not taking water directly from water surface (5) Stomachs (2) Rainwater harvesting (1) Tasting water with the mouth (1) Affected by diarrheal diseases such as Cholera (5) 	<ul style="list-style-type: none"> Not knowing about how to measure water quality (15) Sieving of water (1) Conflict with neighbor for water (1) Accessing river water (12) Hiring people to bring water (2) 	<ul style="list-style-type: none"> Other people are bathing in the same water / upstream (1) Boiling of water (2) Malaria Breeding Sites (2) Water catchment area fenced / covered (1) Water access depending on climate (2)

	• Accessing drilled water from tabs (7)	• Water from a mountain source (2) (affected?)	• Check through optical inspection (8)
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6.1.3 Economic Capacity

Table 18 shows the results across all villages for the third determinant of economic capacity. Accordingly, the indicator of 'costs' reaches the lowest result among all measured indicators in this work with a very low score of 0.12. On the other side, 'assets' achieved the highest value within the determinant of economic capacity with a score of 0.72 corresponding to a 'high' capacity. The respective results of the four different indicators lead to an overall 'medium' score of 0.42 for the determinant of 'economic capacity'. In the following, quantitative results as well as obtained qualitative information for each of the indicators are discussed.

Table 18: Overall Results for the Determinant of Economic Capacity

Indicator		V1 - Oololaimutia		V2 - Megwara		V3 - Sekenani		V4 - Empopungi		V5 - Enkoriong		V6 - Illturisho		Average (Total)	
3	Economic Capacity	M	0.40	L	0.38	L	0.33	L	0.37	M	0.53	H	0.67	M	0.42
3.1	Income	H	0.67	M	0.50	M	0.42	L	0.33	H	0.67	VH	0.83	M	0.56
3.2	Costs	VL	0.08	VL	0.08	VL	0.04	VL	0.00	L	0.25	M	0.42	VL	0.12
3.3	Assets	H	0.75	M	0.58	H	0.67	VH	0.83	H	0.67	VH	1.00	H	0.72
3.4	Insurance	M	0.42	H	0.67	M	0.50	H	0.67	VH	0.83	H	0.67	M	0.59

6.1.3.1 Income

Indicator 3.1 focuses on the stability and resilience of the landowners' income by firstly determining the diversification of income sources and afterwards identifying to what extent these sources of income are climate sensitive. Although 23 of 27 interview participants mentioned to receive their income from more than one source excluding the lease payments by MSC, the majority of their capacity results only reach 'medium' levels. Accordingly, 12 interviewees achieved a 'medium' score, contributing to the overall value of 0.56. This circumstance is due to the aspect of climate sensitivity consideration. In this regard, 18 participants noted that equal to 50% or more of their income resources are depending on the climate and are therefore sensitive to weather changes and extremes. The village of Empopungi reached the lowest result with a value of 0.33 whereas the village of Illturisho achieved a 'very high' score of 0.83.

Table 19 provides insights into the several different ways of generating income that have been stated by the interview participants. The most distinct income source which has been provided by all 27 landowners is the selling of livestock as it is strongly related to the traditional Maasai lifestyle that is characterized by livestock keeping. In this regard, 25 of the interviewees clearly pointed out that especially the health and quality of their livestock is recognized as climate sensitive. Many of them such as the participants (4), (11), and (22) further elaborate on their perception by explaining that the livestock and in particular the cows are losing weight and becoming sick during drought periods. As a consequence, the market price of livestock decreases sharply which affects the income generation of landowners negatively. Beside the selling of livestock, five interviewees additionally

mentioned that they are selling dairy products, two participants (19) and (23) are running a small food business, and one landowner (7) reported to sell the crops that she is cultivating. A higher share of 13 interviewees also stated that they themselves or their family members are employed. For example, participant (4) from Oololaimutia is working in the tourism industry as well as the husband of interviewee (19) from Empopungi who is also employed at a tourist camp. The two landowners (5) and (6) from Oololaimutia both stated to additionally work as teachers in local schools. The interviewees (14) and (20) moreover emphasized the climate sensitivity of employment with interviewee (20) explaining that the number of tourists, accessing the national park and representing potential customers for her husband, is reduced and correlates with periods of heavy rainfall. Beside the landowners who are directly employed in tourism facilities there are those who are not directly employed in this industry but who also generate income through services provided to the tourists. Accordingly, seven interview participants stated to sell their self-produced bracelets to the tourists whereas interviewee (18) from Sekenani mentioned to entertain them by certain activities such as dancing and singing. Further income sources that have been mentioned are the selling of herbal medicine by the landowners (1) and (21), the carrying out of day-to-day craft work by interviewee (14) from Sekenani and the preparing and selling of charcoal noted by interview participant (22) from Enkoriong. Another crucial factor which needs to be taken into account when analyzing the variety of income sources is the receiving of financial support from relatives. Of the 27 landowners that were interviewed one third or nine participants noted to receive such remittances.

Interview participant (5) from Oololaimutia not only stated that recent drought events and rainfall shortages impacted his livestock but also that wild animals were affected and died which, in his perception, also had a negative impact on the tourism industry. With a decreasing number of tourists visiting Maasai villages the income opportunities for people whose businesses rely on the interaction with those tourists consequently declined either. Four other landowners, all from the village of Sekenani, are sharing a similar view on the relation between climate and tourism as they argue that there is a particular season for tourists to visit the area which is away from drought and rain periods and therefore that they might be impacted by shifting weather patterns and prolonged droughts as indicated by interviewee (13).

Finally, the lease payments that are paid by conservancies such as MSC represent a steady and reliable income source for landowners, although it is not mandatory for those to lease their land for that purpose. Among all interviewees 24 mentioned to receive the conservancy lease while two interview participants stated to not receive the lease payments. In this sense, interviewee (1) from Oololaimutia stated to not receive the lease anymore since her husband has died, possibly due to administrative issues. Landowner (13) from Sekenani however, explained that she and her family are deliberately not leasing their land to the conservancy and therefore do not receive any lease. The data on receiving the lease payment is available only for 26 of the 27 interview participants as in one case, the respective information has not been registered properly.

Table 19: Inductive Codes from Indicator 3.1 'Income'

Indicator 3.1 – Income			
Question	Identified inductive Codes		
3.1	<ul style="list-style-type: none"> • Selling livestock (27) • Climate change indirectly affects tourism because of less wildlife (1) • Receiving financial support from relatives (9) • Doing day-to-day craft work (1) • Selling char coal (1) • Selling herbal medicine (2) 	<ul style="list-style-type: none"> • Being employed (13) • Livestock health and quality climate sensitive (25) • Climate change indirectly affects tourism (4) • Employment climate sensitive (2) • Selling dairy products (5) 	<ul style="list-style-type: none"> • Selling crops (1) • Selling bits to tourists (7) • Receiving conservancy lease (24) • Doing entertainment for tourists (1) • Small food business (2)

6.1.3.2 Costs

After the previous indicator aimed to identify the ways through which the landowners and their families generate their income, the following indicator 3.2 'costs' and its respective two interview questions are designed to determine the landowners' perception about the costs of daily living commodities as well as their capability to cover these costs through their generated income. Furthermore, to obtain the total score for this indicator, the interview participants have been asked about their experience of financial losses through weather events in the past and whether they were able to access means of financial assistance during that time. The total results reveal very low capacity levels across the different villages with Oololaimutia, Megwara, Sekenani, and Empopungi respectively reaching values between 0.00 and 0.08. Illturisho is the only village in which a 'medium' result could be obtained with a value of 0.42, whereas Enkoriong achieved a low value of 0.25. The overall score for indicator 3.2 amounts to 0.12 which is the lowest obtained result for an indicator within this research.

Answering question 3.2 about the landowners' capability to cover their costs and their perception of price fluctuations of living commodities, distinct interview answers could be obtained that draw a picture of a constraining price environment for the people. Accordingly, 23 were reporting an overall increase of the prices particularly for foodstuffs such as sugar, maize flour, and cooking oil as described by interviewee (12) from Megwara. Five landowners moreover highlighted heavy price fluctuations they were affected by. Additional qualitative codes that could be obtained through question 3.2 were that two participants perceived the payment of school fees as a particular burden while interviewee (14) from Sekenani emphasizes that, in this regard however, the lease paid by MSC provides the opportunity to properly cover the school fees. Interview participant (6) brings up the point that price fluctuations also affect the livestock, which has been reflected already in more detail under indicator 3.1. Interviewee (4) additionally mentioned to buy dried grass to feed the livestock during droughts showing that he can afford such additional expenses in comparison to most other landowners.

The results for question 3.3 reveal that the majority of 23 interview participants already experienced economic losses during droughts while at the same time 15 interviewees stated to not have access to additional financial assistance indicating complex conditions for landowners to maintain their livelihoods in such times. On the other side, five interviewees reported to receive remittances from family members or relatives while one landowner (27) from Illturisho particularly mentioned MSC that supported her and her family with financial assistance dedicated to pay the school fees for the children. Another interview participant stated to have access to loans from her self-help group possibly referring to the idea of shared contributions and alternate beneficiaries as presented for indicator 1.3. In the context of economic capacity, three beneficiaries highlighted to spend and invest their money in livestock as an essential asset. Interview participant (24) from Enkoriong argued that she and her husband never experienced financial losses during drought as his employment is said to be resistant to such circumstances.



Figure 18: Weekly Market in the Village of Oololaimutia (January, 2023)

Table 20: Inductive Codes from Indicator 3.2 'Costs'

Indicator 3.2 – Costs			
Question	Identified inductive Codes		
3.2	<ul style="list-style-type: none"> Conservancy lease can pay school fees (1) Payment of school fees as a burden (2) 	<ul style="list-style-type: none"> Prices are higher now (23) Buying dried grass for livestock during droughts (1) 	<ul style="list-style-type: none"> Heavy price fluctuations (5) Price fluctuations affecting cattle (1)

3.3	<ul style="list-style-type: none"> Economic losses during droughts (23) Money is being invested in livestock (3) Possible loans from self-help group (1) 	<ul style="list-style-type: none"> No financial assistance received (15) Support from Mara Siana Conservancy (1) No economic losses during droughts (1) 	<ul style="list-style-type: none"> Remittances from family members / relatives (5) No pumping of water for irrigation during droughts (1)
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6.1.3.3 Assets

To determine the landowners' capability of asset creation and money saving, indicating their economic preparedness and scope of action when it comes to aggravated conditions, the interview participants were asked about the main assets they are possessing and whether they are the legitimate owners of land, livestock, and further farm resources. The total results for the indicator 3.3 'Assets' reveal mainly 'high' and 'very high' capacity values with the village of Illturisho reaching the maximum score of 1.00. Only the village of Megwara obtains a 'medium' score with the lowest value of 0.58 among the villages. With a score of 0.72 however, indicator 3.3 and the aspect of 'Assets' achieved the highest result among the different indicators of the economic capacity determinant. The crucial foundation of these overall good results is the circumstance that all of the interviewed landowners have the ownership for their respective land and livestock, which reflects an essential economic protection factor and is related to the land demarcation activities that happened in recent years with distributing fixed land parcels to the legitimate landowners. The difference between a 'medium' and a 'high' result, each interviewee was graded accordingly, is the additional possession of household savings or other assets of value. If one of these were present, the respective interview participant was graded with a 'high' result. In that regard, seven landowners reported to possess an own motor bike while two other landowners even possess an own car. Only two interviewees stated to have generated household savings. On the contrary, interview participant (9) presented his position as if there is no motivation for her to particularly save money and generate household savings but rather to reinvest obtained money directly into livestock. In this way, financial resources are transformed into assets.

Table 21: Inductive Codes from Indicator 3.3 'Assets'

Indicator 3.3 – Assets			
Question	Identified inductive Codes		
3.4	<ul style="list-style-type: none"> Possessing a motor bike 7) Obtained money is invested in livestock (1) 	<ul style="list-style-type: none"> Possessing a car (2) Improved Massai Manata house (1) 	<ul style="list-style-type: none"> Having household savings (2)

6.1.3.4 Insurance

Indicator 3.4 aimed to determine the level of insurance coverage among the interview participants by asking whether those obtain any insurance for a) social and health matters, b) climate related damage, c) livestock and agriculture, or d) assets and furniture. Accordingly, different cases and constellations of insurance aspects were identified that were graded with a differentiated assessment scheme. If a participant has an external insurance for a) plus either b) or c) the capacity result was graded with the attribute 'high'.

Such a 'high' score was also achieved when the single presence of any of the mentioned options was given in addition to the expressed recognition of the landowners' livestock or other assets as financial capital that would be exchanged or sold for money to compensate emerging costs in the respective areas. A 'medium' score was either assigned when the interview participant only obtains one of the given insurance types or when they are planning with their livestock or other assets as financial insurance. Only if an interviewee stated to not have any kind of insurance the indicator result is considered as 'low'. The defined capacity fulfilment levels with particular attention to the recognition of livestock or other assets as financial insurance are mainly based on inductive coding derived from the interviews.

The total result for indicator 3.4 is calculated with a 'medium' value of 0.59. The lowest result with a value of 0.42 has been reached in the village of Oololaimutia whereas the villages of Megwara, Empopungi, and Illturisho all achieved a 'high' score of 0.67 and Enkoriong a 'very high' score of 0.83. Overall, seven interview participants generated a 'high' score, while 18 participants reached a 'medium' and two a 'low' score meaning that they neither obtain any kind of external insurance nor recognize livestock or other assets as financial insurance. The majority of 15 landowners stated to recognize their livestock or other assets as financial insurance, a circumstance of coping with incidents and periods of economic difficulties that can therefore be assessed as relatively popular among the investigated Maasai communities. In that regard, several interview participants such as the landowners (7) from Megwara and (21) from Enkoriong explained to sell livestock to receive money for buying foodstuffs, fodder, fertilizers or even to be able to pay school fees as in the case of landowner (17) from Sekenani. Additionally, interviewee (15) from Sekenani stated to sell bracelets to tourists to be able to supply her livestock with fodder and to pay for health services.

In total, 11 interview participants noted to obtain a health insurance, some of which such as landowner (4) from Oololaimutia particularly expressed to obtain it through governmental employment. Interviewee (4) from Oololaimutia as well as interviewee (19) from Empopungi for example mentioned to have an official health insurance and a respective insurance card.

Table 22: Inductive Codes from Indicator 3.4 'Insurance'

Indicator 3.4 – Insurance			
Question	Identified inductive Codes		
3.5	<ul style="list-style-type: none"> External health insurance (11) Borrowing money from friends (1) Livestock as financial insurance (15) 	<ul style="list-style-type: none"> Money from carrying passengers with the motor bike as financial insurance (1) Husbands' salary (1) Borrowing money from friends (1) 	<ul style="list-style-type: none"> Buying dried gras for livestock during droughts (4) External insurance for assets (4)

6.1.4 Infrastructural and Technological Capacity

Table 23 shows the results across all villages for the fourth determinant of infrastructural and technological capacity. Accordingly, the indicator of 'connection' reaches the lowest

result among the indicators of the determinant and the second-lowest value of all measured indicators in this work with a 'low' score of 0.25. As the two other indicators 4.2 'housing and living environment' and 4.3 'access to public housing services' both achieve similarly 'medium' results with 0.48 and 0.49, the overall score for the determinant amounts to 0.41. In the following, quantitative results as well as obtained qualitative information for each of the indicators are discussed.

Table 23: Overall Results for the Determinant of Infrastructural and Technological Capacity

Indicator		V1 - Oololaimutia		V2 - Megwara		V3 - Sekenani		V4 - Empopungi		V5 - Enkoriong		V6 - Illturisho		Average (Total)	
4	Infrastructural & Technological Capacity	M	0.49	M	0.42	M	0.43	L	0.25	L	0.39	L	0.36	M	0.41
4.1	Connection	L	0.25	VL	0.17	M	0.42	VL	0.00	VL	0.17	M	0.42	L	0.25
4.2	Housing & Living Environment	VH	0.83	M	0.50	L	0.33	M	0.50	M	0.50	VL	0.00	M	0.48
4.3	Access to public Housing Services	M	0.53	M	0.56	M	0.47	L	0.33	M	0.50	M	0.44	M	0.49

6.1.4.1 Connection

As already mentioned above, indicator 4.1 'connection' obtains relatively low scores among the different villages with three very low values below 0.17 in the villages of Megwara, Empopungi, and Enkoriong. Only the two villages of Sekenani and Illturisho achieved both 'medium' scores of 0.42.

As the total score for indicator 4.1 is computed through the results of the respective two interview questions, a main reason for the overall negative values is the bad or medium status of the road system that is connecting the landowners and their families with the surrounding area. With regards to question 4.1, nine interview participants reported a bad road system as well as the accessibility of major facilities particularly markets, schools, and healthcare in under 60 minutes or even longer resulting in a 'low' capacity. Another nine interviewees reported a bad road system but an accessibility of the respective facilities in under 30 minutes resulting in an individual 'medium' score. Six interview participants who noted to be connected to a road system of medium quality and an overall accessibility of the major facilities in under 30 minutes obtained a 'medium' result. A 'medium' result was also assigned to those landowners who reported a good quality of the road system but a general accessibility of the main facilities in only under or more than 60 minutes. Eventually, the two landowners (25) and (26) from Illturisho were as well assessed with a 'medium' capacity score as they reported a good quality of the road system while stating that the majority of relevant facilities can be accessed in under or more than 60 minutes. Another interview participant (23) from Enkoriong also stated an accessibility of the respective facilities in under or more than 60 minutes but perceived the road system connected to his place as rather 'moderate' leading to a 'low' capacity result.

The analysis by means of inductive codes which is presented in table 24 reveals that three landowners were particularly highlighting a difficult accessibility of the relevant infrastructure during the rainy season, indicating a link between weather events and accessibility

constraints as well as a lack of respective preparedness. One further participant additionally mentioned the main tarmacked road being of high quality and thus indicates a better accessibility.



Figure 19: Main connecting Road, rough and with Potholes (Megwara, January, 2023)

To determine the total score of every interview participant for indicator 4.1 the results of the answers for question 4.2 are presented in the following. Accordingly, this question is related to the provision of communal infrastructure in the surrounding area of the landowners' homesteads that is especially prepared for extreme weather events and natural disasters particularly heavy rainfalls and flooding, however a limiting factor is reflected through the specific infrastructural focus on the connection aspects in particular the road system as the homesteads are usually not connected for example to the energy grid or communal sewage systems. Therefore, the interview participants related their answers specifically to the adjacent road system and whether, in according to their perception, it is constructed and provided in a resilient way so that it withstands extreme weather events and maintains its function. In that regard, 18 landowners were of the opinion that none of the communal infrastructure, with special attention to the road system, has been designed in a resilient way. Another nine interview participants stated that the respective infrastructure at least was partly constructed to withstand extreme weather while not a single landowner mentioned a clear trend of such resilient infrastructural constructions. The additional identification of inductive codes reveals that the majority of 16 interviewees perceive the general road system as becoming impassable during rains while on the contrary, only two participants stated that also the normal roads connected to their lands are able to mainly withstand heavy rain. Accordingly, landowner (12) from Megwara mentioned modifications

such as drainage channels at the sides of the roads through which it is aimed that vehicles do not get stuck. Also, interviewee (25) from Illturisho stated that the normal roads usually withstand heavy rains and only small areas become impassable. Interview participant (19) from Empopungi shares the experience that through the missing preparedness and resilient construction of roads the way to the school is not passable for their children during heavy rain, indicating issues of accessibility of education.

Table 24: Inductive Codes from Indicator 4.1 'Connection'

Indicator 4.1 – Connection			
Question	Identified inductive Codes		
4.1	<ul style="list-style-type: none"> During rainy season facilities are difficult to access due to road conditions (3) 	<ul style="list-style-type: none"> Main tarmac road in good condition (1) 	<ul style="list-style-type: none"> Market only once a week (1)
4.2	<ul style="list-style-type: none"> Main road can withstand heavy rain (7) Way to school is not passable (1) 	<ul style="list-style-type: none"> When it rains the roads become impassable (16) 	<ul style="list-style-type: none"> Normal roads can (mainly) withstand heavy rain (2)

6.1.4.2 Housing and Living Environment

After having considered the resilience of communal infrastructure it is now aimed to assess the resilience and preparedness of the landowners' homesteads, and in particular whether those have already recognized constructions and modifications of their houses preparing them to withstand extreme weather events especially heavy rainfalls. Through the assessment of indicator 4.2 a wide variety of results has been obtained. In the village of Illturisho the lowest possible value of 0.00 was generated whereas, on the other side, in the village of Oololaimutia a remarkable score of 0.83 has been reached.

However, the overall answers of the interview participants and the assignment of assessment codes remain very balanced. Accordingly, eight interviewees stated to already built components of their homestead while actively considering climate and weather events. As an example, interview participant (18) from Sekenani stated that since he and others of the community started to use timber as construction material the lifetime of the houses increased up to 10 to 12 years while they better withstand weather conditions and prevent water from intruding. Interviewee (6) from Oololaimutia additionally mentioned that he located his house in a raised place to prevent flooding. 10 landowners pointed out that their houses are withstanding heavy weather events although they were not actively considering building their houses in an especial resilient way. Interview participant (13) from Sekenani for example brought up the point that difficult income conditions constrain her abilities to carry out constructing activities to adapt the house particularly to climate and weather events. Though at this point it should once more be noted that the interview participants may understand and emphasize their point of view individually. Some are for example highlighting that their houses are withstanding weather events while not directly mentioning an active consideration of these circumstances when carrying out construction activities, even if that was the case. On the other side, there may be landowners whose houses are

withstanding weather events and what may be the reason for them to state that they have actively considered resilience aspects during construction, even if they have not.



Figure 20: Typical Maasai House 'Manata' in the Village of Enkoriong (February, 2023)



Figure 21: Construction of a Manata with an improved Roof using a corrugated Iron Sheet in the Village of Megwara (January, 2023)

Table 25: Inductive Codes from Indicator 4.2 'Housing and Living Environment'

Indicator 4.2 – Housing and Living Environment			
Question	Identified inductive Codes		
4.3	<ul style="list-style-type: none"> House cannot withstand heavy rain (9) 	<ul style="list-style-type: none"> House can withstand heavy rain (15) 	<ul style="list-style-type: none"> Income conditions constrain abilities to adapt house / farm facilities (1)

6.1.4.3 Access to Public Housing Services

The total indicator results for indicator 4.3 reveal consistently 'medium' values among the different villages within a range between 0.44 and 0.56, while only the village of Empopungi reached a 'low' score of 0.33. Accordingly, indicator 4.3 investigates three different aspects with one distinct interview question each contributing to the overall result.

Firstly, it is aimed to determine the provision of sanitation, sewage, and drainage systems available to the landowners whereas both sewage and sanitation are of the same meaning and relate to the presence of one system to safely manage feces and avoid a contamination that affects the health of the own household as well as of other community members. In that regard, the majority of 17 landowners mentioned not to be provided with neither sanitation and sewage nor with a drainage system resulting in an initial 'low' score for this interview question. Further seven interview participants however stated that they are provided either with a sanitation and sewage system or with a drainage system draining wastewater out of their property. For this circumstance, the interviewees are given a 'medium' result. Only three landowners stated to have all the different systems in place generating a 'high' result. Accordingly, interviewees (2) from Oololaimutia, (12) from Megwara, and (23) from Enkoriong explained that they are provided both with a toilet as well as with a certain drainage mechanism through which wastewater is canalized. As the critical assessment codes already cover all relevant information provided through the participants' answers, there are no further inductive codes registered.



Figure 22: Solid Pit Latrine constructed in the Village of Illturisho (March, 2023)

Indicator question 4.5 is dealing with the connectivity of landowners to the external networks and their accessibility of channels through which they are able to retrieve any kind of information and news. The internet is hereby considered as the most essential medium currently by which people are able to stay up to date and access relevant current information to extend their knowledge leading to a 'high' result for this question if fulfilled. In this regard, nine interview participants stated that they use internet specifically to receive information. If the participants were accessing radio, TV, or using telephones as sources to access relevant information and news a 'medium' capacity level was assigned. Accordingly, 24 interviewees mentioned to receive their information through telephones or radio and another six interview participants noted to additionally receive information through TV.

The final question 4.6 which is also contributing to the overall result of indicator 4.3 focuses on the landowners' sources of energy and their potential diversification as well as their reliability. The majority of 21 interviewees explained to be provided with energy and electricity through diversified sources, although of lower reliability resulting in a 'medium' score. On the other side, five interview participants stated to be provided with energy and electricity through diversified sources with a high reliability leading to a 'high' question result. Only one landowner (1) from Oololaimutia mentioned to not be properly provided with energy or electricity. In her case, she was just equipped with a solar flashlight and therefore, she could not run any electrical devices and steady lights. Also, her access to energy sources was neither diversified nor reliable as she argued to only use firewood which was additionally difficult to collect due to the presence of wild animals and conservation issues. Due to time constraints within the interview with landowner (2) from Oololaimutia, not all information specifically regarding the reliability of the energy sources could be obtained. However, it was decided to assign him to the category of 'high' capacity as he is provided with diversified sources of solar energy and firewood and did not particularly mention any shortages and issues of the energy supply. Generally, except landowner (1) all interview participants noted to be provided with solar energy while 18 of those added the information that they were already experiencing electricity shortages when they have not paid the solar company which owns the panels. Another five interview participants pointed out that they would not receive solar energy when the sun is not shining and especially during rainy season. Furthermore, firewood has been identified as the second most popular energy source with 25 landowners utilizing it. Accordingly, three interview participants described their access to firewood as not always possible. Interviewee (25) from Illturisho for example explained that they rely on the local water stream to transport firewood to them which is not always possible whereas interviewees (26) and (27) from Illturisho stated the access is not easy and is accompanied with a certain effort and long ways that collectors need to go to obtain the firewood. Moreover, ten interviewees mentioned to use char coal while two interview participants (23) from Enkoriong and (26) from Illturisho explained that it is relatively expensive to refill gas indicating a lower affordability for that particular source of energy. Beside the previously identified sources also the utilization of gas has been stated by seven participants.

Table 26: Inductive Codes from Indicator 4.3 'Access to public Housing Services'

Indicator 4.3 – Access to Public Housing Services			
Question	Identified inductive Codes		
4.4	(No inductive codes registered)		
4.5	<ul style="list-style-type: none"> Receiving information through internet (9) 	<ul style="list-style-type: none"> Receiving information through telephones and / or radio (24) 	<ul style="list-style-type: none"> Receiving information through TV (6)
4.6	<ul style="list-style-type: none"> Access to firewood may be constrained by wild animals or conservation issues (3) Using firewood (25) Electricity shortages when solar company is not being paid (18) Using energy efficient stove (1) 	<ul style="list-style-type: none"> Provided only with a flashlight run by solar energy (1) Using char coal (10) Access to firewood not always possible (3) Expensive to refill gas (2) 	<ul style="list-style-type: none"> Provided with solar energy (26) Using gas (7) No solar energy without sun and / or during rainy season (5)

6.1.5 Institutional Capacity

Table 27 shows the results across all villages for the fifth determinant of institutional capacity. The total score of the determinant amounts to a 'medium' value of 0.58 including a wide spectrum between 'very low' and 'very high' scores among both of the investigated indicators and the six villages.

Table 27: Overall Results for the Determinant of Institutional Capacity

Indicator		V1 - Oololaimutia		V2 - Megwara		V3 - Sekenani		V4 - Empopungi		V5 - Enkoriong		V6 - Illturisho		Average (Total)	
5	Institutional Capacity	M	0.50	H	0.75	H	0.71	VL	0.17	M	0.42	H	0.75	M	0.58
5.1	Relationship to Government & Authorities	M	0.42	VH	0.83	VH	0.92	L	0.33	L	0.33	VH	0.83	H	0.65
5.2	Access of governmental Support	M	0.58	H	0.67	M	0.58	VL	0.00	M	0.50	H	0.67	M	0.54

6.1.5.1 Relationship to Government and Authorities

Indicator 5.1 'relationship to government and authorities' aims to firstly identify the extent of connection and communication between landowners and government authorities as well as the level of satisfaction of interview participants about the relationship. The overall capacity result for this indicator is quantified with a 'high' value of 0.65 with calculated village results comprising 'low' values of 0.33 that were obtained in the villages of Empopungi and Enkoriong as well as 'very high' results between 0.83 and 0.92 which were generated in the villages of Megwara, Sekenani, and Illturisho. The village of Oololaimutia achieved a 'medium' score of 0.42. On closer examination, a group of 15 interviewees mentioned to know the respective local authorities, be able to approach them, and that they are satisfied with the relationship. This evaluation is graded with a 'high' initial assessment result. Five interview participants stated to know the local officials without being able to properly approach them reporting a moderate level of satisfaction about the relationship and thus

reaching a 'medium' initial result for this indicator. Another group of seven landowners noted that those local authorities are not known at all and that there is no relationship possible leading to a low level of satisfaction and a respectively 'low' indicator result. The registration of further inductive codes revealed that eight landowners argued to be directly known with government authorities. Particularly in the village of Illturisho the relationship between the community and the authority appears to be comparatively close as all of the three landowners explain accordingly, with interviewee (25) specifically naming the area chief who is said to be supportive with any kinds of problems. Also, three of the four interview participants who stated to keep regular communication with the government are those landowners from Illturisho as well as interviewee (4) from Oololaimutia. Whereas interviewee (4) described the communication with the government and governmental organizations referring to joint collaboration elaborating on managing conservation and climate change issues, interview participants (25) and (26) from Illturisho highlighted that the area chief is usually approachable to them as he regularly visits the village.

Table 28: Inductive Codes from Indicator 5.1 'Relationship to Government and Authorities'

Indicator 5.1 – Relationship to Government and Authorities			
Question	Identified inductive Codes		
5.1	<ul style="list-style-type: none"> Communication with government (4) 	<ul style="list-style-type: none"> Not educated people do not know about government authorities (1) 	<ul style="list-style-type: none"> Known with the authorities (e.g. chief) (8)

6.1.5.2 Access to Governmental Support

Within the assessment of indicator 5.2 'access to governmental support' the level of governmental support services accessible for the landowners is determined. Accordingly, a total result of 0.54 has been generated among all villages with Oololaimutia, Sekenani, and Enkoriong achieving 'medium' scores, Megwara and Illturisho reaching a 'high' score of 0.67, and Empopungi a 'very low' result of 0.00. The eight landowners that were graded with a high initial assessment score stated to access information and governmental support services such as school and healthcare as well as to receive further personal support from the government for example during crisis such as natural disasters or the COVID-19 pandemic. Another 12 interview participants who were assessed with an initial 'medium' result noted to either access information and support services from the government or to receive further personal support from governmental institutions. The remaining seven interviewees expressed to neither accessed information and support services from the government nor to ever received further personal support from governmental institutions.

Table 29 reveals the interview results for the inductive coding that were obtained. Overall, 13 landowners stated to receive basic governmental support services while nine of them noted to have also received particular support in times of crisis including droughts and COVID-19. With regards to the provision of relevant information by the government it could be retrieved that 15 landowners were regularly receiving information whereas eight participants particularly expressed to not access any governmental information service. Three interview participants including interviewee (18) from Sekenani reported that they were supported with educational assistance such as the payment of bursaries through the

government. Interview participant (3) from Oololaimutia additionally mentioned that also the provision of governmental schools reflects the support by the local government.

Eight of the interviewed landowners mentioned to receive financial support of some kind from the government. While most of the landowners did not receive the governmental financial aid via M-PESA or did not state to have received it, only a few interview participants such as interviewee (10) from Megwara, (13) from Sekenani, and (23) from Enkoriong reported to successfully have accessed the payments. Interviewee (25) from Illturisho mentioned that she received the assistance even four times. The example of interview participant (26) from Illturisho reflects the present complexity about inequitable conditions between women and men also at the household level. Whereas interviewee (22) from Enkoriong explained that, even if she did not, her husband has received the governmental mobile money support, landowner (26) explained that she could not access it, although she actively registered herself as a beneficiary, and that she never asked her husband whether he received the payment. Another way of financial support from the government that has been described by landowners is the provision of regular auxiliary payments to old-aged community members. Accordingly, interviewee (1) from Oololaimutia reported to not receive this kind of social assistance although she argued to be a legitimate beneficiary due to her high age. On the contrary, interviewee (2) from Oololaimutia and the husband of interviewee (8) from Megwara reportedly accessed the payments. Interviewee (6) from Oololaimutia additionally mentioned to access further financial support as he is employed as a teacher through the government.

The interview participants (5) from Oololaimutia and (14) from Sekenani both emphasized governmental health support. Interviewee (14) highlighted services in the form of the provision of healthcare facilities and hospitals as well as medicine during disease outbreaks and interviewee (5) further explained that hospital bills are sometimes paid forward by the government helping affected people to cover treatment costs. Another supportive service that the interviewees (3) from Oololaimutia and (14) from Sekenani reported is that governmental police is available and can be called to solve emerging conflicts. Additionally, the interviewees (13) from Sekenani and (25) from Illturisho mentioned that police officers are even called to scare wild animals away and thus contribute to solve HWCs. Further ways of governmental support are brought up by interviewee (18) from Sekenani and interviewee (23) from Enkoriong who explicitly mentioned the assistance with veterinary services through the government in form of sending veterinaries conducting livestock vaccinations and interviewee (20) from Empopungi who perceived the provision of infrastructure in particular the main tarmacked road in the nearby village of Nkoilale as distinct governmental support.

Apart from the interviewees' answers about positive governmental support, there are also those perceptions which state that support services especially during times of crisis such as drought and COVID-19 have been carried out by other non-governmental or private organizations as interview participant (21) from Empopungi argued. In her example, these organizations drilled water and provided tab stands for the community. Particularly unsatisfied voices such as those of interviewees (4) from Oololaimutia and (8) from Megwara have been recorded arguing that governmental authorities are only talking but not acting in according to their promises. Interviewee (8) brought up the example of the mobile

money assistance through M-PESA once again that was announced by the government and which many of the community including her did not receive.

Table 29: Inductive Codes from Indicator 5.2 'Access to governmental Support'

Indicator 5.2 – Access to governmental Support			
Question	Identified inductive Codes		
5.2	<ul style="list-style-type: none"> Getting information through the government (15) Support with school (1) Governmental support in times of crisis (9) Support from government due to employment (1) No information provided by the government (8) New government has been established (1) Support with wildlife conflicts (2) (13/25) 	<ul style="list-style-type: none"> Legitimate money for old people is not being accessed (1) Governmental support (13) Educational support from government (3) Support with main road (1) Government is only talking but not helping (2) Veterinary support from Government (2) Police solving conflicts (4) 	<ul style="list-style-type: none"> Legitimate money for old people is being accessed (2) Financial support (8) Health support from Government (2) Support comes from other organizations (5) Knowing government authorities (1) Mediators between authorities and community (1)

6.2 Results in accordance with the Villages

In the following, the obtained indicator results are presented based on the respective performance aspects for each of the investigated villages including detailed results for every interview participant.

Table 30: Overall Results for all Determinants across all Villages

Indicator		V1 - Oloolaimutia		V2 - Megwara		V3 - Sekenani		V4 - Empopungi		V5 - Enkoriong		V6 - Illiturisho		Average (Total)	
1	Socio-Cultural Capacity	H	0.68	H	0.67	H	0.71	H	0.67	H	0.75	H	0.71	H	0.69
2	Natural Resources Capacity	M	0.48	H	0.73	H	0.63	M	0.58	H	0.79	H	0.79	H	0.65
3	Economic Capacity	M	0.40	L	0.38	L	0.33	L	0.37	M	0.53	H	0.67	M	0.42
4	Infrastructural & Technological Capacity	M	0.49	M	0.42	M	0.43	L	0.25	L	0.39	L	0.36	M	0.41
5	Institutional Capacity	M	0.50	H	0.75	H	0.75	VL	0.17	M	0.42	H	0.75	M	0.59
Total		M	0.53	M	0.57	M	0.56	M	0.45	H	0.60	H	0.63	H	0.55

6.2.1 Village 1 – Oloolaimutia

With estimated 4.400 inhabitants Oloolaimutia is by far the biggest of the investigated villages around MSC (see Annex V). As one of the more popular villages in the closer area there has been a distinct upsurge in tourism including the establishment of several hotels

and safari camps as well as the growing orientation of residents towards providing services to tourists such as guided tours through Maasai homesteads or the sale of homemade crafts. This development can probably also be attributed to the direct proximity to the nearby MMNR, to which there is a main entrance in the direction of Oololaimutia. The extensive center of the village contains many buildings and facilities including apartments, different kinds of shops, a big square for the weekly market, a hospital, and a primary school. As the population and settlement of the area increases, so does the pressure on natural resources such as local streams and grasslands, as well as the occurrence of HWCs. In the following, the CCAC results for the village of Oololaimutia are comprehensively presented and analyzed focusing on major findings and strengths and weaknesses that have been emerged in comparison with the performance of the other villages. Figure 24 shows the total results for the five determinants while table 31 presents the comprehensive CCAC results for Oololaimutia.

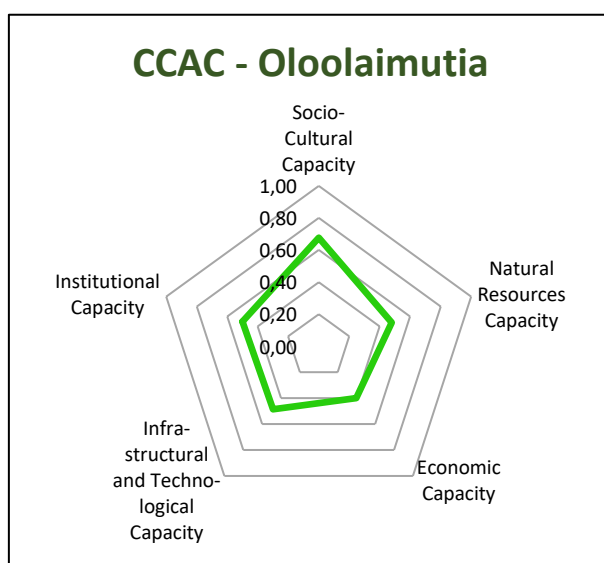


Figure 24: Total CCAC Results for the Village of Oololaimutia

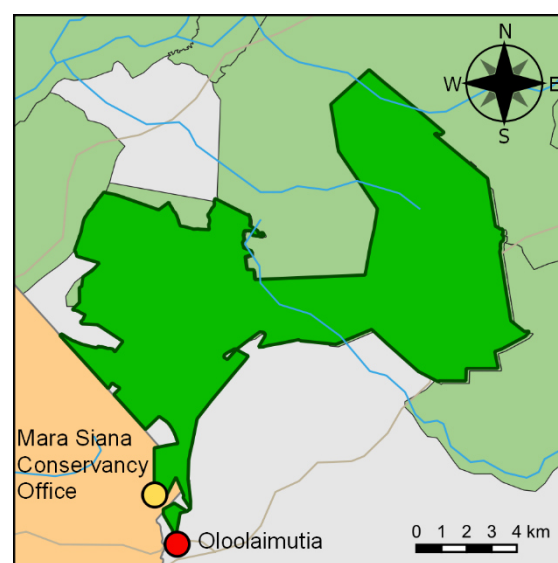


Figure 23: Location of the Village of Oololaimutia

Overall, the total interview results from the village of Oololaimutia reveal a score of 0.53 which is the second lowest among all the investigated villages and slightly below the computed total CCAC of 0.55 for the whole group of interviewees. For the four determinants of 'socio-cultural capacity', 'natural resources capacity', 'economic capacity', and 'institutional capacity' the obtained values for Oololaimutia are respectively below the total average scores.

Within the dimension of socio-cultural capacity, the village of Oololaimutia achieved relatively average indicator results not majorly differing from those of the other villages with a total score of 0.68 compared to the average of 0.69. Accordingly, the indicators of 'gender integration and participation' as well as 'attitude and social attributes' both achieved 'medium' scores while the indicators of 'social network and community' and 'skills and knowledge' reached 'high' results.

Considering the determinant of 'natural resources capacity' however, all three indicators remain below average with a particularly huge gap for indicator 2.2 'land usability' reaching a score of 0.67 while all the other villages achieved a result of 1.00. This is due to the circumstance that only three of the six interviewed landowners mentioned that the

conditions for livestock are good, whereas two interview participants stated that conditions for either livestock or agriculture are moderate, and interviewee (6) even perceived the conditions of his land as bad. The reasons for these perspectives on constrained natural resources in Oololaimutia are provided by the respective landowners as difficulties in livestock and agriculture because of wildlife conflicts, low fertility during droughts, and especially land pressure by livestock overload which has been mentioned by three of the participants. Another identified weakness is reflected by the obtained information on indicator 2.3 'water resources', for which a value of 0.33 has been generated, compared to the total average result of 0.61. Accordingly, even though five of the interviewees stated to either access seemingly good water quality or apply treatment steps if the quality is doubtful, three of the participants noted that they have already been affected by diseases related to water consumption in the past. Moreover, four interviewees additionally mentioned a low reliability of their water source and regular shortages that occur especially during droughts.

For the determinant of 'economic capacity' an overall score of 0.40 was obtained which is slightly lower than the average of 0.42. The indicator of 'income' generated an above average value of 0.67 as five interviewees stated to have more than one income source beside the conservancy lease while only for two of the participants equal two or more than 50% of their income sources have been identified as directly climate sensitive. Also, for the indicator of 'assets' an above average value of 0.75 could be obtained reflecting the number of three interviewees who stated to be in possession of either household savings or further assets of value such a motor bike or a construction improved house. On the opposite, the indicator of 'costs' only generated a score of 0.08 which is caused by the combination of the inability to cover living costs, the experience of financial losses, and a missing access to financial assistance. Accordingly, three participants mentioned to not be able to cover the usual living costs while two other interviewees stated that they are able to only cover the costs for their basic needs. At the same time all six interview participants complained about price fluctuations and increases especially of food items as well as about financial losses that they were already experiencing while five of those explained to not receive any kind of financial assistance. Another weakness applying to the village of Oololaimutia is reflected in indicator 3.4 'assets' for which a 'medium' score of 0.42 has been obtained, thus representing the lowest value among all villages and below the average of 0.59. This is due to the circumstance that none of the interviewees could generate a 'high' individual result as no one obtained the comprehensive insurance coverage defined. In that regard, one interview participant stated to get no kind of insurance whereas three other interviewees mentioned to recognize or plan with their livestock as financial insurance.

Even though four landowners stated to be provided with governmental support services, the minority did not receive personal support in terms of financial assistance or with the provision of goods. Only interviewee (2) mentioned to receive auxiliary payments for old aged people and interview participant (6) noted to be employed through the government and thus access financial assistance. The remaining four landowners indicated to not receive any personal support from the government.

However, the one determinant in which the village of Oololaimutia performed best in comparison to the other villages is the fourth one of 'infrastructural and technological

capacity'. Accordingly, with a score of 0.49 Oololaimutia finds itself distinctively above the determinant's average of 0.41. This is mainly due to the 'very high' capacity result of 0.83 that has been obtained for indicator 4.2 'housing and living environment'. In this regard, five of six landowners directly stated that their houses are withstanding heavy weather events and rainfalls with four of them having already actively considered climate changes and weather events during construction.

Finally, another particularity that can be identified through the analysis from Oololaimutia is that the first interviewed landowner is distinctively behind the others with a total score of 0.33 in the CCAC performance while interviewee (4) reached a specifically high result with 0.67. All other interview participants from Oololaimutia achieved medium results ranging between 0.42 and 0.54.

Table 31: CCAC Results of Interview Participants from the Village of Oololaimutia

Indicator		Interviewee 1		Interviewee 2		Interviewee 3		Interviewee 4		Interviewee 5		Interviewee 6		Average (Total)	
1	Socio-Cultural Capacity	M	0.50	H	0.69	H	0.63	H	0.75	VH	0.81	H	0.69	H	0.68
1.1	Family & Relatives Environment	-	-	-	-	-	-	-	-	-	-	-	-	N.A.	N.A.
1.2	Gender Integration & Participation	-	-	M	0.50	M	0.50	M	0.50	M	0.50	M	0.50	M	0.50
1.3	Social Network & Community	VH	0.83	VH	0.83	H	0.67	H	0.67	H	0.67	H	0.67	H	0.72
1.4	Attitude & social Attributes	M	0.50	M	0.50	M	0.50	M	0.50	VH	1.00	M	0.50	M	0.58
1.5	Skills & Knowledge	VL	0.17	H	0.67	H	0.67	VH	1.00	VH	1.00	VH	0.83	H	0.72
2	Natural Resources Capacity	M	0.50	H	0.75	M	0.50	M	0.50	L	0.38	L	0.25	M	0.48
2.1	Livestock & Agriculture	L	0.25	M	0.50	M	0.50	M	0.50	M	0.50	M	0.50	M	0.46
2.2	Land Usability	VH	1.00	VH	1.00	VH	1.00	M	0.50	M	0.50	VL	0.00	H	0.67
2.3	Water Resources	M	0.50	VH	1.00	M	0.00	M	0.50	VL	0.00	VL	0.00	L	0.33
3	Economic Capacity	VL	0.10	L	0.30	M	0.50	H	0.70	M	0.40	M	0.40	M	0.40
3.1	Income	VL	0.00	VL	0.00	VH	1.00	VH	1.00	VH	1.00	VH	1.00	H	0.67
3.2	Costs	VL	0.00	VL	0.00	VL	0.00	M	0.50	VL	0.00	VL	0.00	VL	0.08
3.3	Assets	M	0.50	VH	1.00	VH	1.00	VH	1.00	M	0.50	M	0.50	H	0.75
3.4	Insurance	VL	0.00	M	0.50	M	0.50	M	0.50	M	0.50	M	0.50	M	0.42
4	Infrastructural & Technological Capacity	L	0.25	M	0.58	M	0.42	H	0.67	M	0.42	M	0.58	M	0.49
4.1	Connection	L	0.25	L	0.25	L	0.25	L	0.25	L	0.25	L	0.25	L	0.25
4.2	Housing & Living Environment	M	0.50	VH	1.00	VH	1.00	VH	1.00	M	0.50	VH	1.00	VH	0.83
4.3	Access to public Housing Services	VL	0.17	H	0.67	L	0.33	VH	0.83	M	0.50	H	0.67	M	0.53
5	Institutional Capacity	L	0.25	M	0.50	H	0.75	H	0.75	L	0.25	M	0.50	M	0.50
5.1	Relationship to Government & Authorities	VL	0.00	M	0.50	VH	1.00	VH	1.00	VL	0.00	VL	0.00	M	0.42

5.2	Access of governmental Support	M	0.50	M	0.50	M	0.50	M	0.50	M	0.50	VH	1.00	M	0.58
Total Result		L	0.33	M	0.58	M	0.54	H	0.68	M	0.52	M	0.52	M	0.53

6.2.2 Village 2 – Megwara

With an estimated population of 2,300 Megwara is still considered as a bigger village within this research, thus requiring for six landowners to be interviewed. It is located roughly three kilometers east to the village of Oololaimutia and in the south to MSC territory. In comparison to Oololaimutia, Megwara is less densely built with a smaller manifestation of tourism facilities such as hotels and safari camps as well as respective services provided by the local Maasai population. Nevertheless, the village of Megwara also hosts essential infrastructural facilities such as a primary school, a place where the weekly market is organized, and a local healthcare facility. Similar to Oololaimutia, Megwara is connected to the national electricity grid as well as to the main non tarmacked road which extends from MMNR towards Narok Town. In the following, the CCAC results for the village of Megwara are comprehensively presented and analyzed focusing on major findings and strengths and weaknesses that have been emerged in comparison with the performance of the other villages. Figure 25 shows the total results for the five determinants while table 32 presents the comprehensive CCAC results for Megwara and the respective interviewees.

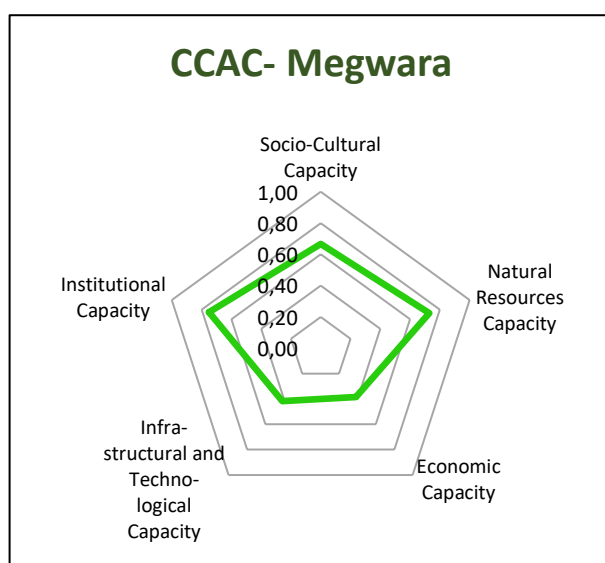


Figure 25: Total CCAC Results for the Village of Megwara

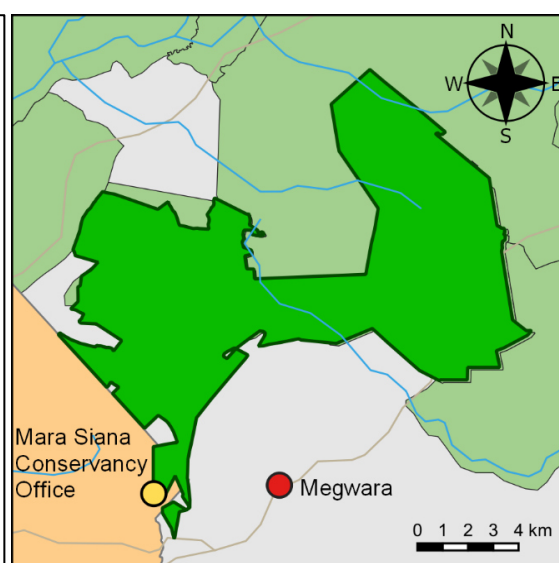


Figure 26: Location of the Village of Megwara

With a total CCAC score of 0.57 the village of Megwara achieved the third highest result among all villages and the highest result among the bigger villages including Oololaimutia and Sekenani. For the two determinants of 'socio-cultural capacity' and 'economic capacity' the obtained values for Megwara are respectively below the total average scores while for the determinants of 'natural resources capacity', 'infrastructural and technological capacity', and 'institutional capacity' above average scores could be generated.

Accordingly, within the dimension of 'socio-cultural capacity' a particularly lower result has been computed for indicator 1.2 'gender integration and participation' with two of the six interview participants mentioned that women are not recognized at all or only in the minority of household decisions whereas three interviewees stated that women are integrated in the majority of household decisions, although the man is the final decision-maker. As only landowner (8) from Megwara argued that in his household men and women are equally participating in general household decisions, the obtained information led to a final indicator result of 0.42. On the other hand, for indicator 1.4 'attitude and social attributes' the village of Megwara reached an above average score of 0.75. Accordingly, three of the interview participants either appeared to lack a comprehensive understanding of the question and especially addressed technologies and gave unprecise examples or seemed to be only moderately open to new technologies and developments. However, another three landowners were assessed with a generally positive attitude towards new developments and technologies and a respectively high understanding of the question.

With a final score of 0.38, within the determinant of 'economic capacity' another below average result has been generated for the village of Megwara. In that regard, a particularly low value of 0.08, similarly to Oololaimutia, was computed for the indicator 3.2 'costs' as two participants stated for question 3.2 to usually not be able to cover their costs while the other four noted that those costs that they are capable of to cover are just related to the basic needs and five of the landowners additionally indicated prices fluctuations. This information led to an overall score of 0.00 for the first indicator question. Additionally, for the second question five interviewees reported to have already suffered from financial losses while only one landowner (12) was able to receive financial assistance resulting in a question score of 0.17. For indicator 3.3 'assets' the village of Megwara reached with a score of 0.58 the lowest result among all the villages, distinctively below the average of 0.72. This circumstance is due to the interview answers which reveal that only interviewee (4) is in possession of additional assets of value as he got an own car whereas the other five participants stated to be the owner of the land, the animals, and the house, but neither having household savings nor further assets of value. However, as the village of Megwara achieved an above average result of 0.67 for the indicator 3.4 'insurance' the overall score for the determinant of 'economic capacity' was lifted to a slightly below average value of 0.38 compared to 0.42. Accordingly, four interviewees were assessed with a 'medium' individual result as they stated to either recognize or plan with assets such as livestock as financial insurance or mentioned to either have an external insurance for health or assets for example or for climate related damage or agriculture and crops. Essentially, two of the landowners from Megwara indicated to either have an external insurance for health or assets or for climate related damage or agriculture and crops plus to recognize or plan with assets such as livestock as financial insurance. Thus, their capacity for the indicator was assessed with a 'high' individual result. More concrete, four participants recognized livestock and one participant the husband's salary, with which the household purchases dried gras during droughts as insurance, two reported to have an external health insurance, and one landowner mentioned to have a medical health insurance due to his governmental employment.

Within the determinant of 'natural resources capacity' particularly positive results in comparison to the other villages were achieved for indicator 2.1 'livestock and agriculture'

as well as for indicator 2.3 'water resources'. Compared to an average score of 0.53, the village of Megwara generated a 'high' result of 0.63 for indicator 2.1 with the main reason that two of the interviewed landowners responded to not only keep livestock but additionally to practice agriculture. This finding is especially remarkable as none of the interviewees from the other bigger villages of Oloolaimutia and Sekenani reported to practice agriculture. Additionally, the answers to the second question of indicator 2.1 reveal that all six participants indicated that their livestock or agriculture have already been affected by pests or diseases in the past while five of them noted that they were able to handle the situation by available means. For indicator 2.3 a result of 0.67 was calculated for Megwara, compared to an overall average score of 0.61. Accordingly, five interview participants indicated to either perceive the accessed drinking water as of good quality or carry out treatment steps while only one interviewee stated to perceive the accessed water as of medium or low quality and does not apply treatment steps. Compared to the village of Oloolaimutia the reliability of the water supply appears to be higher in Megwara with only one interview participant mentioning regular water shortages, however for two further interviewees reliability information could not be obtained and was therefore not considered for the final indicator calculation. Among the bigger villages the share of interviewed landowners who reported that their households were already affected by diseases due to the water consumption is the lowest with two participants only.

The obtained results for the determinant of 'infrastructural and technological capacity' comprise a relatively low score of 0.17 for indicator 4.1 'connection', a quiet average value of 0.50 for indicator 4.2 'housing and living environment', and a relatively high result of 0.56 for indicator 4.3 'access to public housing services' which is the highest value among the different villages. With regards to indicator 4.1, the results for interview question 4.1 reveal that five of the landowners perceived the road system as not good while one participant stated that the road system is moderate. Furthermore, three of the interviewees mentioned that the relevant facilities as market, school, and healthcare can be accessed in under 30 minutes whereas another three interview participants noted that they would access them in up to 60 minutes or even later. Considering the second indicator question 4.2 five interviewees stated that nothing of the communal infrastructure would be especially equipped in a resilient manner while only one interviewee (12) argued that at least a little of communal infrastructure has been designed in a resilient way mentioning that also the main road connection close to her place mainly withstand heavy rain. The investigation of indicator 4.3 comprise the three interview questions 4.4, 4.5, and 4.6. Accordingly, with two landowners stating to be provided with either a sanitation and sewage system or with a drainage system and one participant even mentioning to be provided with all these systems the first question is assessed with a preliminary capacity result of 0.33, the highest among the bigger villages and equal to the results of the smaller villages of Enkoriong and Illturisho. While for interview question 4.5 a rather average value has been generated the result for question 4.6 is outstanding compared to the other villages with a score of 0.67. With regards to the access of energy all interviewees stated to receive energy from diversified sources whereas four of them indicated a low reliability and respective supply shortages and two landowners reported about a high reliability without regular shortages.

The village of Megwara particularly stands out within the determinant of 'institutional capacity' obtaining a score of 0.75, the highest among the six villages together with

Sekenani and Illturisho. With a value of 0.83 that could be generated for indicator 5.1 'relationship to government and authorities' Megwara reached a clear above average result as it did for the second indicator 5.2 'access of governmental support' with a score of 0.67. With regards to indicator 5.1 four of the interview participants indicated to know and be able to access local actors or that they are generally satisfied with the relationship while only two landowners argued differently and stated that they either know these actors without being able to access them or that they are generally not fully satisfied with the relationship. Considering indicator 5.2, four interview participants mentioned to either access governmental support services such as educational support or help from the police, thus obtaining a 'medium' individual capacity result. The two other interviewees even stated to access both public governmental support services as well as personal support resulting in a 'high' individual score. In more detail, three landowners noted to received this kind of personal support in form of financial assistance while also three interviewees indicated that they accessed governmental support especially in times of crisis. With regards to the individual assessment results respectively two interviewees obtained a score of 0.50, a score of 0.75, and even a score of 1.00.

Overall, the variation of total CCAC results among the interviewees from the village of Megwara is relatively low compared to the village of Oololaimutia. While four of the interviewed landowners achieved 'medium' CCAC results ranging between 0.50 and 0.58 two participants reached respectively 'high' CCAC results with values of 0.60 and 0.66.

Table 32: CCAC Results of Interview Participants from the Village of Megwara

Indicator		Interviewee 7		Interviewee 8		Interviewee 9		Interviewee 10		Interviewee 11		Interviewee 12		Average (Total)	
1	Socio-Cultural Capacity	H	0.63	VH	0.81	H	0.69	H	0.75	M	0.44	H	0.69	H	0.67
1.1	Family & Relatives Environment	-	-	-	-	-	-	-	-	-	-	-	-	N.A.	N.A.
1.2	Gender Integration & Participation	VL	0.00	VH	1.00	M	0.50	M	0.50	VL	0.00	M	0.50	M	0.42
1.3	Social Network & Community	H	0.67	VH	0.83	H	0.67	VH	1.00	M	0.50	H	0.67	H	0.72
1.4	Attitude & social Attributes	M	0.50	VH	1.00	VH	1.00	VH	1.00	M	0.50	M	0.50	H	0.75
1.5	Skills & Knowledge	VH	0.83	H	0.67	H	0.67	M	0.50	M	0.50	VH	0.83	H	0.67
2	Natural Resources Capacity	H	0.63	VH	0.88	H	0.75	H	0.75	H	0.63	H	0.75	H	0.73
2.1	Livestock & Agriculture	H	0.75	H	0.75	H	0.75	M	0.50	M	0.50	M	0.50	H	0.63
2.2	Land Usability	VH	1.00	VH	1.00	VH	1.00	VH	1.00	VH	1.00	VH	1.00	VH	1.00
2.3	Water Resources	VL	0.00	VH	1.00	M	0.50	VH	1.00	M	0.50	VH	1.00	H	0.67
3	Economic Capacity	M	0.40	M	0.40	L	0.20	M	0.50	L	0.30	M	0.50	L	0.38
3.1	Income	M	0.50	VH	1.00	VL	0.00	VH	1.00	VL	0.00	M	0.50	M	0.50
3.2	Costs	L	0.25	VL	0.00	VL	0.00	VL	0.00	VL	0.00	L	0.25	VL	0.08
3.3	Assets	M	0.50	M	0.50	M	0.50	M	0.50	VH	1.00	M	0.50	M	0.58
3.4	Insurance	M	0.50	M	0.50	M	0.50	VH	1.00	M	0.50	VH	1.00	H	0.67

4	Infrastructural & Technological Capacity	M	0.42	L	0.33	VL	0.17	L	0.25	M	0.58	H	0.75	M	0.42
4.1	Connection	VL	0.00	L	0.25	VL	0.00	VL	0.00	L	0.25	M	0.50	VL	0.17
4.2	Housing & Living Environment	VL	0.00	M	0.50	VL	0.00	M	0.50	VH	1.00	VH	1.00	M	0.50
4.3	Access to public Housing Services	VH	0.83	L	0.33	L	0.33	L	0.33	H	0.67	VH	0.83	M	0.56
5	Institutional Capacity	VH	1.00	M	0.50	VH	1.00	H	0.75	H	0.75	M	0.50	H	0.75
5.1	Relationship to Government & Authorities	VH	1.00	M	0.50	VH	1.00	VH	1.00	VH	1.00	M	0.50	VH	0.83
5.2	Access of governmental Support	VH	1.00	M	0.50	VH	1.00	M	0.50	M	0.50	M	0.50	H	0.67
Total Result		M	0.56	H	0.60	M	0.50	M	0.58	M	0.50	H	0.66	M	0.57

6.2.3 Village 3 – Sekenani

With a population number of 2,900 Sekenani represents the second largest among the six investigated villages. It is located in the west from MSC and close to the main gate of MMNR. In that regard, the main tarmacked road that was constructed to ease travel from the capital of Nairobi to MMNR is directly adjacent to Sekenani. Due to its proximity to MMNR the economic development of Sekenani is relatively similar to the village of Oloolaimutia in terms of the orientation on tourism services and infrastructure with many visiting tourists passing by the village. Sekenani hosts essential infrastructural facilities such as a secondary school, a place where the weekly market is organized, as well as a local hospital. Similar to Oloolaimutia and Megwara, Sekenani is connected to the national electricity grid. In the following, the CCAC results for the village of Sekenani are comprehensively presented and analyzed focusing on major findings and strengths and weaknesses that have been emerged in comparison with the performance of the other villages. Figure 27 shows the total results for the five determinants while table 33 presents the comprehensive CCAC results for Sekenani and the respective interviewees.

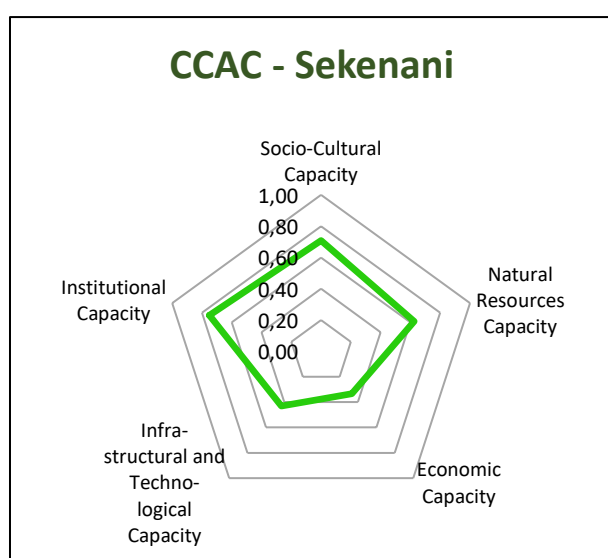


Figure 27: Total CCAC Results for the Village of Sekenani

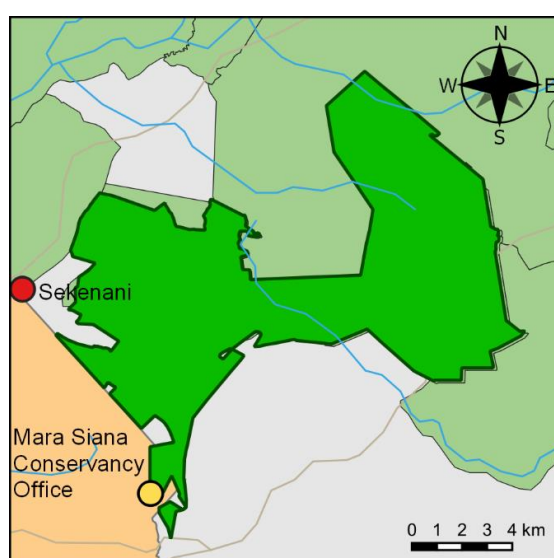


Figure 28: Location of the Village of Sekenani

Overall, the village of Sekenani obtained a total 'medium' score of 0.56, relatively close to but slightly above the average of 0.55. Accordingly, the determinants of 'socio-cultural capacity', 'infrastructural and technological capacity', and 'institutional capacity' generated above average results whereas for the determinants of 'natural resources capacity' as well as 'economic capacity' below average values were reached.

Considering the determinant of 'socio-cultural capacity' the village of Sekenani achieved a score of 0.58 for the indicator 1.2 'gender integration and participation' which represents the highest among all villages. The main reason for that is the response of interviewee (14) indicating that in his household men and women are equally participating in general household decisions. All other interviewed landowners from Sekenani stated that women are integrated, though the man is the final decision-maker. With this point of view interviewee (14) provides a unique result compared to all other interview participants of this study. For indicator 1.3 'social network and community' the village of Sekenani achieved with a 'very high' value of 0.83 the second highest result among all the villages as particularly for the question 1.5 about the receiving of support services during crisis and natural disasters a score of 0.83 has been obtained compared to the average of 0.59. Accordingly, only two interviewees stated to have already received support during certain crisis such as COVID-19 whereas the other four participants mentioned to have additionally received support during natural disasters and especially droughts. One particularity for Sekenani are the very different results of interviewee (14) compared with all other interview participants from the village. Whereas the others received scores of 0.75 and 0.81 for the determinant of 'socio-cultural capacity' interviewee (14) was assessed with a result of 0.38 which is due to his very low performances for the indicators 1.3 'social network and community' and 1.4 'attitude and social attributes'. Concerning indicator 1.3 he especially generated a 'low' individual score of 0.00 for question 1.4 as he reported his community as not close to each other with facing conflicts about land rights and a division between the rich and the poor. In comparison, all other landowners from Sekenani stated that the community they are living in is close. With regards to indicator 1.4 and the respective question 1.7 about the attitude towards new developments and technologies interviewee (14) argued that new technologies generally made life difficult. He brings the example of children that are promoted to visit the school which is accompanied by costs for school fees, school uniforms, and other utensils. Also for indicator 1.4 he therefore received a score of 0.00. His performance for the determinant of 'socio-cultural capacity' is eventually the main reason for his total CCAC result which is with a value of 0.44 the lowest among the interviewed landowners from Sekenani.

Within the determinant of 'infrastructural and technological capacity' the village of Sekenani as well achieved above average results with a score of 0.43 that is mainly due to the comparatively higher result for indicator 4.1 'connection'. Accordingly, the village of Sekenani obtained a 'medium' score of 0.42 which is distinctively above the average of 0.25. A crucial aspect contributing to this result are the answers for question 4.1 which reveal that all six participants mentioned an accessibility of all crucial facilities in less than 30 minutes while four interviewees perceived the adjacent road system as moderate and only two as not in a good shape. Furthermore, the answers for question 4.2 indicate that the majority of four of the interviewed landowners were of the opinion that at least a little of communal infrastructure in their areas were designed in a resilient way and that the main

road can withstand heavy rain while all six argued that all other roads become impassable. The respectively obtained scores of 0.50 for question 4.1 and 0.33 for question 4.2 eventually lead to the indicator result of 0.42, the highest among the villages together with Illturisho. On the contrary, for indicator 4.2 'housing and living environment' a below average value of 0.33 has been generated as only interviewee (18) noted to already considered climate and weather changes when building his house which therefore withstands heavy rainfalls. While two other participants mentioned that their houses can also withstand heavy rain, though they have not actively considered that during construction, the remaining three landowners explained that they did not consider that aspect too, however their houses do not withstand these events.

For the determinant of 'institutional capacity' the village of Sekenani reached, together with Megwara and Illturisho, the highest capacity result of 0.75. The main reason for this is the outstanding score of 0.92 for indicator 5.1 'relationship to government and authorities' which represents the highest value among all villages. Accordingly, five of the interview participants obtained an individual 'high' result as they stated to not only know local authorities but also to be capable of accessing those leaving them overall satisfied. Only interviewee (18) stated to not be fully satisfied with the relationship to the authorities.

With a score of 0.63 for 'natural resources capacity' the village of Sekenani is slightly below the average of 0.65 which is reflected in the individual indicator results. For example, all interview participants were assessed with 'medium' capacity results as they stated to only keep livestock and not practice agriculture with interviewee (14) even assessed with a 'low' individual capacity result as his livestock is not diversified since he only keeps goats. These results from indicator question 2.1 together with the answers for question 2.2 that reveal the ability of all landowners from Sekenani to cope with diseases and pests affecting their livestock lead to the result of 0.46 for indicator 2.1 compared to the average of 0.53.

With regards to 'economic capacity' the lowest result among the investigated villages has been generated for Sekenani with an overall value of 0.33 compared to the average of 0.42. Accordingly, all indicator results remain below average with especially indicator 3.1 'income' and 3.4 'insurance' performing poorly. For indicator 3.1 a score of 0.42, compared to the average of 0.56, has been calculated as more than 50% of the income sources of all six landowners are assessed as directly climate sensitive while interviewee (13) additionally mentioned to not lease their land and therefore does not receive the conservancy lease. Concerning indicator 3.4, a value of 0.50, the second lowest among all interview participants, was generated reflecting a poor presence of external insurances with only interviewee (13) having an external health insurance and interviewee (17) an external insurance for assets. Moreover, only half of the interviewed landowners indicated to recognize livestock or other assets as financial insurance whereas interviewee (18) mentioned to not have any financial insurance at all leading to a 'low' individual score.

Table 33: CCAC Results of Interview Participants from the Village of Sekenani

Indicator		Interviewee 13		Interviewee 14		Interviewee 15		Interviewee 16		Interviewee 17		Interviewee 18		Average (Total)	
1	Socio-Cultural Capacity	H	0.75	L	0.38	VH	0.81	H	0.75	VH	0.81	H	0.75	H	0.71
1.1	Family & Relatives Environment	-	-	-	-	-	-	-	-	-	-	-	-	N.A.	N.A.
1.2	Gender Integration & Participation	M	0.50	VH	1.00	M	0.50	M	0.50	M	0.50	M	0.50	M	0.58
1.3	Social Network & Community	VH	1.00	VL	0.17	VH	1.00	VH	1.00	VH	0.83	VH	1.00	VH	0.83
1.4	Attitude & social Attributes	VH	1.00	VL	0.00	M	0.50	VH	1.00	VH	1.00	VL	0.00	M	0.58
1.5	Skills & Knowledge	M	0.50	M	0.50	VH	0.83	M	0.50	VH	0.83	VH	0.83	H	0.67
2	Natural Resources Capacity	H	0.63	H	0.63	H	0.75	H	0.63	M	0.50	H	0.63	H	0.63
2.1	Livestock & Agriculture	M	0.50	L	0.25	M	0.50	M	0.50	M	0.50	M	0.50	M	0.46
2.2	Land Usability	VH	1.00	VH	1.00	VH	1.00	VH	1.00	VH	1.00	VH	1.00	VH	1.00
2.3	Water Resources	M	0.50	VH	1.00	VH	1.00	M	0.50	VL	0.00	M	0.50	M	0.58
3	Economic Capacity	L	0.20	L	0.30	L	0.30	M	0.50	M	0.50	L	0.20	L	0.33
3.1	Income	VL	0.00	M	0.50	M	0.50	M	0.50	M	0.50	M	0.50	M	0.42
3.2	Costs	VL	0.00	VL	0.00	VL	0.00	L	0.25	VL	0.00	VL	0.00	VL	0.04
3.3	Assets	M	0.50	M	0.50	M	0.50	VH	1.00	VH	1.00	M	0.50	H	0.67
3.4	Insurance	M	0.50	M	0.50	M	0.50	M	0.50	VH	1.00	VL	0.00	M	0.50
4	Infrastructural & Technological Capacity	M	0.42	L	0.33	M	0.50	M	0.50	M	0.25	M	0.58	M	0.43
4.1	Connection	M	0.50	M	0.50	M	0.50	M	0.50	L	0.25	L	0.25	M	0.42
4.2	Housing & Living Environment	VL	0.00	VL	0.00	M	0.50	M	0.50	VL	0.00	VH	1.00	L	0.33
4.3	Access to public Housing Services	M	0.50	L	0.33	M	0.50	M	0.50	L	0.33	H	0.67	M	0.47
5	Institutional Capacity	VH	1.00	VH	1.00	H	0.75	M	0.50	M	0.50	H	0.75	H	0.75
5.1	Relationship to Government & Authorities	VH	1.00	M	1.00	VH	1.00	VH	1.00	VH	1.00	M	0.50	VH	0.92
5.2	Access of governmental Support	VH	1.00	M	1.00	M	0.50	VL	0.00	VL	0.00	VH	1.00	M	0.58
Total Result		M	0.56	M	0.44	H	0.62	H	0.60	M	0.54	M	0.58	M	0.57

6.2.4 Village 4 – Empopungi

With a population of around 1,500 the village of Empopungi is located relatively central in the north of MSC and above the main conservation corridor. It is connected via unpaved roads to the main tarmacked road in the west at the height of the next bigger village of Nkoilale. In the center of the village there is a primary school as well as a healthcare facility provided while the weekly circulating market does not take place in Empopungi, therefore residents need to visit the next closer village of Nkoilale for purchases of respective commodities. Furthermore, due to its remote location the economic structure of the village

is not characterized by the tourism sector as tourists usually not visit this area on their way to MMNR. However, people who are living in Empopungi might be engaged in tourism facilities and services located in other villages such as Oololaimutia or Sekenani to where they are commuting. In the following, the CCAC results for the village of Empopungi are comprehensively presented and analyzed focusing on major findings and strengths and weaknesses that have been emerged in comparison with the performance of the other villages. Figure 29 shows the total results for the five determinants while table 34 presents the comprehensive CCAC results for Empopungi and the respective interviewees.

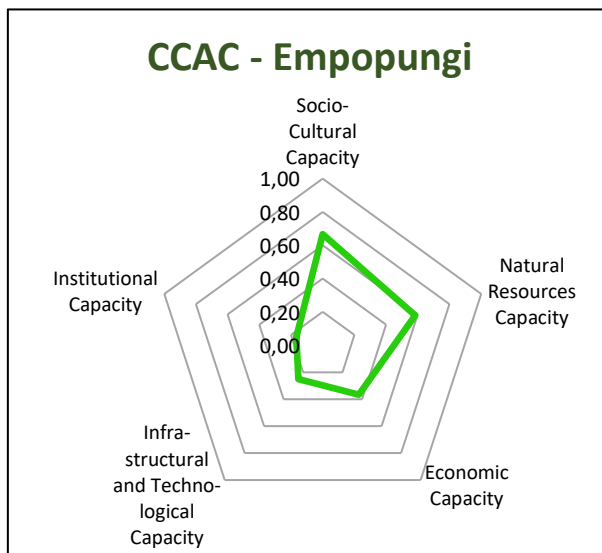


Figure 29: Total CCAC Results for the Village of Empopungi

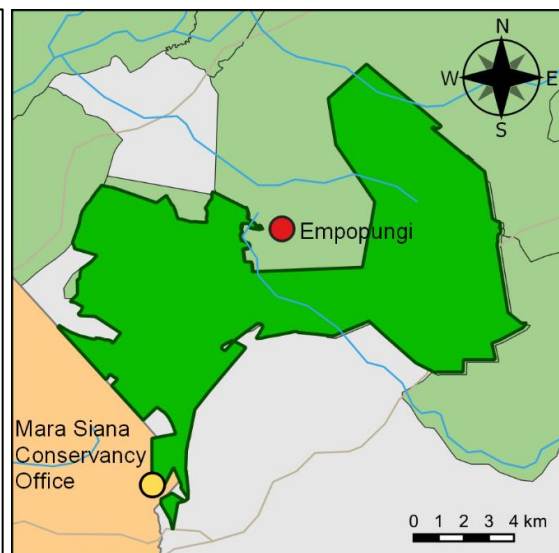


Figure 30: Location of the Village of Empopungi

Overall, the village of Empopungi achieved the lowest total CCAC among all villages with a score of 0.45, clearly below the average of 0.55. Moreover, the final CCAC results per interviewee are relatively balanced with values between 0.42 and 0.52. Accordingly, for all determinants below average results were obtained with particularly poor performances within the determinants of 'infrastructural and technological capacity' and 'institutional capacity'.

For 'socio-cultural capacity' a slightly below average value has been generated with 0.67 compared to 0.69 as for indicator 1.4 an especially low result of 0.50 was reached, the lowest among all villages, while for indicator 1.5 'skills and knowledge' a score of 0.78 could be achieved, the highest among all villages. With regards to indicator 1.4, all three interview participants from Empopungi were assessed with a 'medium' individual score as two seemed to lack comprehensive understanding of the question and one presented herself as moderately open to new technologies and developments. For the remarkable result of indicator 1.5 the generated score of 1.00 for question 1.8 as well as the achieved value of 0.67 for question 1.9 are mainly responsible. Accordingly, all of the landowners are aware of and believing in the global phenomenon of climate change. Additionally, two of them mentioned without reasonable explanation respectively one and two of the given relevant stakeholders to tackle climate change issues whereas interviewee (20) included all of the given stakeholders.

Considering the determinant of 'natural resources capacity' a score of 0.58 has been calculated for Empopungi which represents the second lowest among all villages compared to the average of 0.65. In that regard, for indicator 2.3 'water resources' a particularly poor result of 0.33 has been generated representing the lowest among the villages together with Oololaimutia. Accordingly, only interviewee (19) reported a good water quality without being affected by diseases while the two others only indicated a medium or low water quality with interviewee (20) stating to have been affected by diseases due to water consumption and interviewee (21) mentioned water shortages during droughts.

Within the determinant of 'economic capacity' the village of Empopungi reached a score of 0.37 which is below the average of 0.42. More concrete, for the indicators 3.1 'income' and 3.2 'costs' below average results of 0.33 and 0.00 were achieved, both respectively the lowest among all villages while for indicator 3.3 'assets' an above average score of 0.83 was obtained, the second highest among the villages. With regards to the particularly poor performance of indicator 3.1 one landowner stated to have only one income source beside the conservancy lease whereas the two others mentioned to have more than one income source beside the conservancy lease. However, for all interviewees equal to or more than 50% of their stated income sources were assessed as climate sensitive leading to two 'medium' and one 'low' individual capacity results. Regarding the high performing indicator 3.3 two landowners explained to not only be the owners of the land, livestock, and house but also that they are both in possession of a motor bike. Only interviewee (20) stated to not possess additional assets of value.

With regards to the determinant of 'infrastructural and technological capacity' an overall result of 0.25 was achieved, clearly below the average of 0.41. Especially for indicator 4.1 'connection' and 4.3 'access to public housing services' poor results were obtained, respectively the lowest among all villages. Concerning indicator 4.1, all interviewees noted that the road system in their area is in a bad shape and that critical infrastructure such as market, school, and healthcare are only accessed in under 60 minutes or even longer. Moreover, all participants argued that nothing of the existing communal infrastructure, mainly referring to the road system, is equipped to withstand extreme weather events leading to an indicator result of 0.00. For indicator 4.3 the interview results among the landowners are again very consistent with all of them mentioning to not be provided with any sanitation or drainage system but with electricity and energy through diversified sources, though with a lower reliability and regular shortages. Also, all of the interview participants mentioned to use means such as telephone, TV, or radio to receive information and news from outside but particular do not use the internet resulting in a total indicator score of 0.33.

Especially for the determinant of 'institutional capacity' the village of Empopungi obtained a very poor result with an overall score of 0.17 which is by far the lowest result among all villages and clearly below the average of 0.59. Accordingly, for indicator 5.1 'relationship to government and authorities' a low score of 0.33 was calculated as only one interviewee stated to be able to access the authorities and being satisfied with the relationship while the two other participants indicated that local actors are not even known, therefore they are not satisfied with the relationship. Particularly the obtained information for indicator 5.2 are strikingly negative as all the landowners indicated to neither access any kind of information

and governmental support services nor any other personal support from the government resulting in an indicator score of 0.00.

Table 34: CCAC Results of Interview Participants from the Village of Empopungi

Indicator		Interviewee 19		Interviewee 20		Interviewee 21		Average (Total)	
1	Socio-Cultural Capacity	H	0.69	H	0.63	VH	0.69	H	0.67
1.1	Family & Relatives Environment	-	-	-	-	-	-	N.A.	N.A.
1.2	Gender Integration & Participation	M	0.50	M	0.50	M	0.50	M	0.50
1.3	Social Network & Community	VH	0.83	L	0.33	VH	0.83	H	0.67
1.4	Attitude & social Attributes	VH	0.50	M	0.50	M	0.50	M	0.50
1.5	Skills & Knowledge	H	0.67	VH	1.00	H	0.67	H	0.78
2	Natural Resources Capacity	H	0.75	M	0.50	M	0.50	M	0.58
2.1	Livestock & Agriculture	M	0.50	M	0.50	M	0.50	M	0.50
2.2	Land Usability	VH	1.00	VH	1.00	VH	1.00	VH	1.00
2.3	Water Resources	M	1.00	VL	0.00	VL	0.00	L	0.33
3	Economic Capacity	M	0.50	L	0.30	L	0.30	L	0.37
3.1	Income	M	0.50	M	0.50	VL	0.00	L	0.33
3.2	Costs	VL	0.00	VL	0.00	VL	0.00	VL	0.00
3.3	Assets	VH	1.00	M	0.50	VH	1.00	VH	0.83
3.4	Insurance	VH	1.00	M	0.50	M	0.50	H	0.67
4	Infrastructural & Technological Capacity	VL	0.17	L	0.33	L	0.25	L	0.25
4.1	Connection	VL	0.00	VL	0.00	VL	0.00	VL	0.00
4.2	Housing & Living Environment	VL	0.00	VL	1.00	M	0.50	M	0.50
4.3	Access to public Housing Services	L	0.33	L	0.33	L	0.33	L	0.33
5	Institutional Capacity	M	0.50	VL	0.00	VL	0.00	VL	0.17
5.1	Relationship to Government & Authorities	VH	1.00	VL	0.00	VL	0.00	L	0.33
5.2	Access of governmental Support	VL	0.00	VL	0.00	VL	0.00	VL	0.00
Total Result		M	0.52	M	0.42	M	0.42	M	0.45

6.2.5 Village 5 – Enkoriong

The village of Enkoriong is located in the south-west of MSC and relatively northwards from the bigger village of Megwara. Enkoriong, with its population size of roughly 300 people can be considered as a smaller and scattered settlement of several homesteads without hosting critical infrastructural facilities such as a primary school, a marketplace, or a healthcare service. To access these, the residents would walk to the next closer village of Megwara with which Empopungi shares a respective governmental authority (see Annex IV). Since Empopungi has been established on a higher altitude midst a hilly landscape close to conservation area, there are no paved roads or any further communal infrastructure. Generally, because of the small population and less constructed infrastructure in contrast to a wider space with grass and pastureland the pressure on natural resources through human impact seems still smaller than in other bigger and more developed villages. Also,

similar to Empopungi, due to its remote location the economic structure of Enkoriong is not characterized by the tourism sector. However, people who are living in Enkoriong might be engaged in tourism facilities and services located in other villages such as Ololaimutia or Sekenani to where they are commuting. In the following, the CCAC results for the village of Enkoriong are comprehensively presented and analyzed focusing on major findings and strengths and weaknesses that have been emerged in comparison with the performance of the other villages. Figure 32 shows the total results for the five determinants while table 35 presents the comprehensive CCAC results for Enkoriong and the respective interviewees.

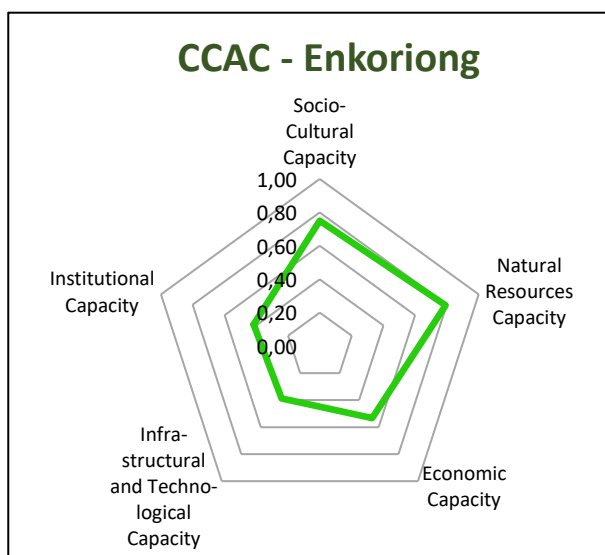


Figure 32: Total CCAC Results for the Village of Enkoriong



Figure 31: Location of the Village of Enkoriong

With an overall CCAC score of 0.60 the village of Enkoriong achieved the second highest result among all villages. More concrete, for the first three determinants of 'socio-cultural capacity', 'natural resources capacity', and 'economic capacity' above average results were obtained whereas for the two determinants of 'infrastructural and technological capacity' and 'institutional capacity' below average values have been reached. The CCAC results obtained in Enkoriong are not as consistent as those of other villages with a distinct difference between the performance of interviewee (23) and the other landowners. Accordingly, interviewee (23) achieved the best overall CCAC result among all 27 interview participants with a score of 0.83 while the other two interviewees (22) and (24) respectively generated below average results of 0.50 and 0.48.

For the determinant of 'socio-cultural capacity' an above average result of 0.75 has been calculated, the highest among all villages. Accordingly, for indicator 1.2 'gender integration and participation' a particularly poor score of 0.33 was achieved as two of the female landowners stated to be integrated in general household decisions, though the husband is the final decision-maker and interviewee (22) mentioned that she would not be considered at all in general decision-making. However, for the indicators 1.3 'social network and community' and 1.4 'attitude and social attributes' very high values of respectively 0.89 and 0.83 could be reached. With regards to indicator 1.4 the three interviewed landowners all reflected the same position for the questions 1.3 and 1.4 as all of them noted to be active in self-help groups while all of them reported a close and integrative community of which

they are part of. Furthermore, two of the interview participants already experienced support from organizations during certain crisis but not natural disasters while interviewee (23) even received assistance during droughts.

Together with the village of Illturisho, Enkoriong reached the highest capacity result among all villages for the determinant of 'natural resources capacity' with a value of 0.79. This is mainly due to the outstanding score of 1.00 generated for the indicator 2.3 'water resources'. Although, all of the landowners mentioned to access river water, they reported it as of seemingly good quality without ever been affected by diseases.

Within the determinant of 'economic capacity' an overall score of 0.53 was obtained which is clearly above the average of 0.52 and the second highest among all villages. Accordingly, for the indicator 3.2 'costs' a score of 0.25 has been obtained, which is still a 'low' capacity result but distinctively above the average of 0.12. Although all landowners were mentioning fluctuations and price increases as a response to question 3.2, two interview participants stated to be able to usually cover the costs that are related to their basic needs whereas interviewee (24) even indicated to be capable of covering all further costs. For question 3.3 the three interview participants gave various answers and were assessed with different codes. Accordingly, two were already experiencing financial losses in the past while interviewee (23) had access to financial assistance, but interviewee (22) did not. Interviewee (24) reported to not experienced financial losses and to not receive financial assistance. Furthermore, the interviewed landowners from Enkoriong especially performed well with indicator 3.4 'insurance' as two of the interviewees (22) and (23) were assessed with a 'high' individual result since both stated to have an external health insurance and both plan with livestock or household savings as insurance assets. Only interviewee (24) mentioned to not have any kind of external insurance, though she also stated to recognize livestock as financial insurance as well as the borrowing of money from friends.

A slightly below average CCAC result has been computed for the determinant of 'infrastructural and technological capacity' with a value of 0.39 compared to an average of 0.41. Main reason for that is the weak performance for indicator 4.1 'connection'. In that regard, interviewees (22) and (24) not only indicated a bad quality of the road system with an accessibility of critical infrastructure in only under 60 minutes or longer but they also stated their perspective that, with particular focus on the road system, nothing of the communal infrastructure is especially equipped for extreme weather events. Only landowner (23) reported a moderate road system, also with an accessibility of under 60 minutes or longer, further arguing that communal infrastructure is at least partly equipped for resilience purposes referring to the main road in Megwara that withstands heavy rain. The provided information by the interview participants led to a 'very low' indicator result of 0.17.

Within the determinant of 'institutional capacity' the village of Enkoriong achieved the second lowest result among all villages with a value of 0.42 compared to an average of 0.59. Accordingly, together with the village of Empopungi, Enkoriong generated the lowest result of 0.33 for indicator 5.1 'relationship to government and authorities' compared to an average of 0.65. Only interviewee (23) stated to not only know local actors but also to be able to approach them leaving her with a higher satisfaction level while the two remaining landowners noted that they would not even know local governmental authorities and are

therefore not satisfied. For indicator 5.2 'access of governmental support' Enkoriong reached a relatively average score of 0.50.

Table 35: CCAC Results of Interview Participants from the Village of Enkoriong

Indicator		Interviewee 22		Interviewee 23		Interviewee 24		Average (Total)	
1	Socio-Cultural Capacity	H	0.69	VH	0.94	H	0.63	H	0.75
1.1	Family & Relatives Environment	-	-	-	-	-	-	N.A.	N.A.
1.2	Gender Integration & Participation	VL	0.00	M	0.50	M	0.50	L	0.33
1.3	Social Network & Community	VH	0.83	VH	1.00	VH	0.83	VH	0.89
1.4	Attitude & social Attributes	VH	1.00	VH	1.00	M	0.50	VH	0.83
1.5	Skills & Knowledge	H	0.67	VH	1.00	M	0.50	H	0.72
2	Natural Resources Capacity	H	0.75	VH	0.88	H	0.75	H	0.79
2.1	Livestock & Agriculture	M	0.50	H	0.75	M	0.50	M	0.58
2.2	Land Usability	VH	1.00	VH	1.00	VH	1.00	VH	1.00
2.3	Water Resources	VH	1.00	VH	1.00	VH	1.00	VH	1.00
3	Economic Capacity	M	0.40	H	0.70	M	0.50	M	0.53
3.1	Income	M	0.50	VH	1.00	M	0.50	H	0.67
3.2	Costs	VL	0.00	L	0.25	M	0.50	L	0.25
3.3	Assets	M	0.50	VH	1.00	M	0.50	H	0.67
3.4	Insurance	VH	1.00	VH	1.00	M	0.50	VH	0.83
4	Infrastructural & Technological Capacity	L	0.25	H	0.67	L	0.25	L	0.39
4.1	Connection	VL	0.00	M	0.50	VL	0.00	VL	0.17
4.2	Housing & Living Environment	M	0.50	M	0.50	M	0.50	M	0.50
4.3	Access to public Housing Services	L	0.33	VH	0.83	L	0.33	M	0.50
5	Institutional Capacity	L	0.25	VH	1.00	VL	0.00	M	0.42
5.1	Relationship to Government & Authorities	VL	0.00	VH	1.00	VL	0.00	L	0.33
5.2	Access of governmental Support	M	0.50	VH	1.00	VL	0.00	M	0.50
Total Result		M	0.50	VH	0.82	M	0.48	H	0.60

6.2.6 Village 6 – Illturisho

The village of Illturisho is located in the north of MSC and directly tangents the main tarmacked road between MMNR at Sekenani and Nairobi and is close to the village of Nkoilale which hosts the largest population among the villages around MSC with estimated 5,600. With an estimated population size of 1,900 Illturisho is still considered as a smaller village within this research (see Annex V). Also, similar to other smaller villages, Illturisho does not host much of critical infrastructural facilities. In that regard, Illturisho has its own primary school, however, to access the weekly market and healthcare services residents are obliged to visit the village of Nkoilale. Apart from the main tarmacked road close to the village, there are not any paved roads or any further communal infrastructure within Illturisho. From an economic perspective, people living in Illturisho are not only focusing on livestock keeping but might also be employed in tourism facilities and services in adjacent

villages such as Nkoilale to where they are commuting. In the following, the CCAC results for the village of Illturisho are comprehensively presented and analyzed focusing on major findings and strengths and weaknesses that have been emerged in comparison with the performance of the other villages. Figure 34 shows the total results for the five determinants while table 36 presents the comprehensive CCAC results for Illturisho and the respective interviewees.

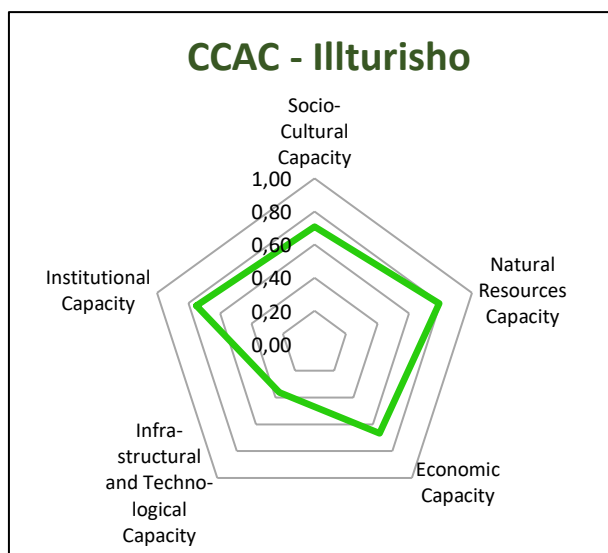


Figure 34: Total CCAC Results for the Village of Illturisho

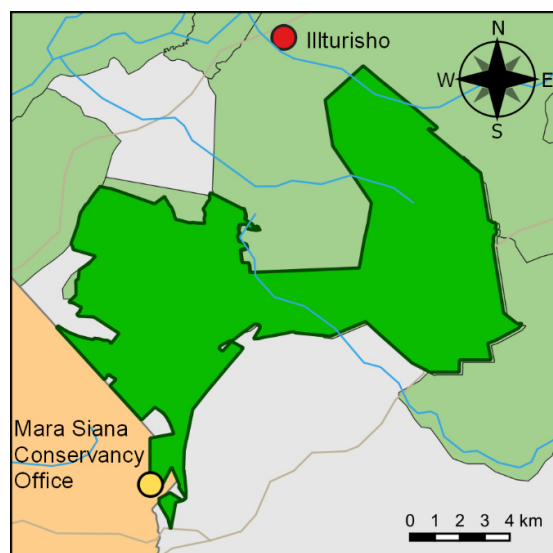


Figure 33: Location of the Village of Illturisho

With a total CCAC score of 0.63 the village of Illturisho achieved the highest result among all villages. Moreover, with only a small deviation between the individual CCAC scores per landowner the results reflect a relatively high consistency compared to other villages. In more detail, Illturisho obtained above average results for all determinants except of the fourth one 'infrastructural and technological capacity'.

Within the determinant of 'socio-cultural capacity' a slightly above average score of 0.71 was reached which is mainly due to the very good performance of indicator 1.4 'attitude and social attributes' for which a value of 0.83 has been generated, the highest among all villages together with Enkoriong. In that regard, two of the landowners were assessed with a generally positive attitude towards new technologies and developments mentioning different aspects such as recent education opportunities as well as modern clothes that they appreciate. Only one of the three landowners has been assessed as lacking a comprehensive understanding of the question and therefore argued imprecisely. For the other indicators of the determinant relatively average results were obtained.

With a score of 0.79 Illturisho achieved the highest CCAC result among the villages, together with Enkoriong. Main cause for that is the outstanding performance for indicator 2.3 'water resources', for which a value of 1.00 could be generated. Accordingly, all of the landowners mentioned to access river water, however they also reported to dig the sand close to the water stream to not take surface water, therefore perceiving it as of seemingly good quality without ever been affected by diseases.

Considering the determinant of 'economic capacity' the village of Illturisho clearly achieved the best result among all villages with a score of 0.67. Main contributing factors to that

performance are the obtained results for the indicators 3.1 'income', 3.2 'costs' and 3.3 'assets'. With regards to indicator 3.1 all landowners stated to have more than one income source beside the conservancy lease whereas only interviewee (27) has been found with 50% or more of her income sources to be climate sensitive leading to a final indicator score of 0.83 for Illturisho. For indicator 3.2 two of the participants explained that they would only be able to cover the costs for their basic needs while interviewee (25) stated to usually not be able to cover even these. Additionally, all landowners mentioned to already experienced financial losses in the past while having access to financial assistance through family remittances or conservancy support. Through this information an indicator result of 0.42 was generated. Eventually, with a score of 1.00 the village of Illturisho achieved the highest result among all villages for indicator 3.3 as all interview participants noted to not only be the owner of land, livestock, and house but additionally to possess further assets. In that regard, interviewees (25) and (27) mentioned to possess an own motor bike whereas interviewee (26) even stated to have an own car.

Also for the determinant of 'institutional capacity', Illturisho reached a 'high' result of 0.75 as for indicator 5.1 'relationship to government and authorities' a 'very high' value of 0.83 and for indicator 5.2 'access of governmental support' a 'high' value of 0.67 was calculated. Accordingly, two participants stated to know the authorities and be able to communicate with them reflecting a high level of satisfaction while interviewee (27) argued that she is not fully satisfied with her relationship as she explained that the authorities would not be regularly approachable. Furthermore, two of the landowners indicated to receive information and governmental support services as well as further personal support from the government whereas only interviewee (26) reported to not access any of the mentioned services.

Only within the determinant of 'infrastructural and technological capacity' Illturisho obtained a below average result of 0.36 which is mainly due to the very poor performance for indicator 4.2 'housing and living environment' with a score of 0.00 compared to an average of 0.48. In that regard, all three interview participants consistently stated that they have not actively considered the aspects of climate change and extreme weather events during construction of homestead facilities and that their houses cannot withstand heavy rainfalls.

Table 36: CCAC Results of Interview Participants from the Village of Illturisho

Indicator		Interviewee 25		Interviewee 26		Interviewee 27		Average (Total)	
1	Socio-Cultural Capacity	H	0.75	H	0.63	H	0.75	H	0.71
1.1	Family & Relatives Environment	-	-	-	-	-	-	N.A.	N.A.
1.2	Gender Integration & Participation	M	0.50	M	0.50	M	0.50	M	0.50
1.3	Social Network & Community	VH	0.83	M	0.50	VH	0.83	H	0.72
1.4	Attitude & social Attributes	VH	1.00	M	0.50	VH	1.00	VH	0.83
1.5	Skills & Knowledge	H	0.67	VH	0.83	H	0.67	H	0.72
2	Natural Resources Capacity	H	0.75	VH	0.88	H	0.75	H	0.79
2.1	Livestock & Agriculture	M	0.50	H	0.75	M	0.50	M	0.58
2.2	Land Usability	VH	1.00	VH	1.00	VH	1.00	VH	1.00
2.3	Water Resources	VH	1.00	VH	1.00	VH	1.00	VH	1.00
3	Economic Capacity	H	0.60	VH	0.80	H	0.60	H	0.67

3.1	Income	VH	1.00	VH	1.00	M	0.50	VH	0.83
3.2	Costs	L	0.25	M	0.50	M	0.50	M	0.42
3.3	Assets	VH	1.00	VH	1.00	VH	1.00	VH	1.00
3.4	Insurance	M	0.50	VH	1.00	M	0.50	H	0.67
4	Infrastructural & Technological Capacity	M	0.42	M	0.42	L	0.25	L	0.36
4.1	Connection	M	0.50	M	0.50	L	0.25	M	0.42
4.2	Housing & Living Environment	VL	0.00	VL	0.00	VL	0.00	VL	0.00
4.3	Access to public Housing Services	M	0.50	M	0.50	L	0.33	M	0.44
5	Institutional Capacity	VH	1.00	M	0.50	H	0.75	H	0.75
5.1	Relationship to Government & Authorities	VH	1.00	VH	1.00	M	0.50	VH	0.83
5.2	Access of governmental Support	VH	1.00	VL	0.00	VH	1.00	H	0.67
Total Result		H	0.66	H	0.64	H	0.60	H	0.63

7) Discussion and Recommendations

In the following, the previously elaborated research questions are taken up and analyzed against the backdrop of the respectively applied methods with the main focus on the obtained interview results. Accordingly, it is firstly aimed to identify climate change effects that are described by the interviewed landowners in the different villages in Mara Siana. Afterwards, the generally obtained CCAC results including all five determinants are discussed and analyzed to eventually draw appropriate conclusions and propose adequate recommendations for improving CCAC of landowners and their homesteads in the future. The feasibility of respectively defined measures and activities is to be proven through further research for which the data of this study serves as a fundamental basis. Recommendations derived from this work are focusing on those activities with seemingly highest benefit potentials while additional suggestions to improve CCAC are moreover included in the sub-chapter ‘further recommendations’.

Discussion

Within the interview process participants repeatedly mentioned particular weather events that they are perceiving, and which are consistent with the cited literature that is introduced in chapter 4.1. In that regard, the vast majority of 25 participants stated to be aware of the process of climate change while all 27 reported to already experienced weather changes by their own. It can be assumed that the own experiences distinctively contribute to the overall awareness of climate change, even if landowners do not access external inputs and information about the topic. However, as different awareness campaigns and other educative measures such as those of local organizations as well as development projects of other institutions are already operative in the region, residents might have been basically sensitized in that way. Respectively supporting arguments for the positive impact of good education and knowledge on the performance of CCAC in the field is also given by Thathsarani & Gunaratne (2018) and Omemo et al. (2017) while other studies rather found a lack of education among community members leading to constrained CCAC (Ofoegbu et al. 2016). Although the interviewees relate these weather events to the phenomenon of

climate change and thus provide respective indications, there is no concrete evidence for this linkage provided through this research. Nevertheless, with 20 of 27 landowners highlighting both the intensification of droughts as well as a particular change in weather patterns in recent years as main observations, a specific picture of local climate change impacts can be drawn which is among others similarly manifested by the MSC manager (see Annex IV) as well as several studies that were carried out in the wider region of the Maasai Mara ecosystem (Bartzke et al. 2018; Nnko et al. 2021; Ogutu et al. 2008; Simotwo et al. 2018). Accordingly, several landowners reported that intense droughts were impacting particularly their economic capacity through degrading the environment and decreasing available fodder resources for their livestock leading to the loss of weight and lives and thus a sharp depletion in asset value. Additionally, when it comes to the resilience of communal infrastructure and constructed private houses, the landowners specifically mention heavy rainfalls as main weather event that these facilities need to resist to. Although it was rather indirectly argued within the interviews, a change in weather patterns and the intensification of droughts as well as the reviewed literature in chapter 4.1 indicate intensified rainfalls as a further aspect of climate change in the region. Having identified those climate change impacts in the study area, the first research objective is achieved and one crucial component for the final determination of measures to strengthen CCAC is provided.

Focusing on the overall results of this work in comparison to the research findings of Chepkoech et al. (2020) who analyzed CCAC of smallholder vegetable farmers in Kenya, similarities and differences with regards to final CCAC results were discovered. Accordingly, also within the CCAC assessment of this work the majority of landowners were scored with a moderate capacity result (~63%), however contrary to Chepkoech et al. (2020), more landowners achieved a 'high' or 'very high' (~33%) and only one landowner a 'low' (~4%) overall score. The obtained findings also reflect major differences compared to the results generated by Dafieta and Rapera (2014) who identified the majority of landowners (60%) with low, 36% with moderate, and only 4% with high CCAC scores. In this context it must still be emphasized that there are generally different factors causing a distinct variability and fragmentation in CCAC assessment results including the selection of individual frameworks, methods, and local settings (Siders 2019). Furthermore, similar to the findings of Chepkoech et al. (2020), social capacity indicators were evaluated as relatively high while performances for economic capacity were found to be consistently poor. In that regard, the obtained research findings of this work generally contradict the conclusion made by D'agata et al. (2020) claiming that climate stress negatively influences the social dimension of CCAC. Accordingly, through this master thesis research it is not only concluded that socio-cultural capacity performs best among the different determinants but also that respective stress factors can push communities to stronger engage in self-help groups and mutually support each other as well as to inform themselves about climate change effects and possible coping strategies. This impression is among others shared by Pike et al. (2022) who attribute an enhanced ability of coping coordination within a community through strong social ties and Brown et al. (2016) who as well identified a clear sense of belonging and social support networks as beneficial for CCA.

As already explained in chapter 4.4.1, for indicator 1.1 'family and relatives environment' and the particular question about the number of children in the landowners' homestead no quantitative assessment has been conducted. However, it can be said that each of the 27

interviewed households inhabited between one and 15 children reflecting a steady population growth that is also mentioned by the MSC liaison manager (see Annex V) as well as further sources (Nkedianye et al. 2020). Such population growth in combination with the demarcated land parcels that were divided between Mara Siana landowners in the respective villages and beyond lead to enhanced resource pressure as more people settle down and utilize the available land for economic purposes, mainly livestock keeping. Therefore, a proper family and children planning, for which consulting and awareness trainings are already taken place across Mara Siana, is one crucial method to sustainably steer regional population growth and prevent a steady increase of land and resource pressure. Nonetheless, it must also be taken into account that having children is considered asstantial support not only for household as well as economic activities as it equals a higher working capacity for example in livestock keeping but also as old age insurance since the younger generation takes care of the elderly.

Considering the aspect of gender integration, the respective indicator 1.2 remains of consistently moderate performance among the villages which is due to the cultural and traditional societal patterns particularly determining the relationship between men and women within households with the man being the final decision-maker and the woman who is usually not equally integrated. Accordingly, only one of the interviewed landowners stated that in their household husband and wife are equally participating in decision-making, however, as the husband acted as interview participant the confirming perspective of the wife is missing. For that reason, it is questionable to what extent a reliable answer to the question of gender integration can be given by a male household who does not represent the female perspective. However, the obtained answers reveal that equally one woman as well as one man reported about equal participation and two women and one man assessed the integration level as especially low, though there were proportionally more women than men interviewed within the study. Therefore, it cannot specifically be argued that interview answers for that indicator are false, but possibly biased. The inequality that is resulting from the poor gender integration is expressed particularly in the economic situation of women who often lack a regular income and are dependent on the husband's contributions as he administers the financial resources of the household. In that regard, this research agrees with the argumentation of Bedelian and Ogutu (2017) who moreover question the system of conservation lease payments especially to male landowners whereas women might not directly benefit from such income resulting in particular disadvantages for women. Further studies obtained similar findings reflecting lower CCAC results of women compared to men especially with regards to the integration in family and household decision-making (Pike et al. 2022, Matewos 2020).

Overall, the comparably positive CCAC results for the determinant of socio-cultural capacity present a rather consistent manifestation of especially the mutual support of landowners and their community for each other reflected through widespread associations of residents particularly female community members that establish self-help groups aiming to overcome the previously mentioned critical circumstances of economic constraints through joined cooperation. Joining forces accordingly implies not only mutual support especially in hard times but also a certain social protection and assurance mechanism that is contributing to an increased CCAC. Nevertheless, some respondents' answers also indicate potential

conflicts and mistrust among a smaller percentage of the community which reveals entry points for further capacity strengthening efforts.

From the obtained research results it can moreover be indicated that the identified higher occurrence of diseases related to water consumption in the bigger villages especially in Oololaimutia and Sekenani is correlating with a higher population density as these villages are quickly growing along the increasing tourism industry. This assumption is based on the theory that the pressure on natural resources such as water streams as well as land for living or pastureland distinctively increases through rapid population growth (Nkedianye et al. 2020). Resulting inabilities of landowners in accessing reliable water sources and accompanied inefficient coping strategies were also detected by Chepkoech et al. (2020) in their study about CCAC of smallholder farmers in Kenya. Accordingly, residents do not only withdraw drinking water from streams but also use them for doing laundry or taking a bath. Additionally, harmful bacteria and other organisms are transmitted from spots where people practice open defecation through groundwater and particularly surface runoff into the water sources (McCann & Knudsen 2018). That people practice open defecation is mainly due to cultural behavior patterns that are rooted in the original nomadic lifestyle of the Maasai and is as well accompanied by a low availability of sanitation facilities and latrines that have been provided to the communities so far. As residents in the bigger villages of Oololaimutia and Sekenani but also Empopungi seem to be disproportionately more affected by water related diseases which, to some extent, is related to high pressure on water streams and a respectively low sanitation density there is a clear potential for improvement visible. A crucial aspect that is supporting the hypothesis of diseases that are particularly induced by unreliable water sources is moreover reflected in the comparison of respective health impacts affecting those landowners who fetch water from streams and those who withdraw water from tab stands. Accordingly, none of the participants who stated to access water from tabs were affected by related diseases. Since the consumption of good quality water and related health and well-being is a crucial component of landowner's CCAC the improvement of such conditions and the extension of adequate services is to be facilitated.

The overall CCAC result for the determinant of 'economic capacity' appears as lower moderate especially due to the very poor performance of indicator 3.2 'costs'. In that regard, the occurrence of financial losses that have already been experienced by the majority of landowners is furthermore strongly related to the diversification of income sources and the respective indicator 3.1 'income' as well as the sensitivity of these income sources towards the climate. Whereas Nelson et al. (2010) perceive non-farm income sources in general as less climate sensitive, Rotich et al. (2019) who attribute an increasingly important role to the tourism industry for the diversification of income sources of respective communities also emphasize a certain vulnerability of this industry towards extreme weather that is intensified by climate change. The resulting vulnerability therefore incorporates financial losses reducing communities' CCAC for which indications were also identified within the assessment of economic capacity in this research. Accordingly, although bigger villages in Mara Siana are more touristic influenced their economic capacity was rather found to be equal or lower than in smaller villages. This circumstance however is correlating with the fact that landowners who live in smaller villages may also be employed in tourism facilities in bigger villages leading to resulting difficulties in establishing respective dependencies.

Correspondingly poor results which were generally identified within this work in the area of economic capacity are shared by further research in the field that reflects a lack of access to financial capital and credit (Hogarth & Wójcik 2016; Ofoegbu et al. 2016) as well as low income (Omemo et al. 2017) and restricted economic participation (Ofoegbu et al. 2016). The instability of financial capital in the context of elevated prices for general commodities such as foodstuffs moreover results in challenges for the people to cover their basic needs. A relevant factor to this circumstance is brought up by Nkedianye et al. (2019) who identified disparities between rich and poor households as well as between male and female community members as it was also examined through this work. Nonetheless, landowners in Mara Siana are in possession of valuable assets that mainly comprise their land, houses, and further assets such as motor bikes and cars or even household savings. However, it should be ensured that no downward spiral is emerging in which landowners might lose these assets particularly their land parcels through selling those to external businesses out of desperation to generate money for covering needs. As a consequence of protecting these assets further negative impacts on the other indicators such as 3.4 'insurance' can be prevented. Accordingly, possessing livestock represents a popular asset (Nkedianye et al. 2019) especially among the Maasai culture which as well can be considered as financial insurance. However, since the results for this indicator emphasized a lack of sustainability in insurance options such as the recognition of assets as livestock and household savings, a stronger focus on the provision of alternative external insurance schemes for health and particularly climate related damage is suggested.

The obtained information on the connectivity of Maasai homesteads through the conducted interviews revealed relatively low performance results. However, data on the accessibility of critical infrastructure such as healthcare facilities, schools, and markets and especially the time that landowners and their families need to access them is highly dependent on the location of the respective homestead within the area of a certain village. These regional differences in accessibility of education, health, and other services were also identified by Brown et al. (2016) as certainly impacting communities' CCAC. A huge difference may also emerge between the information provided by different interview participants from the same village with regards to the time it takes them to reach these facilities. This is especially relevant as conducted interviews in the villages of Megwara and Empopungi for example did neither cover a wide geographical area nor stretched from remote areas to the center of the village but were rather concentrated on more fringe locations indicating individual perceptions that lead to different CCAC results. That essential infrastructure and the provision of main services are usually located in the central part of a village may therefore be an important aspect considering the very poor results of the interviewed landowners from these both villages due to the long distances. In general, strengthening respective infrastructural capacity to improve the situation for those landowners who own land parcels in a far distance from the village center can be assessed as quite complicated. Nevertheless, a simple measure that has already been applied in according to interviewees' answers is the construction of water drainage channels along paved as well as unpaved roads in very rural parts of the area. Through digging out these channels the water which comes from events of heavy rainfall can drain out and does not entirely flood the roads that therefore stay passable for the people. With regards to the access to public housing services and the results for the respective indicator 4.3 the composition of answers for the three

indicator questions about electricity and energy, network and communication technology, as well as sanitation are relatively consistent among the villages. Accordingly, the distribution of sanitation facilities and particularly drainage and sewage systems has been found to be even lower than the availability of communication technology, access of information through internet, and reliable energy supply. Accordingly, a particular impact on landowners' CCAC through limitations in the accessibility of medias and information as it was found during the CCAC assessment has also been reported by other research in the field (Matewos 2020). Moreover, the lack of sanitation facilities and hygienic awareness which is strongly linked to the issue of open defecation, the contamination of water sources, and the outbreak of water-related diseases (McCann & Knudsen 2018) is assessed as especially problematic. Thus, further improvement is required which will be taken up comprehensively within the recommendations of this research. Regarding the consideration by landowners to apply weather and climate adaptive measures for their houses and the respective capacity to withstand heavy rainfalls, construction improvements can be applied across the villages that may orientate on the example of Oololaimutia. There, the obtained CCAC results suggest that the majority of landowners already considered adaptive techniques when building their houses which are therefore able to withstand heavy rainfalls and which could be transferred to the other villages. However, it should also be taken into account that the perception of interview participants about the resistance of their houses might differ fundamentally which provides for a certain inaccuracy in the analysis. Also, shortages of electricity due to missed payments of residents towards providers are problematic but are not considered for further recommendations as the focus of measures in that regard will be put on the strengthening of economic capacity to better afford provided energy.

The data that has been generated for the determinant of 'institutional capacity' reflects particularly different performances across the villages instead of clear trends for the respective indicators. Accordingly, it can be assumed that the relationship between residents and the government as well as accessed governmental support is strongly dependent on the respective authority in charge for a certain village and their respective proximity and presence in front of the community. Consequently, the relationship of residents and local authorities should be further developed with particular focus on the villages of Empopungi, Enkoriong, and Oololaimutia. Moreover, governmental support services were found to not reach all residents equally across the different villages but also within the same communities given the examples of school bursaries, financial assistance for old people, as well as the governmental aid for COVID-19 that should have reached the beneficiaries via mobile money accounts. Especially the latter has been identified as problematic with a distinctively unequal payment outreach of beneficiaries while neglecting the majority of residents as it can be indicated from the interview results. Also in comparable literature (Aryal et al. 2021, Matewos 2020) authors reported impressions of negative impacts on CCAC through inadequate governmental and institutional systems characterized by significant differences between individual landowners and especially female and male headed households while Simotwo et al. (2018) particularly point out the meaning of information channels between authorities and communities. Accordingly, the researchers also describe those channels as fragmented, diffuse and rather vague eventually resulting in negative socio-ecological effects that subsequently reduce CCAC.

Based on similar findings that were obtained through this research existing inter-relations between the different determinants of this work are further examined as a low information accessibility is directly linked to a lack of knowledge and awareness about the phenomenon of climate change as analyzed in indicator 1.5 'skills and knowledge'. Since especially the COVID-19 financial aid was meant to support every landowner through their mobile money account a systematic failure can be assumed that reveals a lack of appropriate governmental structure and accountability and opens the question where the determined financial means were drained. Consequently, it is highly suggested that local and regional authorities should conduct a review of their governmental structure with particular focus on the delivery of financial assistance that is dedicated to beneficiaries. Such a lack of accountability must be improved in order to ensure equal and successful support services for the people and to eventually strengthen their CCAC.

Conclusively, the previously discussed CCAC results are consolidated and the respective second research question is finally answered. Accordingly, a proper level of categorization of the obtained data from the villages in Mara Siana into a wider CCAC context is difficult due to the restricted availability of comparable data as well as the individuality and uniqueness of the applied approach involving a particular indicator set in combination with the elaborated interview questions and the semiquantitative assessment scheme. However, the comparison of the results between the six investigated villages reveals valuable insights into CCAC differences and sheds light on individual capacity characteristics. More important, as it was comprehensively examined within this chapter, the findings of this work mainly correspond with referenced literature from the field of interest and the wider geographic region. Overall, the final CCAC for the different villages comprise moderate and good results reflecting consistently positive outcomes for 'socio-cultural capacity' across all villages and for 'natural resources capacity' in the majority of villages whereas rather low and moderate performances for 'economic' as well as 'infrastructural and technological capacity' were generated. Especially the latter provides clear differences between the results of the bigger villages with generally higher infrastructural and technological development compared to the smaller villages that appear less developed. The analysis of 'institutional capacity' moreover revealed a distinct gap between the different villages with regards to the relationship between residents and the authorities as well as the provision of governmental services. Accordingly, the village of Empopungi in particular has been identified in which the surveyed landowners feel strongly neglected by the government.

Limitations

There are several different aspects that may limit the expressiveness and truthfulness of this research, and which are extensively highlighted in the following section.

Firstly, the investigated indicators are thoroughly derived from literature that is especially dealing with adaptation of people and communities towards climate change impacts and is being selected by representing a concrete relevance for the study case. Accordingly, these indicators are displaying a comprehensive coverage about different and significant topics, though there might be individual aspects of high significance for this particular study area that have not been provided as an input for the indicator set and subsequently the questionnaire.

In general, the underlying methodological approach with the conduct of interviews fully relies on the truthful provision of correct answers by the interview participants. Personal perception and attitude of people for example comprising attributes such as optimism, pessimism, happiness, and sadness may influence their answers. This means that in reality, different interview participants might fulfill a certain indicator to a different extent, however due to their individual perception, understanding and attitude towards the respective question and the context they are providing similar or even equal information leading to the same evaluation score. Moreover, interviewees might retain valuable information that is of high relevance for answering a specific question because they personally do not relate that information to this question. To reduce incidents of that kind, the interviews are designed in a qualitative and open-ended way and generally allow for individual queries to possibly clarify such misunderstandings and keep the interviewee on the right track.

Furthermore, restrictions of a certain variety of individual answers may be induced through the translation support of the interpreter who may translate the original answer from Maasai to English in her own words, leading to noticeable repetitions of especial expressions during the conducted interviews as for example in question 1.4. Here it is strikingly mentioned that the respective community 'lives as one' which refers to a positive social environment and relationship to the other community members and a high level of trust. Additionally, a change in the way of translating and asking interview questions may possibly also be indicated for the example of indicator 2.2 'land usability' for which the registered inductive codes were thus only assigned for the village of Oololaimutia that was interviewed first.

A main thematic limitation within the applied research methodology is reflected in the culturally determined constitution of Maasai households and the respective relationship between men and women. Accordingly, wives are often living solely with the children in one house whereas the husband often lives in another house in the same homestead, possibly having two or more wives in total. This circumstance plus the fact that in general men are still representing the household head and often administer the generated income, financial resources may not be shared equally between men and women, possibly even disadvantage women. Officially however, husband as well as wife are considered as the legitimate landowners which is the basis for the respective approach that has been conducted throughout the research. Therefore, it was always the one who was found during the site visit that was interviewed. In this regard, the recorded interview data shows that predominantly women were encountered for interviews whereas men were usually less frequently encountered. Also, a particular limitation constraining a precise comparison between different households is the difference between answers from men and women. Whereas women often relate the household only to themselves including the husband but not the other wives possibly belonging to the same husband, the men's understanding of their household is usually comprising all different wives with their respective children that may be present. This situation in fact does not only limit the comparability of the study results between the different households but also implies that women generally are less equipped with financial resources particularly and an equal comparison foundation between information given by female and male landowners cannot be assured.

Referring to the set of indicators that has been used to design the interview questionnaire, interviewees were not asked about their particular health status because of respecting their

privacy. However, the inclusion of the health status as an indicator would be considered as important for a comprehensive CCAC assessment (Park et al. 2012; Williamson et al. 2012) as the exposition of Maasai for example towards infections with HIV and other communicable diseases, possibly related to poor sanitation and hygiene practices as well as cultural beliefs and behaviors, might be of higher significance. Accordingly, the effects from a constrained health may negatively affect their ability to adapt to climate change.

Another limitation is given by the applied assessment ranges to quantify the degree of indicator fulfillment for each question, and which are used to determine final CCAC results. The ranges are not based on any evident and scientific guidelines ensuring a precise quantification. Rather it is aimed to give a rough orientation about the fulfillment of adaptive capacity indicators by the landowners that have been interviewed providing a basis to compare the obtained results with each other.

Moreover, inconsistencies of an interviewee's answers for different questions may occur throughout the research. Accordingly, contradictory statements can be identified for example in the interview with participant (17) from Sekenani who in question 3.1 firstly states that she is given money from family members as income source whereas with regards to obtained financial assistance in question 3.3 she argues that her household does not receive financial support from family members. Also, the respective assessment and scoring of different and inter-related indicators may seem contradictory as for example the aspect of income diversification may be positively evaluated whereas the same interview participant reports that general costs can usually not be covered properly.

Finally, minor anomalies in the suitability of certain predefined questions that were identified during the conduct of interviews have been slightly adjusted to improve the quality of the questionnaire. However, due to this circumstance and emerging slight differences in the formulation of specific questions to different interviewees marginal information gaps are being opened which are indicated within the interview results through the assignment of codes expressing a lack of provided information.

Recommendations

With regards to the third research question to be answered, the main recommendations in form of concrete measures based on the research results are presented in the following sequence. These are mostly suggestions for implementation of specific measures or for verifying their feasibility. In that context, additional information is provided for each recommended measure, such as the target beneficiaries, the target area, and the CCAC indicators that the respective measure will help to improve. As the CCAC results particularly for the determinants of economic capacity and infrastructural and technological capacity were assessed as comparatively low, improvement measures that target especially those indicators of the respective determinants are predominantly considered. Integrated into the actual planned activities, an important factor considered is the design of every recommended measure in a gender sensitive way to holistically support gender equity and female participation throughout implementation following the poor CCAC results for indicator 1.2 'gender integration and participation'. Furthermore, a crucial part of prospective feasibility assessments of the proposed measures should include a comprehensive cost-benefit analysis. Eventually, it is emphasized that, although respective demands for the

implementation of those recommended measures were identified through this research, there might be already similar activities in place carried out by different actors including local community-based organizations (see Annex IV).

Table 37: Measure 1 - Provision of Kitchen Gardens

Measure 1	Provision of Kitchen Gardens	
Objective	Increasing self-sufficiency and food security of landowners and their families	
Targeted CCAC Indicators	2.1	'Livestock and agriculture' (0.53)
	3.1	'Income' (0.56)
	3.2	'Costs' (0.12)
Target Area	Across all villages (with particular attention to Oololaimutia and Sekenani)	
Target Beneficiaries	The focus of this activity is mainly on female residents who are severely constrained in their economic capacity and struggle to afford basic commodities leading to food insecurity.	
Description	<p>There are multiple reasons for the introduction of an activity that promotes the implementation of so-called 'kitchen gardens' across Mara Siana villages. Increasing costs and price fluctuations as well as economic constraints through financial losses and the lack of financial assistance during crisis put pressure on people's ability to obtain sufficient food and other basic necessities. As a result, their capacity to adapt to climate change and related effects is significantly limited.</p> <p>While striving to reduce the economic dependency from livestock keeping, the provision of kitchen gardens aims at increasing self-sufficiency and food security of the beneficiaries and their families through the promotion of agricultural productivity and income diversification as well as the reduction of the beneficiaries' vulnerability towards market volatility and price fluctuations especially for foodstuffs.</p> <p>The provision of kitchen gardens should be accompanied by practical training sessions in which beneficiaries are taught how to set up and run a kitchen garden on their own. With regards to localization, experienced landowners from other Mara Siana villages who already apply agricultural cultivation should be integrated into the sessions and take crucial responsibility as they are already part of the community and have a personal connection to the other beneficiaries. Also essential for a successful project outcome is an adequate participation rate of beneficiaries (Deppenbusch et al. 2021). Therefore, it must be ensured that participants are provided with appropriate circumstances which enable them to take part in these trainings. Additionally, the provision of agricultural inputs such as seeds, fertilizer, and further technical equipment is an essential component of this measure. However, the promotion of locally available resources which can be used to elevate farm productivity should be prioritized. In comparable projects it has already been recognized that the manure of livestock can be utilized for</p>	

	<p>the purpose of fertilizing soils whereas pepper or ash can be used as means for pest and disease control (Sinoya 2019). To benefit from field expertise and get access to financial means the collaboration with and commissioning of different governmental or non-governmental organizations is suggested.</p> <p>Consequently, CCAC will be improved through both the strengthened self-sufficiency and economic capacity as well as enhanced food security and nutritional situation especially among women and children. Furthermore, surplus that is produced by landowners and their families can be sold for example at local markets which generates an additional household income.</p>
Limitation	<p>As indicated by the conservancy manager (see Annex IV), measures that lead to enhanced agricultural production might increase the risk for HWCs as for example elephants or buffalos can be attracted by planted vegetables and approach such kitchen gardens. However, it would need further analysis to determine through which actions that can be avoided. In that regard, maintaining elephant corridors to remain untouched and systematically identifying a proper selection of crops can play a crucial role. Also, opportunities for installing hard structures separating the kitchen gardens from outside and preventing wild animals to enter should be investigated. Further challenges of kitchen gardening in Kenya include unfavorable climatic conditions, the accessibility and affordability of agricultural inputs, and comprehensive knowledge that might be constrained (Hansen et al. 2022).</p>

Table 38: Measure 2 - Conducting a WASH Program

Measure 2	Conducting a WASH Program	
Objective	Preventing contamination of water sources and reducing cases of water-related diseases while improving water quality	
Targeted CCAC Indicators	2.2	'Land Usability' (0.93)
	2.3	'Water Resources' (0.61)
	4.3	'Access to public housing Services' (0.49)
Target Area	Focus on bigger villages with reportedly poor water quality and higher rates of water-related infections such as Oloolaimutia.	
Target Beneficiaries	The targeted beneficiaries are divided by the respective components that are part of this measure. Accordingly, children are targeted for the planned awareness campaign in schools whereas adult residents including men and women will be addressed for sanitation construction exercises.	
Description	The main rationale behind the recommended implementation of this activity is the present spread of water-related diseases such as diarrhea and cholera that interview participants were reporting and which is caused for example by the contamination of water sources through open defecation practices from residents. This is particularly relevant in the	

	<p>context of climate change and CCAC as particularly the intensification of flooding may elevate the risk of contamination of water sources and the transmission of pathogens to humans.</p> <p>The WASH program which is presented in the following therefore aims at improving sanitary conditions and water quality and thus reducing the spread of diseases through firstly raising awareness about the relationship between defecation practices, water sources, and disease outbreaks and eventually carrying out community-based sanitation construction exercises.</p> <p><u>Component A: Awareness creation in schools</u></p> <p>The first component is focusing on the aspect of awareness creation among Mara Siana residents with particular focus on school children. It is the objective to directly educate especially those children in primary as well as secondary schools who will furthermore transfer the obtained knowledge then to their families representing a multiplying knowledge sharing factor. Accordingly, children are taught about the basic cause-effect relationships of the spread of diseases through open defecation and water consumption as well as the respective measures that must be complied with to prevent water sources from contamination. In that context, the learning units are based on the SPHERE handbook containing the humanitarian charter and minimum standards in humanitarian response. Its second chapter, focusing on humanitarian WASH, should generally be considered as central framework for both components as it integrates the aspects of hygiene promotion, water supply, excreta management, vector control, and solid waste management which are strongly interlinked (McCann & Knudsen 2018, p.90). Another concept that illustrates ways of transmission within the general fecal-oral chain of infection in a simple way and that is therefore considered as an appropriate tool for the education of school children is the '5-F' concept. It raises awareness about the transmission for instance through insufficient body hygiene and unclean fingers, by vectors such as flies, and as a consequence of flooding through which the ingestion of pathogens by a susceptible person may occur (Reed et al. 2012). Furthermore, the integration of hygienic measures particularly handwashing is crucial to cut the transmission chain and prevent people from taking up contaminants. Especially activities for the promotion of behavioral changes in WASH practices are of high significance as these remain crucial to sustain a long-term improvement even after project implementation (Bratz et al. 2022, p.27). Nonetheless, chlorine tabs as an effective instrument to improve utilization of water of low or moderate quality can be handed out to school children and their families by implementing organizations to enable Maasai households to purify drinking water by their own. Finally, for the sustainable success of the awareness creation component it is also important to closely cooperate with local communities and leaders.</p> <p><u>Component B: Sanitation construction exercise</u></p>
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	<p>As the second component of the WASH program a comprehensive sanitation construction exercise is set up. Accordingly, the focus of the component is put on the common construction of latrines and the additional provision of handwashing stations and water tabs. In that regard, the selection of a proper type of latrines that is suitable for the local conditions is of high importance. Characteristics and indicators specified by the SPHERE (2018) handbook among others are therefore playing a vital role in the selection process. The excreta management standard 3.2 'access to and use of toilets' of the SPHERE (2018) handbook specifies key actions to be taken and further aspects to be considered for the design and construction as well as the ratio of shared latrines within a community and the distance between latrines and water sources among others (McCann & Knudsen 2018, pp.115). Another activity which may take part in the WASH program is the installation of rainwater harvesting technologies for example in the form of rainwater tanks as already used by interviewee (4) from Oloolaimutia. By using such technology water accessibility as well as overall water quality can be enhanced additionally providing a resource buffer during times of droughts with less rainfall and low water availability. As it is crucial to reach a sustainable project outcome and a long-term improvement of WASH conditions local communities, leaders, and community-based organizations are integrated in the conception, planning, and conducting of this component to intrinsically support the activities, maintain the constructed facilities, and adapting social behavior changes (Bratz et al. 2022, p.27).</p>
Limitation	<p>A major limitation of the proposed measure is represented as it is unclear to what extent the contamination of water sources is related to human defecation in comparison to livestock manure which can be found in large quantities especially in densely populated areas. However, awareness raising about vector control and respective social behavior change may have the potential to also address alternative ways of transmission.</p>

Table 39: Measure 3 - Set up of a Climate Damage Insurance Scheme

Measure 3	Set up of a Climate Damage Insurance Scheme	
Objective	Preventing landowners and their families from facing substantial economic and livelihood constraints through climate-related damage affecting agriculture and livestock resulting in financial losses	
Targeted CCAC Indicators	2.1	'Livestock and Agriculture' (0.53)
	3.2	'Costs' (0.12)
	3.4	'Insurance' (0.59)
Target Area	Across all investigated villages within Mara Siana	
Target Beneficiaries	Integrating all landowners that are cooperating with MSC and signed the lease agreement	

Description	<p>Extreme weather events such as heavy rainfalls and particularly droughts were found to be intensified by climate change in recent years with the consequence that landowners are facing critical challenges affecting their economic activities to secure the household income. Especially livestock keeping has been identified as prone to prolonged droughts since grass and fodder resources become scarce and cattle drastically lose weight or even die because of such circumstances. Furthermore, the price for livestock on the market declines sharply which makes trading more difficult. As a result, landowners that generate their income mainly from selling livestock face distinct financial losses. As one consequence of the drought conditions is that landowners increasingly bring their livestock into the conservancy to access fodder resources, actually dedicated to wild animals, also MSC has an interest in reducing the effects of droughts on livestock. Thus, it is aimed to include MSC as an essential partner into the insurance scheme.</p> <p>In concrete, all landowners that have signed the lease agreement with MSC are recognized for the insurance scheme, though a pilot phase which is targeting selected landowners from one specific village might be worthwhile as an initial stage. In addition to the already signed agreement a contract extension is to be signed which contains further requirements the landowners must fulfill to participate in the insurance scheme. Accordingly, landowners not only commit themselves to stop cattle grazing in the conservancy outside of the permitted periods, but also to maintain a certain maximum number of cows that they keep. This is to avoid excessive resource pressure and to encourage landowners to focus more on quality rather than quantity. In this context, the insurance scheme will also provide informative support for the selection and breeding of resilient cow species.</p> <p>Within this measure proposal it is furthermore not suggested to compensate for livestock which had already suffered or even died but to provide financial assistance in times of prolonged drought through which landowners are able to buy additional fodder stocks for their livestock preventing them from further slimming. This could be facilitated for example by establishing appropriate early warning systems (EWS) and through the utilization of Geographic Information Systems (GIS) and Remote Sensing applications carrying out precise weather forecasts and predicting droughts early to ensure a quick and timely response. By doing so, it can be ensured that landowners are able to purchase additional fodder before their livestock is slimming and market prices are declining preventing them from facing climate-related financial losses. The appropriate amount of payments needs to be clarified through further analysis and by means of the proposed pilot stage. Since the suggested insurance scheme to be implemented covers individual landowners it is considered as 'micro-level index insurance' (Global Index Insurance Facility 2023). As the insurance</p>
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	<p>scheme generally aims to increase risk awareness and provide respective payments as incentive to the landowners to strengthen their own resilience this approach can be categorized as 'climate risk management insurance'. Accordingly, the selected insurer must be able to identify and quantify the concrete risks of an expected extreme weather event and bear the costs when it occurs (European Union 2018).</p> <p>Further positive effects that may result from the insurance scheme include the flexibility of landowners to decide how to exactly spend the received assistance. In that regard, they may not only need to buy additional fodder but can also decide to purchase other necessities such as foodstuffs for which market prices might also increase during events such as prolonged droughts. Also, due to the promotion of quality livestock diseases and pests affecting the cattle can be reduced. Overall, through the prevention of climate-related financial losses the CCAC of landowners is strengthened. However, as evidence from standalone insurance projects conducted by the World Food Programme (WFP) in Kenya showed similar resilience developments of supported households compared to households that were not insured, it can be indicated that the integration of further complementary services and risk management approaches is crucial for a long-term improvement of CCAC and resilience (World Food Programme 2022).</p> <p>The insurance scheme is also strongly linked to MSC and embedded in their activities as it promotes their legitimacy and meaning for the region through not only providing lease payments but also acting as an important link between insurance providers and beneficiaries, enabling financial support in times of crisis. The main benefit for MSC is moreover presented through a decreased pressure on the conservancy as the number of livestock would be reduced and landowners increasingly commit themselves to fulfill the requirements of the insurance scheme to not face punishments or get excluded.</p> <p>Since in the area of Mara Siana alternative compensation schemes focusing on the financial compensation of livestock losses resulting from HWCs, initiated by Chance e.V. among others, are already in place it is recommended to facilitate a cooperation and information exchange with these organizations to benefit from emerging synergies.</p>
Limitation	<p>A crucial limitation is given by the selection of an appropriate insurance provider who bears the costs for the scheme and the compensation payments to the beneficiaries. However, those organizations that already promote and support MSC with financial means may be contacted and a respective scheme be proposed, possibly sharing costs between multiple stakeholders. The availability of fodder resources that can be purchased by landowners is an essential prerequisite to enable a proper outcome of the proposed measure. Accordingly, if those resources are not sustainably provided, the success of this measure is severely constrained.</p>

Table 40: Measure 4 - Facilitation of a Dialogue between Communities and Authorities

Measure 4	Facilitation of a Dialogue between Communities and local Authorities	
Objective	Strengthening or establishing the link between communities and authorities to improve relationships and enable exchange of interests and opinions	
Targeted CCAC Indicators	5.1	'Relationship' (0.65)
	5.2	'Access of Governmental Support' (0.54)
Target Area	Focus on those villages that obtained the lowest results for the institutional capacity indicators and particularly the village of Empopungi.	
Target Beneficiaries	Basically, all participants of the respective village within the territory of the local authority are addressed by this measure as everyone should be enabled to establish and maintain a relationship to the authority and express their concerns.	
Description	<p>Indicator 5.1 revealed substantial differences in the satisfaction of landowners with their relationship to local governmental authorities. Although individual perceptions are subjective and might differ between the participants, the obtained data indicates an overall need for the improvement of these relationships. Furthermore, the main issue about the access to governmental support services, investigated through indicator 5.2, is the inequality that has been reported within this research. Accordingly, not all landowners receive financial support services or other personal support which has been particularly evident in the unfair disbursement of COVID-19 aid to the population.</p> <p>The proposed measure therefore aims to firstly tackle the issue of inadequate relationships between communities and the local authorities by facilitating meetings and information exchange enabling community members to express their concerns and expectations towards the government. In the following, a review process of institutional structures will be promoted in which the local authorities are coming together to manage a mainstreaming of their administrative and institutional structures and processes.</p> <p><u>Component A:</u> Dialogue between communities and their local authority Under the first component meetings of communities of the investigated villages together with their respective governmental authorities are planned and organized under oversight of MSC staff who will be responsible for the moderation and facilitation of the dialogue. Thus, a platform is provided through which residents can directly get into contact with the officials to express their concerns and ask questions. As a consequence, relationships can be established and improved, and suggestions be raised about a better implementation of governmental support services.</p> <p><u>Component B:</u> Meeting of authorities from different villages</p>	

	<p>After authorities have met with the respective communities of their local jurisdiction and thus obtained valuable insights and information about their perspectives, another exchange platform is facilitated. In this regard, it is aimed that officials from the different villages discuss about a common sense to mainstream governmental services and administrative systems to ensure that resources and services are provided equally to members of different communities. These activities should moreover be facilitated under oversight and moderation by MSC as well as other community-based organizations in the area that already maintain relationships with the local communities and are able to establish respective links to authorities.</p> <p>Through the described measure and the two components it is aimed to improve the relationships and communication between communities and authorities as well as to promote a more equitable provision of governmental support services. The resulting strengthening of institutional capacity through increased transparency and improved accountability will further benefit the CCAC of the landowners.</p>
Limitation	<p>One aspect that can present a major limitation to the successful implementation is the availability and willingness of the local authorities to participate and particularly stand accountable for expressed concerns and criticism expressed by the communities.</p>

Further Recommendations

In addition to the presented elaboration of detailed measures to purposefully improve CCAC in specifically identified areas of concern further recommendations for improvement requiring CCAC factors are briefly summarized. Firstly, as a lack of resilient construction of Maasai homesteads has been identified throughout the CCAC assessment, it is suggested to support Maasai landowners with the climate resistant modification of their houses. Accordingly, in the villages of Sekenani and Illturisho significant potential for improvement was detected as the majority of landowners reported their houses as not being able to withstand weather events particularly heavy rainfalls and flooding. In the village of Oloolaimutia however, most landowners emphasized to have already prepared their homesteads in a resilient way so that they specifically resist to such weather events. In that regard, it may be a viable option to set up a workshop for targeted communities in which already experienced landowners for example from Oloolaimutia share their knowledge about the appropriate construction of houses. At the same time, this process can be guided by further local community-based organizations as well as MSC assisting with the provision of respective construction materials and further resources. Moreover, it may be considered to also focus on the particular assessment of the resilience and preparedness of critical public infrastructure including markets, schools, and healthcare facilities towards climate change effects. Subsequently, appropriate structural resilience improvement measures can be identified and initiated as well.

Another aspect that has the potential to possibly reduce resource pressure and costs as well as increase energy efficiency is presented by the introduction of energy efficient stoves which can predominantly be installed in vulnerable Maasai houses. Accordingly, the

demand of firewood can significantly be decreased which leads to a reduced exposition of Maasai landowners and their families to HWCs when collecting firewood accompanied by a reduction of illegal deforestation within MSC and beyond. Another main argument for the introduction of this activity is the saving of costs in the case that landowners are usually tied to buy respective firewood on local markets or additionally need to pay a service provider for the transportation. The suggested activity of introducing energy efficient stoves may also be combined with the previously introduced facilitation of a construction workshop to achieve complementary process synergies.

Furthermore, within the determinant of infrastructural and technological capacity also the indicator of 'connection' appears potentially eligible, as activities have also been applied to strengthen the extreme weather resilience of main roads in certain parts within the Mara Siana area, as reported for the village of Megwara. In this context, channels are being dug on the sides of certain roads so that rainwater can drain safely and the road remains passable, especially during heavy rainfalls. Activities to introduce such structural measures in other communities in the vicinity can also be initiated through awareness raising and technical support of the local communities.

Finally, it is emphasized that increasingly those processes should be promoted in which communities from different villages or social groups generally demonstrate different CCAC performances in a way that allows them to share and support each other to effectively achieve synergies independently from the assistance of external organizations and institutions.

8) Conclusion

This research contributes to an in depth understanding of CCA aspects within communities in Mara Siana and points out strengths and weaknesses that influence their capability to cope with present and future climate change impacts especially comprising prolonged droughts and heavy rainfalls. The results of this work therefore provide a comprehensive foundation for local decision-makers to better understand socio-economic dynamics in the respective communities in the context of CCA and make concrete recommendations for the implementation of measures that show the potential to sustainably improve CCAC. Nonetheless, a profound classification of the study results in the overarching research field of CCAC assessment is made difficult by a high degree of scientific fragmentation and the presence of a multitude of different determination methods as well as due to the unique assessment approach and the individual focus of this research on the specific local context.

Through the method of conducting semi-structured and qualitative interviews in various villages in the region of Mara Siana using a predefined, multidimensional CCAC indicator set not only the scientifically projected climate change effects particularly intensified droughts and heavy rainfalls could be identified as already being recognized by local people but especially their CCAC was computed in detail. Accordingly, for socio-cultural capacity relatively positive results were obtained across the different villages predominantly characterized by local residents who are organizing themselves in self-help groups to mutually support each other, keeping generally close bonds within the communities, and are committed to sending their children to school. However, a lack of gender integration and participation of women at the household level has been identified which can be attributed to cultural and traditional norms and values and which leaves women especially vulnerable. With regards to natural resources capacity, it was found that the vast majority of interviewed landowners reported a high quality and usability of their farmland whereas land use activities are little diversified and mainly focus on livestock with only a few landowners practicing agriculture. One crucial issue is represented by the aspect of water resources and the relatively high distribution of water related diseases, specifically in the bigger villages, that were attributed to the contamination of water bodies possibly through open defecation practices of residents and a lack of further sanitary and hygienic measures. Within the determinant of economic capacity, a very critical finding has been detected as severe price fluctuations of basic commodities such as foodstuffs were reported with many landowners struggling to cover the costs for their basic needs while additionally facing financial losses due to the impacts of prolonged droughts on livestock health and value. Positive factors however are presented through the ownership of assets such as land, houses, and other minor possessions that represent a certain level of economic security as well as the existence of different types of insurance, which are either mainly based on the availability of livestock and household savings or are contracted through the government. For infrastructural and technological capacity particularly in the smaller villages poor CCAC results were generated as the expansion of infrastructure including road network, residential buildings, and critical facilities as well as the provision of public housing services is strikingly limited in its development. Differences in CCAC results between the villages were especially identified for institutional capacity indicating generally different manifestations of relationships between communities and their local authorities as well as an inequitable

provision of governmental support services with actually targeted beneficiaries who did not receive respective assistance. Eventually, the overall CCAC of landowners in Mara Siana is calculated with a medium score pointing out general strengths and weaknesses as well as very differentiated results across individual interviewees and villages.

With the aim to sustainably strengthen CCAC of landowners and their families the final research objective that is achieved by this work comprises four precise recommendations that target specific CCAC indicators with an identified potential of improvement. Accordingly, through the suggested provision of kitchen gardens landowners are supported with the diversification of their agricultural activities by means of trainings and the provision of agricultural inputs and technical equipment aiming at increasing their self-sufficiency. As a result, landowners are less dependent on local markets with drastically fluctuating and increasing prices and might additionally be able to sell their own-grown crops through which they gain an additional income. To tackle the issue of widespread water-related diseases it is recommended to set up a WASH program comprising awareness raising and practical sanitation construction exercises following a community-based approach. Through the education about pathways of pathogen transmission through open defecation and a lack of further hygienic behavior in addition to the provision of latrines, handwashing stations, and water taps the spread of water-related diseases can be reduced. Moreover, to prevent landowners and their families from facing substantial economic and livelihood constraints through climate-related damage affecting agriculture and livestock resulting in financial losses, the establishment of a climate damage insurance scheme is recommended. As this measure is accompanied by limitations and regulations in livestock management also MSC can benefit from restricted grazing and decreased resources pressure. Finally, the last recommended measure refers to the facilitation of a regular dialogue between communities and their respective local authorities to establish and improve their relationships, enabling communities to raise concerns, and promoting the mainstreaming of governmental structures and support services to become more equitable and accountable. Based on the research results, this work provides additional suggestions beyond the recommended measures already elaborated. Those involve practical workshops for improving resilience and preparedness of Maasai houses and critical public infrastructure, the installation of energy efficient stoves, and the construction of water drainage channels along main roads.

Eventually, as the defined recommendations for adequate measures comprise interventions that directly address the improvement of CCAC indicator performances, future research should further prove the suitability and feasibility of these measures as well as their respective scope. Essential considerations should also include the identification of available and appropriate partners and organizations as well as the execution of a cost-benefit analysis. Based on the limitations in the underlying methodology of this work future research could focus in more detail on the individual determinants to obtain more specified and substantial insights into the respective capacities which is especially suggested for the determinants of economic and infrastructural and technological capacity. Future research should also elaborate more on the topic of gender inequality and specifically focus on the determination of CCAC divided by gender to identify gaps and differences between male and female household members more clearly, assessing women's CCAC independently from their husbands' characteristics.

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