

MSc Thesis

Local-scale Vulnerability and Adaptive Capacity to Climate Variability and Change: a Case Study from Northern Central Namibia

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Summary

This thesis analyzes how adaptation to climate variability and change is built endogenously by local resource users, and exogenously by a cooperation of an international donor and a community-based organization. The research is exemplified by a case study in the northern central regions of Namibia. The research area is characterized by mean annual rainfall of 450mm, with 50% inter-annual variability. Climate change projections predict a further increase in extreme rainfall events. Livelihoods in the remote village are largely subsistence-based agro-silvo-pastoralism with marginal market involvement. The concepts of local knowledge, vulnerability, adaptive capacity, and adaptation and development are used to theoretically frame the analysis. Empirical data was collected through semi-structured interviews on local, regional and national scale. Additional means of data gathering were participant observation and participatory community workshops.

When analyzing endogenous adaptation practices, rainfall was identified as the main determinant of agricultural and livestock productivity in the area. Moderate rainfall is most favorable for local agro-silvo-pastoralists. In addition, the community is highly exposed to non-climatic stressors, in particular increasing population density. The local population perceived an earlier onset of the rainy season, and an increase in total precipitation over the past two decades. Climatic records confirm this pattern. The crop and livestock species used are highly adapted to arid conditions, but can buffer extremely low or high rainfall only to certain degree. A fundamental adaptation strategy is spreading risks to different livelihoods. Local 'safety nets' are furthermore composed of strong social cohesion within the community, and extended family networks beyond the village borders. Given the complex interplay of climatic and non-climatic stressors in the area, vulnerability was found to be ambiguous. There is considerable local knowledge on coping strategies and risk spreading mechanisms, however, climate change combined with non-climatic stressors can potentially devalue a part of it.

Exogenous adaptation in the research area is implemented via OIKE, a community-based organization. OIKE drafted the project proposal, whereas the donor agency guided the writing process and included their conceptual ideas on adaptation. The adaptation project focuses on technological, institutional, and educational aspects. Given the high climate variability in the area, it is extremely difficult to separate adaptation from development. OIKE perceives any development initiative – whether related to climate change or not – as contributing to reducing the vulnerability of the local community. The piloting of some of the adaptation technologies in the project is considered limited in scope, because it does not consider how these technologies can be adopted and afforded by the local community in the post-project phase.

A number of synergies and tensions were identified between endogenous and exogenous adaptation. Whereas some aspects of the project build on local knowledge and practices, the integration is marginal in others. In particular the tight time frame of the project intervention was found to mismatch with local realities. This case study furthermore exemplifies the difficulties of translating global policies into local practices, and local needs and concerns into global policies. Community-based organizations were found to have major potential to act as boundary organizations that mediate between these spheres. Concerning the concept of adaptation, it is recommended to increasingly consider the complex interplay of climatic and non-climatic stressors.

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Abbreviations and Acronyms

CBA	Community-Based Adaptation
CBO	Community-Based Organization
CCA	Climate Change Adaptation
CPP-CCA	Country Pilot Partnership on Climate Change Adaptation
DEA	Directorate of Environmental Affairs
DRFN	Desert Research Foundation Namibia
EWS	Early Warning Systems
FIRM	Forum on Integrated Resource Management
GEF	Global Environment Facility
GTZ	German Technical Cooperation
IECN	Integrated Environmental Consultants Namibia
MAWF	Ministry of Agriculture, Water and Forestry
MET	Ministry of Environment and Tourism
Napcod	Namibia's Programme to Combat Desertification
NCRs	Northern Central Regions (of Namibia)
OIKE	Omalundu Iimuna Kommitiye Elungameno (Committee to Take Care of Livestock Movement)
RWH	Rain Water Harvesting
SARDEP	Sustainable Animal and Range Development Programme
SCF	Seasonal Climate Forecast
SGP	Small Grants Programme
SWAPO	South West African People's Organization
UNDP	United Nations Development Programme

1. Introduction

1.1. Research problem

Climate change is expected to have disproportionate negative effects on the rural poor in developing countries (Ludwig, van Scheltinga et al., 2007). The African continent is one of the biogeographical regions most vulnerable to the impacts of climate change (IPCC, 2007).

In Namibia, climate change is expected to exacerbate the already harsh climatic conditions that farmers and herders face. Since agriculture and animal husbandry in Namibia are characterized by a high exposure and low adaptive capacity, they are among the country's most vulnerable sectors. In order to avoid economic deterioration and foster human development, climate change adaptation is indispensable, especially to ensure the continuous provision of livelihoods of Namibia's rural population in the communal areas (Ministry of Environment and Tourism, 2002; Reid, Sahlen et al., 2008).

Given that the impacts of climate change differ greatly between specific localities, adaptation needs to be thoroughly tailored to local conditions (Adger, Arnell et al., 2005). However, adapting to climate change does not mean to start from zero: over the millennia, human societies worldwide have developed diverse and sophisticated strategies for adapting their cultural systems to climatic variability. Thus, human cultural systems are not only a key element of a society's adaptation pathways, but as such mechanisms of adaptation to their natural environment (Roncoli, 2006). Therefore, local knowledge on how to deal with climatic variability is the baseline for future adaptation practices. This accounts especially for rural settings, which are largely subsistence-based and have little access to knowledge, resources and technology – such as the northern central regions (NCRs) of Namibia.

The first research gap encountered is the lack of in-depth analytical accounts of the existing local knowledge and strategies to adapt to climate variability. This includes aspects such as the history of adaptation, how adaptation is embedded in local culture, coping mechanisms, and institutional arrangements. Baseline data is also missing on vulnerability and adaptive capacity of local communities in Namibia. At present, these concepts have only been described in rather broad terms and not community-specific. Measuring adaptive capacity is very complex, because it is latent and prospective (Lemos, Boyd et al., 2007). When assessing vulnerability at local scale, it is crucial to follow a holistic approach instead of limiting stressors to climate change and variability (O'Brien, Leichenko et al., 2004). Thus, multiple stressors such as economic and social developments also have to be taken into account in such assessments. Understanding the interplay of multiple stressors in relation to vulnerability and adaptive capacity could greatly increase the effectiveness of the adaptation projects and programs, as it is baseline knowledge for any adaptation approach to build on. Furthermore, local knowledge which has been scientifically quantified, is more likely to be taken into account by policy-makers (Button and Peterson, 2009). Human-induced climate change poses additional challenges to local knowledge systems (Orlove, 2005). Therefore, an essential aspect of adaptive capacity is to assess how appropriate local knowledge will be under the given climate change scenarios.

While adaptation needs to be adjusted to local conditions, it has to be kept in mind that it does not operate independently from the broader political environment of regional, national and international agendas (Adger, Arnell et al., 2005). Adaptation policies and programs set the framework for adaptation projects on the ground. Another highly influential factor in adaptation is the way that development practitioners reflect, plan and apply it. An inherent link between climate change and development is now widely recognized by the academic community (Boyd, Osbahr et al., 2008). But even though climate change is acknowledged as an additional challenge to rural development, adaptation continues to be widely unrecognized in development programs and projects in many African countries (Orindi and Murray, 2005). The discussion of mainstreaming adaptation into development determines the degree to which adaptation is perceived as a relevant factor in development projects and pathways (Huq, Reid et al., 2006). While the necessity of mainstreaming adaptation into development projects is widely acknowledged by scholars, the question of the how to ‘develop adaptation’ and how to ‘adapt development’ remains unclear in many aspects (Huq, Reid et al., 2006 ; Boyd, Osbahr et al., 2008). Even though it is indispensable to integrate adaptation into many aspects of rural development, the two concepts are not necessarily fully congruent.

A major research gap is the rudimentary knowledge on how adaptation in rural communities is practiced by development interventions (opposed to endogenous adaptation). Since there is little experience with adaptation projects, there is a need to specify the novel challenges that adaptation adds to rural development. This includes the need to analyze the interrelationship – and overlap – of adaptation and development. In addition, there is little experience on how specific vulnerabilities (such as the interplay of climatic and non-climatic stressors) are incorporated on a project level. The role of local knowledge and action as well as structural support is crucial, however, the understanding of how that works in practice is limited (Lemos, Boyd et al., 2007).

1.1.1. Research objective

The goal of this thesis is to analyze how adaptive capacity is built by agro-silvo-pastoralists in northern central Namibia, and how endogenous practices interact with intervention projects on adaptation.

The first objective is to analyze the vulnerability and adaptive capacity of agro-silvo-pastoralists by enhancing the understanding of their coping strategies in regard to climatic variability. By applying ethnographic and participatory approaches, vulnerability is mapped and described via indicators. Based on this characterization of vulnerability, adaptive capacity is critically assessed.

Furthermore, this research aims to critically analyze how adaptation is practiced by a development intervention. This is done by improving understanding of how a specific community-based project in Namibia builds adaptive capacity, and in which aspects this differs from conventional rural development approaches. By elaborating distinctions between adaptation and rural development, a clearer picture of what additional challenges adaptation has to incorporate to be effective shall be generated.

On a broader scale, this research seeks to shed light on the actual needs that rural communities face to be able to adapt to climate change, and thereby contribute knowledge to enhance the adaptive capacity of rural communities in Namibia.

1.1.2. Research questions

Research question one: adaptation as an endogenous practice

Because there is a limited body of empirical knowledge on the local implication of climate variability and change, the first part of this research investigates the following question:

What is the vulnerability and adaptive capacity of the residents of the research area to climate variability and change?

This research question includes a delineation of the risks and the level of exposure the local population faces. Furthermore, the research addresses what the local perceptions of climate variability and change are, and how institutional arrangements and practices on land and water use manage scarce goods under fluctuating climatic conditions. To answer the research question from a broader perspective, it is analyzed how livelihoods in the research area have developed historically in relation to changing environmental and socio-political conditions. A key aspect of this research question is what local knowledge on adaptation to climatic variability the residents of the research area have. This includes a delineation of the techniques, coping mechanisms and institutional arrangements which have been developed to adapt to climatic variability. Combining these aspects, it shall be answered what the adaptive capacity of the local population to climate variability and change is.

Research question two: adaptation as an intervention

Since there is little experience with adaptation projects, the second part of this research is guided by the following question:

How is climate change adaptation practiced by a development intervention?

To answer this question, it shall be investigated how the conceptual agendas of the donor organization are integrated with the ideas of the community-based organization that implements the project on the ground. Thus, this research question seeks to delineate the 'translation' process of adaptation agendas into practice. To put adaptation in a broader development context, it is then elaborated which aspects of the intervention project in the research area relate specifically to climate change adaptation. These aspects are connected to answer how the intervention project in the area contributes to building adaptive capacity to climate variability and change. The final part of this research seeks to combine the two leading research questions and delineate how endogenous and exogenous adaptation interact on local scale, and how this contributes to overall adaptive capacity in the community.

1.2. Namibia – a historical introduction

This section presents an outline of the main events and developments of the more recent Namibian history. The major events in this time period were German colonization (1884-1915), South African rule (1915-1990) and the country's

independence in 1990. Historical patterns are elaborated in the context of present-day practices of land and resource use – in particular in the NCRs of the country.

1.2.1. Colonial history

The first parts of the present area of Namibia were annexed in 1884 – and called German South West Africa. German colonialists faced strong armed resistance by the local population – especially in the areas populated by the Ovambo people (see Chapter 1.3). Thus, the colonialists were de facto never in control of all the land they occupied. The colonial regime arbitrarily ordered dispossession and redistribution of land. Through the denial of access to land, many native Namibians were forced into wage labor, which was needed by the white settlers – especially in the agriculture and mining sectors. The resistance against the colonial oppressors culminated in the Herero and Nama revolt from 1904-1907. The failing of the revolt resulted in a genocide of unimaginable dimensions: the German colonialists murdered approximately 75,000 individuals - 80% of the Herero and 50% of the Nama population (Newsham, 2007). The outbreak of World War I terminated the German rule in Namibia. After the German capitulation in 1915, Namibia became a protectorate of Great Britain, but soon after, the League of Nations gave South Africa the mandate to rule over the country. Even though South Africa was not allowed to annex Namibia, the government policies continued to systematically favor the interest of white settlers. The majority of the native Namibian population was excluded from political processes. The systematic political oppression and segregation established by German colonialists was largely adopted by South African rulers (Newsham, 2007). Therefore, it is no surprise that the struggle against the occupying forces continued under South African rule.

Since access to and control over land were key organizing principles of both German and South African colonial regimes, it is crucial to understand the private-communal land tenure division in Namibia (Newsham, 2007). Based on the proposition of the Odendaal Commission in 1964, the South African apartheid regime started to establish so-called homelands. The extent of the homelands is shown in Figure 1. While the total area of the homelands was a large proportion of the country's surface area, it has to be kept in mind that much of the land was desert or semi-arid land with little commercial or strategic value to the colonial regime (Newsham, 2007). Even though the regime formally acknowledged the self-governing of homelands, the local population was prohibited to leave the area. Thus, the establishment of homelands was nothing but another endeavor to institutionalize racial segregation. What the apartheid regime had established as homelands became communal land as the country gained independence. Communal land means that there is no individual ownership of land (with few exceptions). This land is managed by local communities and traditional authorities. Today, approximately 40% of Namibia's area is communal land. Private land amounts 44% of the surface area and is mainly used for commercial farming and animal husbandry (FAO, 2010). The largest share of private land is still owned by white farmers. Given the historical inequalities in land distribution and access, the redistribution of land is one of the most urgent – and delicate – political issues since independence. While the government has continuously been trying to solve the issue – including the issuing of several land reform acts – the progress has been very limited so far (Newsham, 2007).

Fueled by the first wave of independence in the African subcontinent, the South West African People's Organization (SWAPO) was formed by Namibian migrant workers in the Cape Town area in the 1950s. Even though SWAPO was not the only Namibian organization active in the liberation struggle, it was arguably the most important driving force in the struggle. SWAPO successfully gained international support for the independence of Namibia. The United Nations, the Soviet Union and the Organization of African Unity became SWAPO's main sponsors. SWAPO also initiated an exile movement: many Namibians were sent abroad to study. As a result, many of today's elite of the country got their education in exile (Newsham, 2007).

Even though SWAPO continued to gain independence through pressurizing the colonial government via the international community, they also initiated armed resistance. The first exchange of blows with the South African Defense Force took place in Omugulugwombashe – located in the North of Omusati region – in 1966. After Angola's independence in 1975, SWAPO increasingly operated from military camps across the border. When the International Court of Justice had declared the rule of South Africa over Namibia unlawful in 1971, the pressure on South Africa rose. However, in addition to the external pressure, a consensus grew among the South African rulers that the costs of holding Namibia were simply too high, and did not outweigh the benefits. Nonetheless, it was not until 1988 that the South African government agreed to negotiate with SWAPO under the auspices of the United Nations.

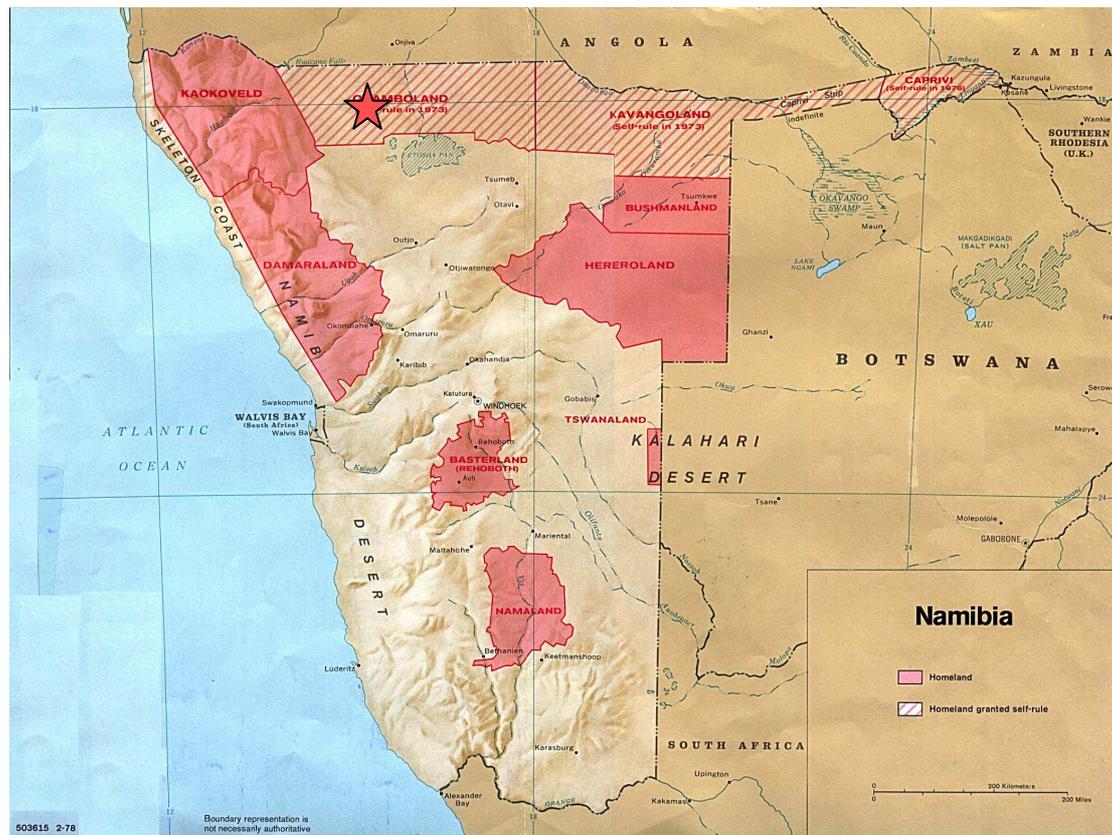


Figure 1: Namibian homelands in 1978 (University of Texas at Austin, 1978)

(The research area is tagged with a red star.)

1.2.2. Independence and present-day Namibia

Independence was declared on 21 May 1990 – thereby, Namibia was the last African country to gain independence. SWAPO won the 1989 elections with a majority of 57%. Due to its central role in the liberation struggle, SWAPO continued to enjoy great popularity throughout the country and has been the ruling party since independence. In the NCRs, SWAPO is traditionally very strong. In the research area, (Otamanzi constituency), the party gained more than 98% in the 2009 presidential elections (Electoral Commission of Namibia, 2009).

According to the latest demographic data, Namibia's population slightly exceeds two million. The mean population density is 2.5 people per km². The expected population growth rate is expected to amount 1.3% per annum, with the strongest increase in the NCRs (United Nations Statistics Division, 2009). For the largest part of the population, the economy is subsistence-based: more than two thirds of Namibians rely on animal husbandry or rain-fed subsistence cropping as a livelihood.

Based on the Atlas method, Namibia's 2008 Gross National Income (GNI) per capita amounted US\$ 4200. For the same year, the GNI per capita, purchasing power parity (PPP) amounted US\$ 6270. Namibia is considered a middle income country (MID) (World Bank, 2009). Even though it is one of the most stable nations in Southern Africa, Namibia is also one of the countries with the highest inequity worldwide. Between different regions and ethnic groups, there are huge disparities of human development, including life expectancy, education, and income (Levine, 2007). A background paper to the 2007/2008 Human Development Report speaks of a downward trend in human development, even though the per capita income keeps increasing. The main reason for a decreased life expectancy is the increasing death toll of the HIV/AIDS epidemic. The estimation for the percentage of the population to be infected with HIV/AIDS exceeds 20% (Levine, 2007). The life expectancy since 1990 has decreased by more than ten years (Central Bureau of Statistics, 2001).

Nonetheless, it has to be stated that considerable achievements have been made in Namibia's recent history. In 2000, 82% of the children between six and 15 years attended school (slightly more girls than boys). Literacy rate of citizens above 15 years of age amounted 81% in the same year. The Central Bureau of Statistics (2001) estimated that 87% of households had access to clean drinking water in 2000. The controversy of de jure and de fact access to drinking water will be discussed in Chapter 3.4.3.

1.3. Northern central regions

1.3.1. General introduction

Namibia's NCRs constitute four regions: Ohangwena, Omusati, Oshana and Oshikoto – often referred to as the 'four Os'. In many aspects, the NCRs differ greatly from the rest of Namibia. While the NCRs constitute 10% of the country's surface area, they are home to approximately 43% of the country's population (Central Bureau of Statistics, 2001). The population in the NCRs is expected to approach one million by 2015. In 1951, the population in the NCRs amounted to merely 200,000 people. Today, the NCRs are Namibia's most densely populated areas. In Omusati region, population density amounts twelve people per km² – almost five times higher

than the national average. Even though the NCRs are strongly characterized by the agro-silvo-pastoral subsistence practices up to this day, the percentage of the urban population is continuously growing. Trade is the main source of income for urban dwellers in the NCRs (Mendelsohn, el Obeid et al., 2000).

Biogeographically, the NCRs are mainly influenced by the Cuvelai Basin, an ephemeral river system bringing runoff rainwater from Angola during the rainy season. The Cuvelai Basin drains in the Etosha Pan in the South of the NCRs. There are six main landscape types in the NCRs: Western and Eastern Kalahari woodlands, Cuvelai, Karstfeld, mopane shrublands, and salt pans and surrounding plains (Mendelsohn, el Obeid et al., 2000).

The quality of groundwater in large parts of the NCRs is extremely poor and of limited use for human purposes – especially due to high groundwater salinity. In many areas, total dissolved solids amounts to more than 5000 milligrams per liter, whereas 2600 milligrams per liter are considered the maximum concentration suitable for human consumption. Approximately half of the area of the NCRs has medium to high soil salinity. The potential for crop cultivation is high in the northwestern part of the NCRs, but low to very low in most other parts. Livestock densities are highest in the central and northeastern part of the NCRs. About 25% of cattle, 43% of goats and 70% of donkeys in Namibia are found in the NCRs (Mendelsohn, el Obeid et al., 2000).

Plant diversity is between medium and very low in most parts of the NCRs. High and very high plant diversity is only found in the northwest and southeast of the NCRs. The populations of large mammals concentrate in Etosha National Park, which was established as a game reserve by the German colonial regime in 1907. Inhabitants have been banned from the National Park ever since its establishment. The solid iron fence of the park erected in the 1960s also impedes migration of large mammals. The combination of hunting and human population pressure has drastically diminished wildlife stocks outside of the park's borders. The concentrations of large wildlife beyond the park's fence are very low – on average less than 0.1 animals per km². Nonetheless, animal sightings outside of the park's border – including elephants and lions – occur regularly (Mendelsohn, el Obeid et al., 2000).

The direct interference of the colonial regimes – both under German and South African rule – in the NCRs was comparatively low, because the military forces were limited, and the natives were relatively well-organized and well-armed. Residents of the NCRs had profited economically from trade with South Africa. On top of this, they had been exposed to education through the various missionaries that had been established in the NCRs before the arrival of the Germans. Given the limited military forces to control the NCRs, German rulers established a so-called police zone – officially to protect white settlers from the local population. The South African regime took over the concept of this police zone (Newsham, 2007). In 1967, the NCRs were declared a homeland by the name of 'Ovamboland'. Within this homeland, there were comparatively few white settlers occupying agricultural areas. Etosha National Park lies within the NCRs, however, it was never part of the homeland or communal areas. Until today, Etosha National Park is administered by the national government, not by regional authorities.

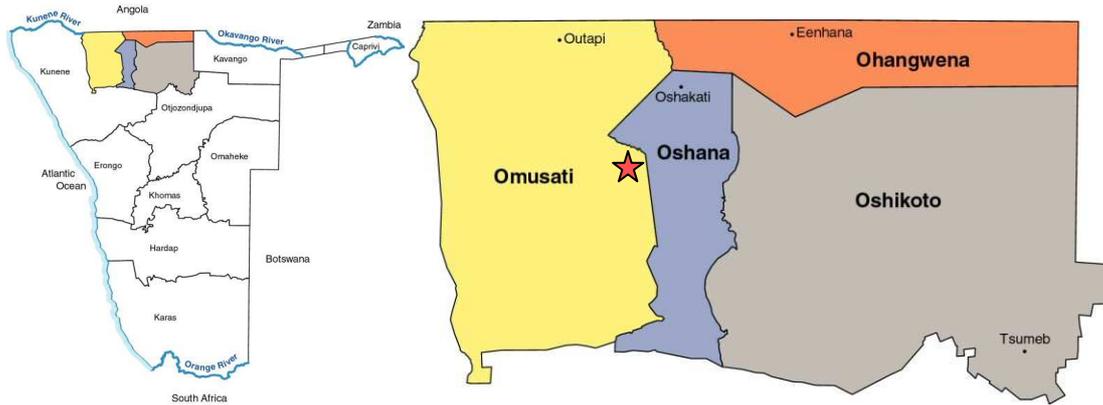


Figure 2: Administrative division of Namibia and location of the northern central regions (Mendelsohn, el Obeid et al., 2000)

(The research area is tagged with a red star.)

About 95% of the population in the NCRs belongs to the Ovambo people. Ovambos constitute approximately half of Namibia's population, and are by far the largest of the country's eleven main ethnic groups. The language spoken by Ovambos is called Oshiwambo. The 2001 Population and Housing Census identified 48% of Namibians to be native Oshiwambo speakers (Central Bureau of Statistics, 2001). There are nine different Oshiwambo dialects, the main one being Oshindonga. The population in the study area is almost exclusively composed of Ovambos, most of them belonging to the Kwambi tribe (Mendelsohn, el Obeid et al., 2000).

The livelihood of Ovambos has been described as agro-silvo-pastoral (Kreike, 1995). Up to this day, a large part of Namibia's Ovambo population – especially those living in the NCRs – practice a form of this livelihood. An in-depth analysis of Ovambo livelihoods is presented in Chapter 1.6. Today, most Ovambos have converted to Christianity, in particular to Lutheran churches. Finish Lutheran missionaries arrived in the NCRs as early as 1870. Today's Ovambo population is concentrated in Namibia's NCRs and Southern Angola (Kreike, 2004). There are huge Ovambo populations in larger cities of the country. Ovambos are estimated to have migrated to the NCRs about 400 years ago. They belong to the larger ethnic group of the Bantus and are expected to be descendants of a group which had originally occupied areas in Nigeria (Kreike, 2004). Even though the establishment of colonial states in Namibia and Angola impeded movements across the borders, this practice remained common. Two drastic examples shall illustrate the border crossing activities: firstly, in 1926, approximately 40,000 Ovambos fled from Angola to Namibian Ovamboland to escape Portuguese rule. And secondly, during the 1929 – 1931 famine, large numbers of Ovambos fled to Angola (Mendelsohn, el Obeid et al., 2000).

Even in pre-colonial times, Ovambos have been reported to be involved in trade, especially with iron and copper items, salt, and cereals. Contract labor was introduced by German colonialists and become fairly common under South African rule. The main unit of the Ovambo livelihood system is the household. Traditional Ovambo households consist of a fenced agglomeration of huts – and are called homesteads (Kreike, 2004). Ovambo culture was not influenced to a degree by the colonial regime as experienced by other ethnic groups in the country, e.g. the Herero or Damara. However, the colonial state did severely limit the mobility of Ovambos in the NCRs,

e.g. by impeding transhumance in 1960 (Kreike, 2004). These factors influence land and resource use up to this day (Newsham, 2007). Interestingly, colonial regimes in Namibia did not necessarily undermine the power of traditional Ovambo leaders in the NCRs. In fact, there are cases where colonial regimes granted traditional leaders power over natural resources which they did not have beforehand – such as water and grazing land (Werner, 2009). Post-colonial transformations in the Ovambo society include the phenomenon of male migrant labor and changing patterns in agricultural systems. This has caused an increase in the percentage of female household heads (Schäfer, 2002). Even though there is a clear increase of engagement in commercial activities, the more remote areas are only marginally included in this process so far (Mendelsohn, el Obeid et al., 2000).

1.4. Namibia's climate

1.4.1. Current state

Namibia is located on Tropic of Capricorn. Its climate is furthermore influenced by the Benguela current, which cools the coastal zone of the country. During summer, the Inter-tropical Convergence Zone (ITCZ) brings moisture to the north-eastern part of the country. Namibia harbors five climatic zones, however, more than 90% of the country's total surface area is within the semi-arid, arid, or desert zone (Ministry of Agriculture, 1995). The fractions of the given climate zones in proportion to the land's total surface area are as follows: Semi-arid: 37%; arid: 33%; desert: 22%; semi-humid and sub-tropical (8%) (Ministry of Agriculture, 1995).

Mean annual rainfall amounts 272mm, but varies highly in different parts of the country: While the southwest receives a yearly average of 25mm, the average precipitation in the northeast amounts 700mm (see Figure 3). In most parts of the country, more than 90% of the rainfall occurs in summer (November to April), often in the form of showers and thunderstorms. Only in the south-western part of Namibia, most precipitation occurs in winter. As shown in Figure 3, the inter-annual variability of rainfall (expressing the standard deviation as a percentage of the mean) ranges from 25% in the northeast to more than 80% in the southwest (Ministry of Environment and Tourism, 2002). This high variation in rainfall causes consecutive years of drought to be a common phenomenon (Shanyengana, Henschel et al., 2002). El-Niño Southern Oscillation (ENSO) influences both temperature and precipitation in Namibia. During ENSO events, summers are extremely dry and warm (Ministry of Environment and Tourism, 2002). In the Namib Desert, which stretches from the coast of Angola through Namibia to South Africa, coastal fog is an important source of water. In this area, fog precipitation is five times higher than that of rain. Moreover, fog precipitation is less subject to fluctuations and thus more predictable (Shanyengana, Henschel et al., 2002).

In the coastal areas, mean temperatures throughout the year range from 10-22°C. Temperature extremes are rare because of the maritime influence. In the inland areas, temperatures range from 13-37°C in summer and from 2-30°C in winter. On the Central Plateau and in the Kalahari, there are high diurnal temperature ranges of more than 30°C in summer and less than 10°C in winter. High solar radiation, low humidity

and high temperatures cause a very high evaporation. Coupled with the virtual absence of surface water, low and highly variable precipitation, water is a scarce resource in Namibia (Ministry of Environment and Tourism, 2002). In terms of climatic conditions, Namibia is a country of extremes: without taking climate change projections into account, Namibia is considered the most arid country in sub-Saharan Africa (Ministry of Environment and Tourism, 2002; Zeidler and Chunga, 2007).

Microclimate of the study area – northern central regions

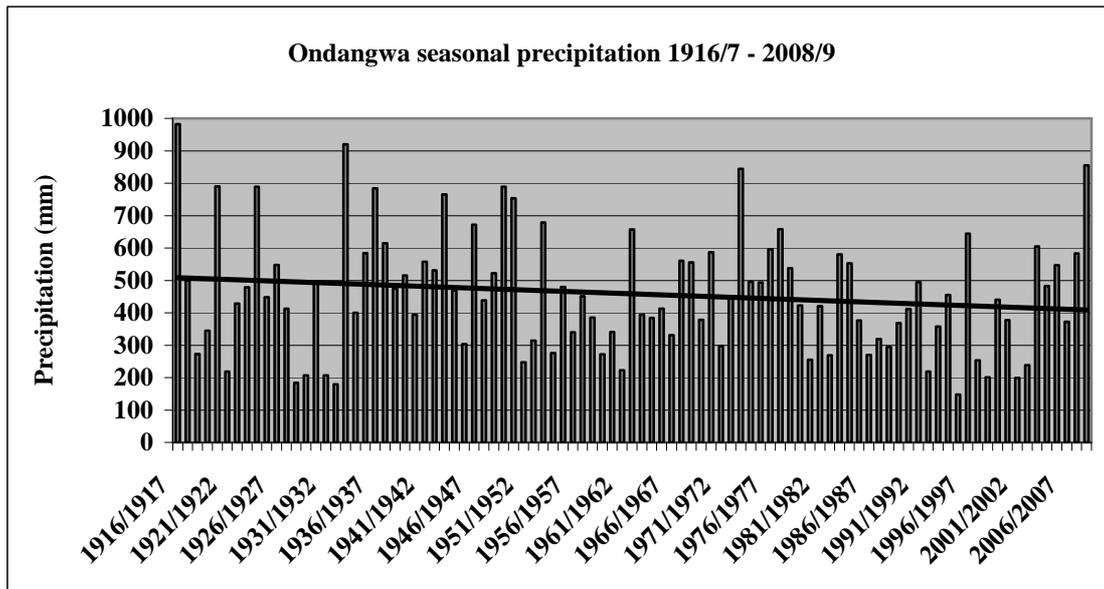


Figure 4: Ondangwa seasonal precipitation 1916/7 - 2008/9

(Due to considerable data gaps, the given primary data was complemented with data from Oniipa weather station and Onkani Agricultural Extension Office.)

Average rainfall in the NCRs is highest in the eastern part (up to 550 - 600mm per year) and decreases toward the West and South-west (up to 250 - 300mm per year). On average, January is the month with the highest precipitation and the rainy season lasts from November to April. However, the variability of precipitation in terms of time, space and quantity is large. The variability of the annual amount of rainfall in the NCRs ranges from 30% in parts of the Etosha Pan to 60% in the West (see Figure 3) (Mendelsohn, el Obeid et al., 2000).

Average daily temperatures in the NCRs reach the highest value of 25°C in November and December and the lowest value of 17°C in June and July. The average daily temperatures are relatively low due to the sharp temperature drops at night – especially in winter. Average maximum temperatures reach 30 - 35°C in summer and average minimum temperatures are 7 - 8°C in winter. Temperatures close to 0°C are usually limited to a few days per year. In the NCRs, annual evaporation amounts approximately 2500mm per year – which exceeds the amount of rainfall by five to six times. High temperatures, high solar radiation, strong winds and scarce vegetation cover contribute to this phenomenon (Mendelsohn, el Obeid et al., 2000).

Microclimate of the study area – Onkani

As precipitation data for Onkani’s Agricultural Extension Office is only available from 1997/98 onwards, data from the closest weather station (located in Ondangwa, approximately 60km from Onkani) is used as a proxy. However, even the data from Ondangwa has severe gaps, especially throughout the 1980s and 1990s. Therefore, the data had to be complemented with records from the Oniipa weather station (circa 10km from Ondangwa) and Onkani Agricultural Extension Office.

Long-term precipitation records from 1916/17 to 2008/09 show a slight but clear downwards trend (see Figure 4). When analyzing the mean annual record per decade for the period of 1919 - 1928 to 1999 - 2008, the downwards trend is even slightly sharper. The average seasonal rainfall for the given time period amounts 454mm, with an inter-annual variability around 50%.

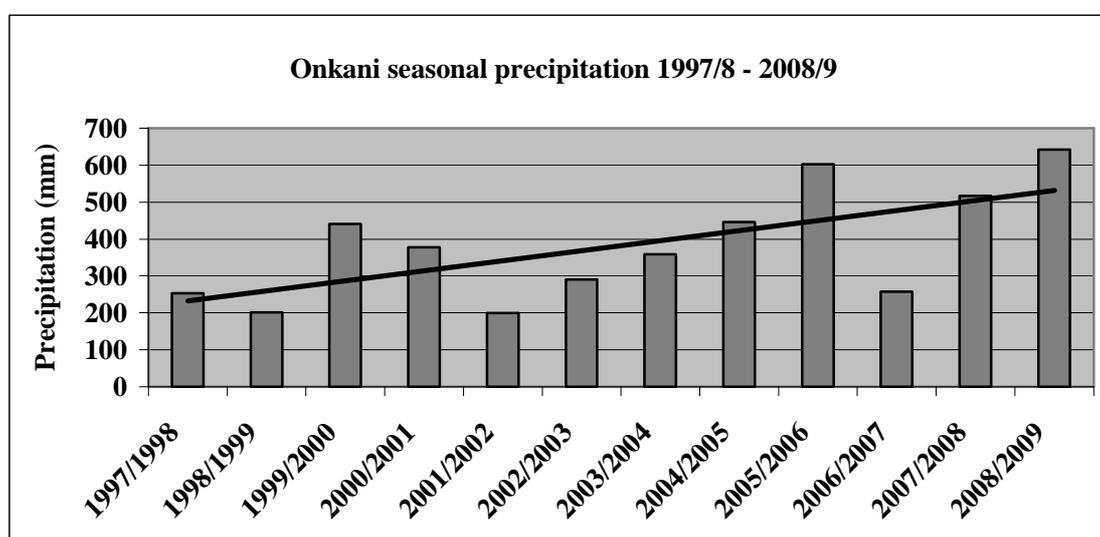


Figure 5: Onkani seasonal precipitation 1997/8 - 2008/9

When looking at the past eleven seasons in Onkani, the precipitation records show a clear trend of increasing rainfall between 1997/98 – 2008/09 (see Figure 5). The mean value per season for the given time period amounts 382mm. However, given the short time frame of the data from Onkani, no definitive statement on local precipitation trends can be made. Moreover, the reliability of the data is precarious. Based on the given data from Onkani, approximately 60% of the total precipitation in Onkani occurred in January and February, and 85% from December to March.

1.4.2. Climate change projections

While different climate models are relatively persistent on the warming trend of the African continent, there are considerably higher uncertainties in rainfall prediction (Boko, Niang et al., 2007). Even though different models do not agree on a clear trend in the predicted amount of precipitation, there is a consensus that rainfall variability will increase (Ministry of Environment and Tourism, 2002). This accounts especially

for the inland areas. When rainfall occurs, it is predicted to come in such great intensity that it will lead to erosion and flooding (Reid, Sahlen et al., 2008).

Between 1950 and 2000, an annual temperature increase of 0.023°C has been recorded. Under IPCC's A1 Scenario, temperatures on the Central Plateau in 2100 are predicted to be 4.5-6.0°C above the mean values of the 1961-1990 period. Under the B1 scenario, the predicted temperature increase for the Central Plateau in 2100 amounts 2.0-3.0°C (Ministry of Environment and Tourism, 2002). The predicted temperature increase will cause a rise in evaporation of approximately 5% per degree of warming. Thus, even if precipitation will remain at its current level, water availability is expected to decline (Ministry of Environment and Tourism, 2002).

Under the given projections, climate change is highly likely to exacerbate the dry conditions already experienced in Namibia (Reid, Sahlen et al., 2008). This is a great threat to Namibia's agricultural productivity and the associated livelihoods. However, given the great uncertainties of the projections (in particular concerning precipitation) the question what future climatic conditions Namibia is expecting remains partly unanswered (Dirkx, Haeger et al., 2008).

1.5. Research area

The research area was Onkani village, located in Otamanzi constituency in the South-east of Omusati region. The constituency's population was estimated to amount approximately 13,000 individuals in 2001. Child mortality is 130 per 1000 children born. Life expectancy is 54 years for women and 50 years for men (Central Bureau of Statistics, 2005). Otamanzi constituency is very rural and remote. Homesteads are scattered and there are no settlements exceeding a few hundred households. Onkani village lies close to the border with Uvudiyah constituency in Oshana region. The village is located approximately 40 kilometers north of the veterinary fence of Etosha National Park and about 50 kilometers south-west of Oshakati. As Onkani is located in the lower part of the Cuvelai Basin, it is less flood-prone than the areas close to the Angolan border. The main vegetation types are mopane shrub and low trees on loamy sands, and mopane shrub and low trees on oshanas (seasonal wetland). The South of Onkani is dominated by dense mopane thickets, whereas a saline grassland called Ombuga stretches in the North-east (Klintonberg and Verlinden, 2008). The decrease of mopane density correlates with the decrease in population density along the North-south gradient. Soils are sands and loams with medium salinity and the potential for crop cultivation is estimated to be low (Mendelsohn, el Obeid et al., 2000).

The village counts approximately 120 households and covers the area of a five to ten kilometer radius. In the village center, the following infrastructure is available: clinic, agricultural extension office, combined school (up to grade ten), police station, and church. Additionally, there are about 15 so-called 'cuca shops' selling alcoholic and non-alcoholic beverages and a very limited selection of packed food and household articles. Except for the government buildings, which are equipped with small-scale solar panels, Onkani is not electrified. There is no telephone land line to Onkani, and cell phone reception is very weak to non-functional. Road access is possible through 25km sand tracks to Onaanda, which is connected by a gravel road to a paved overland road. In Ovambo culture, communities do not necessarily cluster around a center. Onkani clearly reflects this pattern. Even though there is a village center with key infrastructure, the homesteads are sparsely scattered over the entire area of the

village. Apart from the public infrastructure in the center, the area seems to lack distinct land use zones. Homesteads are scattered all over the village area, agriculture is practiced on the fenced fields around the homesteads, and grazing land has no limitations outside these fences. It has to be kept in mind that the availability of certain infrastructure does not necessarily mean that all citizens have de facto access to it. This can be due to lack of funds to pay fee-based products or services or the far distance of many homesteads from the location of the given public infrastructure, almost all of which is clustered in the village center. The village has been provided with tap water since 1998. The water provision is enabled by two pipelines: one coming from Oshakati (Oshana region) and the other from Ogongo (Omusati region). Both pipelines are off-takes from the Etaka Canal. At the time of research, there were five community water taps in Onkani, and approximately 30 private water taps. The water supply, however, is not fully reliable throughout the year. Water cuts of several weeks are not an uncommon phenomenon, especially towards the end of the dry season. As discussed above, not all household within reach of a water tap have a de facto access to fee-based tap water.

There are contrary statements of the year in which the first settlers arrived in Onkani, however, this most likely occurred around 1970. Half of the interviewees had established their homesteads in Onkani in the 1970s. In the 1980s and 1990s, 10% and 15% of interviewees had settled in Onkani, respectively. The remaining 25% of the interviewed agro-silvo-pastoralists came to Onkani between 2000 and 2009. Prior to the establishment of permanent housing structures in Onkani, the area had been used for cattle and hunting – first by San (bushmen) and Himba people, then to an increasing degree by Ovambos. At present, all villagers in Onkani are Ovambos. A small and scattered population of San was reported to have settled in adjacent villages, however, not in Onkani itself. Thus, the village is relatively uniform in terms of ethnicity. There are two different tribes in Onkani, the Okwambi and the Okandjela. There are no signs of hostility or quarrels between members of the two tribes.

The household is the fundamental unit in Ovambo culture. An Ovambo household is called homestead and consists of a fenced agglomeration of huts and open areas, each with a distinct function, e.g. cooking, storage, threshing, sleeping, or receiving guests. Traditionally, household heads in Ovambo culture were primarily male (Kreike, 2004). However, based on the interview sample, the number of households with a female household head equaled the amount with a male household head. The sampled households consisted of 7.7 individuals on average, 4.5 thereof children under the age of 18. Even though polygamy was common in Ovambo culture, it strongly decreased with Christianization from the late 19th century onwards (Kreike, 2004). Polygamy has become uncommon in Onkani, however, it still exists marginally. In the case of Onkani, the community boundaries are defined by the affiliation to a specific headman. Headmen are responsible for the population of their village, thus if a household belongs to a specific village, it is under the patronage of a particular headman. All interviewed households in Onkani were aware of which village they belonged to. What has to be considered in the notion of community in Onkani is that substantial contributions to livelihoods come from outside the geographical boundaries of the village. The most important factors in this context are cattle posts south of the village, and financial contributions from family members working in the cities.

In Onkani, the government is represented by the counselor of Otamanzi constituency, who is a member of the ruling SWAPO party. The counselor's office is in Otamanzi

village, but his private residence is in Onkani. The headman is the traditional leader of an Ovambo community (Kreike, 2004). The Onkani headman died in June 2009, just shortly before this research was conducted. The two wives of the late headman functioned as interim representatives at the time of research. The future headman was already appointed by the late headman, however, this is not publicly announced in the community before a period of mourning has passed. The role of the village headman in Ovambo culture is a mediator and supporter rather than a ruler with strong power over resources or decisions in the community. The main function of the headman in Onkani can be specified as follows: settle disputes among community members, allocate land, advice people on resource use practices, and ensure that law and regulations are adhered to in the community.

1.6. Livelihoods baseline

The livelihoods of Ovambo societies have been described as agro-silvo-pastoral (Kreike, 1995). Here, the livelihoods are described in depth for Onkani. It will be shown that rural economies in the community are mainly based on subsistence agro-silvo-pastoralism. Small-scale market involvement is practiced by a majority of villagers, however, besides many structural obstacles, it is limited by relatively low agricultural and livestock outputs. These, in turn, greatly depend on rainfall. Cooperation with formal institutions is not strongly performed, but informal cooperation with neighbors and family members is practiced widely. There are vast differences in living conditions, wealth and access to resources within the community.

1.6.1. Agriculture and animal husbandry

Farming is the main pillar of livelihoods in Onkani and practiced by all interviewees. About 85% of the interviewees additionally keep livestock. Natural resources from the wild are utilized by all interviewees, whereas the intensity and types of resources used differ greatly. It is difficult to estimate average field sizes in the area, as more than 70% of the interviewees were not able to indicate the size of the area under cultivation. Based on the available data, field sizes per household are estimated to be about three hectares on average, ranging between approximately two and seven hectares. Thus, the area under cultivation is very small-scale. This finding is in line with a study from Matanyaire (1996), who estimated farmers in northern central Namibia to grow 3.5 hectares of pearl millet on average (standard deviation ± 1.76). Even though there are other crops grown, pearl millet was arguably stated to be the most important staple food in the area.

As shown in Figure 6, pearl millet (called ‘mahangu’ in Oshiwambo language) and sorghum are the main staple food in the area: they are grown by 100% and 95% of the households, respectively. Maize and cowpeas (*Vigna unguiculata*) are the second most important crops, both grown by more than 80% of the households. In addition approximately two thirds of households in Onkani grow groundnuts and watermelons (*Citrullus spp.*), respectively. Bambara groundnuts and sunflowers are cultivated by a small fraction of farmers (9% and 5%, respectively). In addition to crops, fruit trees are commonly grown, mainly marula (*Sclerocarya birrea*) and vegetable ivory palm (*Hyphaene petersiana*).

Animal husbandry shows a more differentiated pattern than crops: while almost one fifth of households have herds larger than 30 animals, some 14% do not own livestock at all. Another 14% of households keep less than ten animals. Half of the households have herds between ten and 30 animals. These indications do not include herds at the cattle posts, which are treated separately in the following paragraph. Goats are the most common livestock species in Onkani (owned by 73% of the interviewed households). Approximately two thirds of the households own cattle, and 46% donkeys. Sheep (9%) and pigs (5%) are more of an exception. The average herd composition and size per household is shown in Figure 7. Chicken are furthermore very common farm animals in Onkani: they are kept by at least three quarters of households. Besides grazing, browsing trees and shrubs are substantial nutritional components of livestock in the NCRs, especially in the dry season (Kreike, 2009). Furthermore, crop residues such as pearl millet and sorghum stems are commonly browsed. Storage of other animal fodder is not unheard of, but not very common.

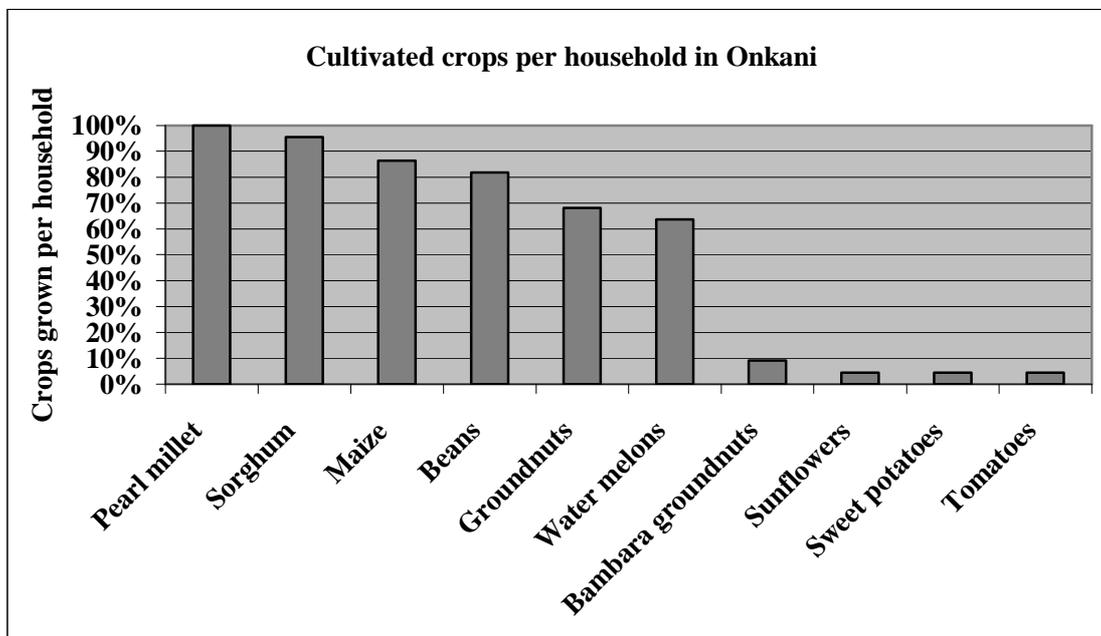


Figure 6: Cultivated crops per household in Onkani

Since livestock graze on communal land in the NCRs, they mate freely. The purposeful mating of genetically favorable bulls and cows is an exception: just a few livestock breeders stated that they intentionally use the fittest males and females to mate, including the exchange with animals of neighbors or family member for that matter. The headman received a bull for breeding purposes from the government. Even though this bull may be used by all residents of Onkani, only few herders were aware of this possibility. As there is no legal regulation of herd size, the main limitations seem to be the availability of labor and fecundity of females.

Cattle is the livestock most valued in Ovambo culture (Kreike, 2004). Products obtained from cattle include food (meat, milk and grease), manure, leather, and various household items (e.g. made from bones or tendons). Bulls are also used for ploughing. Only about 15% of respondents stated that they sell cattle. However, the value of cattle goes far beyond its use value, as its ownership is closely related to a

family’s social status in the community. In general, cattle is kept for emergencies, and only slaughtered for special occasions such as funerals and wedding ceremonies. It can also compensate misdemeanors or crime. A common quote on the value of cattle was the following: “People with a lot of cattle are rich – whenever they are in trouble, they can sell some and all their problems are solved.” Kreike (2009) called cattle a ‘social currency’ in Ovambo culture, which is redistributed to maintain and enhance social networks.

It is crucial to mention that cattle was not only culturally valued, but also a highly traded commodity in northern Namibia and southern Angola before the colonial conquest. This fact was greatly ignored by colonial governments, who dispersed the belief that native Namibians saw cattle as a cultural object rather than a commodity, and therefore were unable to market it. The belief that Ovambos have a cultural resistance to marketing livestock is commonly shared in Namibia up to this day. Ironically, it was colonial rule which restricted animal husbandry in northern central Namibia. Thus, cattle lost its role of a cross-border commodity and was pushed into subsistence (Kreike, 2009).

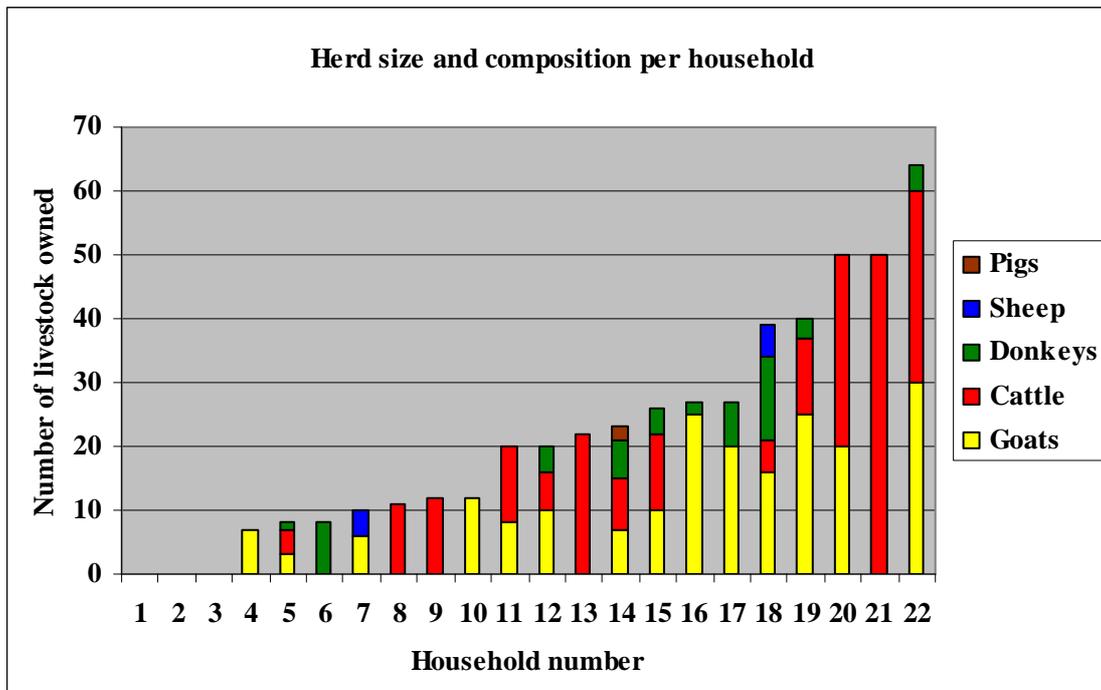


Figure 7: Average livestock per household in Onkani (excluding cattle posts)

Cattle posts of Onkani

It is important to keep in mind that crucial livelihood components are not only the farms and animal herds within the village, but also the larger herds kept at the so-called cattle posts. Cattle posts are remote locations where – unlike in the populated village areas – large livestock herds are sustained during the dry season. Therefore, cattle posts form a fundamental part of village economies. The cattle posts used by Onkani residents are located between 20 and 40 kilometers south of the village center, close to the veterinary fence of Etosha National Park. There are no reliable

estimations of the percentage of households in Onkani who have livestock at the cattle posts. However, since grazing was generally considered abundant in 2009, the number is expected to be low.

Given that the locations of the cattle posts are very sparsely populated, grazing is more abundant and the shrub cover substantially thicker than in Onkani. The herds kept at the cattle posts are much larger than in Onkani: the number of animals per herd ranged from approximately 100 to 270. Average herd size was 170, with a standard deviation of 66. About 70% of the animals kept are cattle, the remaining 30% goats. Loss of livestock to predators (especially by hyenas and jackals) is far more common than in the village. As flood water rarely reaches as far south as the cattle posts, open water bodies are exclusively fed by rainwater. Tap water is not available at the cattle posts, so during the dry season, herders and livestock obtain water from hand-dug wells. Groundwater at the cattle posts tends to be less saline than in Onkani, however, the deeper the herders have to dig for water, the more saline it gets. In contrast to the shallow wells in Onkani, the hand-dug wells at the cattle posts are up to 15 meters deep. The wells are commonly dug and shared, and most herders use petrol pumps.

The vast majority of herders at the cattle posts are waged workers not related to the livestock owner. The owners stated that owners prefer waged workers, because they have more respect for their property than family members. This means that waged workers (who can be easily dismissed) are less likely to slaughter livestock for own consumption – and are less demanding in terms of catering and living conditions. Traditionally, cattle posts are a male domain, and even today, women are rarely encountered there. Herders are commonly catered with food by their employer. Most of the interviewed herders were paid extremely low wages – even by Namibian standards. The wages of some of the herders amounted to less than N\$ 300 (about US\$ 37¹) per month. Officially, the minimum wage for farm workers was raised to N\$ 860 (US\$ 107) per month in 2009 (Shejavali, 2009). Given the poverty of the herders at the cattle posts, it is likely that poaching is practiced to complement food. Some herders were also observed to possess rifles or bow and arrow. However, the availability of game – and thus its contribution to livelihoods – is difficult to assess, as the topic is greatly evaded by the herders.

Technically, the headman of Onkani is in charge of the cattle posts and has to be asked permission of use by outsiders. However, given the far-off location of the cattle posts, there is very little control or law enforcement in these areas, and many activities take place without the headman's permission. The amount of herds at the site has reportedly risen in the past years. Most herders at the cattle posts spoke of improved rainfall conditions in the past years, and stated that grazing was abundant to sustain their herds. A common problem, however, was the water shortage during the dry season. There is no tap water access at the cattle posts, so hand-dug wells are the only source of water during the dry season.

Livestock owners from the adjacent constituencies keep their animals for the sake of its cultural value rather than for commercial purposes. Even though three quarters of the interviewed herders sell livestock, most of them do this rather sporadically and in low amounts. Those livestock owners who produce commercially usually come from

¹ All conversions from N\$ to US\$ and vice versa in this thesis are based on the exchange rate of 1 November 2009 by OANDA (2010). "Currency Converter." Retrieved 15 March, 2010, from <http://www.oanda.com/currency/converter/>.

Namibia's urban areas. They are more highly educated than locals, cling less to cultural patterns of conduct, and breed animals as a business. They also sustain the largest herds. This pattern of urban dwellers taking control of (some of the) grazing land in Namibia's communal areas is a more recent phenomenon in the country's history. As there are no mechanisms in place to limit access or avoid overgrazing in the communal areas, this may have a substantial impact on the availability of this resource in the long run – especially in drought years.

1.6.2. Natural resource use

After agriculture and animal husbandry, the use of natural resources from the wild forms the third pillar of traditional Ovambo livelihoods. A resource inventory carried out with community members during a workshop yielded more than 50 species of wild flora and fauna used for food, medicines, tools, ornaments, or household utensils. Species include (fruit) trees, herbaceous plants, mammals, birds (especially waterfowl), fish and other aquatic animals, and aquatic plants. The most commonly mentioned use forms of natural resources from the wild were construction wood (88%), grass for thatched roofs (82%) and firewood (53%).

Mopane (*Colophospermum mopane*) is by far the most abundant and economically important tree species. Its wood is used for fuel and the construction of homesteads, fences and tools. The wood of other tree species is used for specific purposes, such as the manufacturing of tools and utensils. Wild fruit trees are used as a supplementary food source. They are protected by law and may not be cut. Wild fruit trees were found to have higher than natural densities in populated rural areas of the NCRs (Kreike, 2006). Different medicinal plants to cure humans and animals are also found in the area.

Waterfowl, which is abundant during the rainy season, is commonly hunted, and its eggs are collected. Open water bodies furthermore provide fish and a number of edible aquatic plants. The abundance of aquatic plants and animals clearly correlates with rainfall and afflux from the upper Cuvelai Basin, whereas the latter plays a more important role. As hunting of wildlife is strictly prohibited by federal law in the NCRs, the topic was difficult to enquire in face-to-face interviews. During the resource inventory, however, it was revealed that different species of small game are used as a food source. Abundant species include klipspringer (*Oreotragus oreotragus*), duker (subfamily Cephalophinae), guinea fowl (family Numididae), skunk (family Mephitidae) rabbit, and mouse. Scarcer edible animals include hedgehogs and tortoises. It is very difficult to assess the role that small game plays in the diet of the local population. However, it is assumed that it is only a minor food supplement.

As natural resources in the wild are mainly on communal land, they are usually not subject to explicit regulations. Wood is the only exception, as it underlies regulations by the Directorate of Forestry. Customary restrictions for wood cutting include only the near vicinity of one's crop field. The Directorate of Forestry requires Onkani residents to get a logging permit in Okahao, which is a two-hour drive from Onkani. Given the limited access to transportation facilities, this is a major barrier to Onkani residents. The Directorate of Forestry charges N\$ 15 for the first ton of wood and N\$ 30 for each additional ton. The maximum harvesting amount is 14 tons. The logging permit is also given to non-residents of the area. As the Directorate of Forestry does not have any statistics or monitoring system for forest development, there is no

possibility to ensure that logging occurs within a sustainable range. Furthermore, law enforcement is a major weak point, given the vast area of Namibia and the limited staff of the Directorate of Forestry. Thus, wood is, as most other natural resources in the area, de facto managed as an open access regime. Limiting factors for resource availability in the area are the number of users, the use intensity, and rainfall. Population pressure in Onkani has been increasing and rainfall may get more irregular in the future – therefore, competition for natural resources is expected to rise with increased scarcity.

1.6.3. Rural economies

Traditional Ovambo societies relied on sharing and bartering products, mainly between and within adjacent communities (Kreike, 2004). With increased urbanization and mobility in the NCRs, opportunities to involve in markets have arisen for citizens. Income is a delicate topic in rural settings in the NCRs and therefore difficult to enquire and estimate. Based on proxy indicators, at least three quarters of the respondents have access to some sort of income.

Close to 70% of the villagers in Onkani sell a part of their agricultural or livestock surplus. Most of them sell their products locally, mainly at the cuca shops in the village center. Only 14% sell goods at regional markets, which are usually facilitated by relatives living in the respective town. Pearl millet, chicken and goats are the most commonly sold commodities (sold by 23% of respondents, respectively). Baskets are the only relevant manufactured good which is sold (by 18% of interviewees). Firewood is sold by 14% of the respondents. It has to be kept in mind that the mentioned selling of products is mostly small-scale, and may include only a few animals or kilograms of grains per year. The only residents with a regular salary are the government employees at the clinic, agricultural extension office, school, and police station.

Two thirds of the households stated to receive support from the government or other external organizations. The most common support is the governmental drought relief (36%) and pension (32%). Pension amounts N\$ 450 per month, and is granted to every Namibian of at least 60 years of age. Both drought relief and pension were emphasized to be an important livelihood component for many villagers, especially in years with low agricultural and livestock output due to climatic extremes. Less than ten percent had an income through wage labor. Approximately one fourth of the households in Onkani get financial support from family members living in town. Migrant labor (mainly male) in Namibia's cities is a more recent phenomenon in the NCRs. Furthermore, it has to be considered that the support of rural and urban families is reciprocal rather than one-sided, as natural resources such as firewood are commonly sent to urban family members in town.

It has been found that even though almost half of Onkani's population owns herds larger than 20 animals (excluding cattle posts), marketing is only practiced marginally. On top of the cultural factors elaborated in Chapter 1.6.1, there are strong structural obstacles for selling livestock in remote areas of the NCRs – the most important ones shall be briefly outlined. The geographical remoteness of many areas in the NCRs is a major obstacle for small-scale producers to access markets. Compared to meat produced in Namibia's commercial areas, the market prices for meat from the NCRs are relatively low. This can partly be explained by the fact that the veterinary status of

livestock from the NCRs is generally considered insecure (many animals are not vaccinated). Therefore, meat from the NCRs may not be exported. Furthermore, the Meat Corporation of Namibia (MeatCo) practically has a monopoly on meat acquisition, which enables them to furthermore cut prices. Even though trade of livestock was very common in the pre-colonial era, it has not been an integral part of Ovambo societies in the past century (Kreike, 2009). Therefore, most present livestock owners have very low knowledge of business practices.

More than two thirds of the households stated not to cooperate with any organization in regard to their livelihoods. Even though approximately two thirds knew OIKE, only 14% stated to actively cooperate with the CBO. More than 40% knew the Agricultural Extension Office, but only one fourth cooperates with them. Approximately 60% buy seeds at the Onkani Agricultural Extension Office. The most commonly bought seeds are drought-tolerant and early maturing pearl millet cultivars. About one third of respondents have participated in trainings or information sharing of the extension office, and 12% has attended a workshop on the use of artificial fertilizer. Even though the Agricultural Extension Office sells artificial fertilizer, it is not commonly used. This may be explained by the low liquidity of most community members. While cooperation of locals with institutions such as the Agricultural Extension was relatively low, informal collaboration was often mentioned as part of a ‘safety net’ in times of water and food shortage.

1.7. National framework of adaptation

1.7.1. Framing discourses and papers

Initial National Communication to UNFCCC

As a signatory to the UNFCCC Namibia is obliged to report to the convention in so-called ‘national communications’. Namibia’s Initial National Communication was completed in 2002. The Second National Communication was under revision in early 2010. The Initial National Communication is a baseline for adaptation and mitigation. As mitigation is irrelevant for this research, it is not furthermore elaborated here. Starting from the projected impacts and vulnerabilities, the report stresses the need to adapt to climate change (Ministry of Environment and Tourism, 2002). Agriculture, animal husbandry, water, and health are identified as the most vulnerable sectors. Proposed policies and measures focus mainly on coordination and cooperation of a national climate change policy and action plan. The National Climate Change Committee is designated to have a key role in the policy formulation. The need for research is emphasized, especially improved spatial and temporal resolution of climate models. Public awareness campaigns on climate change are to be intensified according to the report. Financial and technology needs are requested from the international community, in particular to enable the aforementioned climate change policy and action plan, research activities, and adaptation projects concerning agriculture, water, health, and education (Ministry of Environment and Tourism, 2002). The Initial National Communication is mainly a background paper on the Namibian climate change context. It establishes the need for adaptation and defines areas of key concern, but it does not outline concrete policies, measures or activities. The Namibian Climate Change and Action Plan is under preparation, however, it had not been completed when this research was conducted.

Community-based adaptation approach

The recognition that adaptation needs to be fit to local scale has been discussed in the introduction. Different actors in development cooperation have therefore defined a conceptual approach called ‘community-based adaptation.’ The approach seeks to integrate the new challenges of adaptation into bottom-up rural development (Huq and Reid, 2007). The Fourth Conference on Community-based Adaptation was held in February 2010 in Dar es Salaam, Tanzania. There were more than 170 participants from NGOs, CBOs, international research institutes, universities, and international organizations. The main emphasis of the conference was on sharing knowledge, lessons learned and practices on CBA, and building global networks (IIED, 2010).

In 2008, UNDP has launched a program to pilot community-based adaptation projects in ten of the most vulnerable countries on the globe. The Small Grants Programme (SGP) of the Global Environmental Facility (GEF) is the main financier of these projects. The total budget for the pilot projects on community-based adaptation amounts US\$ 4.5 million, with additional co-funding of US\$ 6.5 million. Individual projects can obtain up to US\$ 50,000 from the Small Grants Programme. The idea is to generate knowledge and lessons learned from a maximum of 20 community-based projects per country. This experience, in turn, shall be used to inform policies and development programs (UNDP, 2008).

Community-based Adaptation Country Programme Strategy

As part of the mentioned global pilot program on CBA, GEF has issued a ‘CBA Country Programme Strategy’ for Namibia (SGP, 2008). The writing of the program was commissioned to the Namibia Nature Foundation (NNF) and the Integrated Environmental Consultants Namibia (IECN). The Namibian CBA program is coordinated by the National Steering Committee of the Small Grants Programme.

The initial project intervention targets small holder farmers and natural resource users. Geographically, it aims at the NCRs and the North-eastern regions Caprivi and Kavango – which were identified as the most vulnerable regions of Namibia. Key topics include technological innovations (climate information systems, drought-tolerant crop cultivars and animal breeds, rainwater harvesting), incorporation of climate change aspects in local management plans (through action research), and raising awareness on climate change impacts and the need for adaptation. The Small Grants Programme supports the pilot projects to reduce vulnerability to climate change in the communities, and to understand local adaptation needs and grasp the range of potential coping mechanisms. The lessons learned from the community-based adaptation projects shall be used to inform adaptation policies and programs. Eligible grant recipients are community-based organizations, such as farmer’s associations and conservancies. NGOs do not qualify as project grant recipients, however, they can function as intermediaries between local projects and the donor. When proposals do not fulfill the standards of the Small Grants Programme, applying organizations may revise them and hand them in again. Applicants also have the opportunity to receive trainings on proposal writing (SGP, 2008).

The country program strategy is a conceptual roadmap for the piloting of community-based adaptation projects in Namibia. Key areas and sectors are identified, and activity guidelines issued. However, as project proposals are written by local organizations, they are the ones who ultimately determine priority issues and activities.

1.7.2. Local project framework

OIKE community-based organization

The community-based organization OIKE from Onkani launched the first project in Namibia which was granted financing under the 'CBA Country Programme Strategy'. According to its mission statement, OIKE is devoted to the sustainable development of agriculture and animal husbandry in the region (Kalenga, Amakutsi et al., 2009). The CBO was established in 1994. The OIKE headquarters – a building with an office and a store room – are located in the center of Onkani and owned by the CBO. The building was co-financed by the Japan International Cooperation Agency (JICA). The OIKE management committee consists of five individuals, and there are a few dozen members spread over Onkani and the surrounding villages. Decisions within the organization are made by a consensus of the management committee and the members. Since its formation, OIKE has been involved in different development projects and trainings. The first intervention project in the area was the Sustainable Animal and Range Development Programme (SARDEP), a cooperation of the Namibian government and the German Technical Cooperation (GTZ). As SARDEP introduced participatory methodologies, OIKE functioned as a facilitator between the project and the community. After SARDEP ceased in 1999, Namibia's Programme to Combat Desertification (Napcod) became active in the area. Currently, the Forum on Integrated Resource Management (FIRM) holds consultative community meetings about three times a year. With financial support from the Japan International Cooperation Agency (JICA), OIKE had sold animal medicines over the last years. The community-based organization was the executive body of this project. On top of development projects, ample research has been conducted in the area, including dissertations and MSc theses.

OIKE has been actively involved in different development projects in the area for 15 years. The community-based organization often functioned as a mediator between the community and intervention projects. In addition, OIKE had a key role in project implementation. Given the ample project experience of OIKE, it can be considered an advanced community-based organization.

Outline and approach of community-based adaptation project

OIKE's adaptation project officially started in April 2009, and will run for a two year period. US\$ 48,000 are provided by the Small Grants Programme and additional US\$ 50,000 from the Japan International Cooperation Agency (JICA) (Kalenga, Amakutsi et al., 2009). The main goal of OIKE's CBA project is to adjust agricultural practices to reduce the community's vulnerability and enhance its adaptive capacity to climate change. In contrast to typical interventions, this project is actually run by the community-based organization. Everything from proposal drafting to implementation and monitoring and evaluation is conducted by OIKE. The Small Grants Programme provides technical support where demanded by the community-based organization. The main activities specified in OIKE's project proposal are soil conservation, rain water harvesting, improving the infrastructure of hand-dug wells, increasing forest cover, climate change awareness, and sharing the lessons learned with policy-makers and other community-based adaptation initiatives. OIKE plans to pilot these activities in four communities: Onkani, Ungungulume and Onkankaa (Otamanzi constituency in Omusati region) and Onakapya (Uuvudhya constituency in Oshana region) (Kalenga,

Amakutsi et al., 2009). However, due to time and budget constraints of the research, this thesis focused on Onkani village only. The pilot character of the project is central. The idea is to implement the aforementioned project activities in several specific locations and communicate the results to the wider community. The overall intention is that the piloted techniques and technologies get adapted by a wide variety of community members after the two year financing phase. OIKE aims to foster a strong community ownership of the project. Within the proposal writing, community meetings were held in two of the four communities included in the project. In the community meetings, the planned project activities were discussed to find out about the concerns and needs of the villagers. Originally, OIKE planned to hold at least one meeting in all four communities included, but a lack of funds and transportation did not allow this. Membership of OIKE is furthermore open to all community members. There is neither an official registration nor a membership fee (Kalenga, Amakutsi et al., 2009).

1.8. Outline of thesis

Chapter one introduced the specific climatic context of the research area, and delineated the strongly resource-based livelihoods practices of the local population. These two aspects are a fundamental baseline to answer the first research question. The chapter also outlined the political framework of adaptation in Namibia, and the specific arrangements of the intervention project in the research area. This knowledge is a basis to answer the second research question. Chapter two presents the theoretical concepts and explains how they were used to build the analytical framework for the research questions. The methods and the process of gathering empirical data in the field are described, and a schematic overview of the data sets collected is presented. Chapter three and four are both results chapters. Chapter three is guided by the research question: what is the vulnerability of the residents of the research area to climate variability and change? In this chapter, it is analyzed how livelihoods depend on (and have been adapted to) climatic variability in Onkani village. Based on this analysis, the vulnerability and adaptive capacity of the community is assessed. Chapter four investigates the research question: how is climate change adaptation practiced by a development intervention? This chapter moves its analytical focus from endogenous adaptation practiced by the local community to exogenous adaptation practiced by a development intervention. The chapter analyzes how development agendas are translated and implemented in practice, and in which aspects the project in the research area differs from a conventional rural development intervention. In the discussion and conclusions, (chapter five), endogenous and exogenous adaptation are juxtaposed and conclusions are drawn on how the interaction of the distinct approaches contributes to building adaptive capacity in the area. Chapter five is concluded by delineating the implications of this research on methodologies and literature, and adaptation practices at large.

2. Theories and methods

2.1. Theoretical framework

2.1.1. Introduction

This theoretical framework puts relevant theories in context of the research problems and thereby offers an analytical approach to interpret adaptation practices in the research area. For this thesis, the theoretical framework assists in analyzing how endogenous and exogenous adaptation interact and shape the adaptive capacity of the community. The key concepts of the research are local knowledge, adaptation, rural development, and adaptation and development. The relevant constructs and variables within these concepts are outlined in this paragraph and elaborated in the following sub-sections.

For the first part of the research, the theoretical framework assists to analyze which factors influence adaptation practices on community and household level. The concept of local knowledge is used to explain how agro-silvo-pastoralists have built capacities to cope with climatic fluctuations, and how their livelihoods are characterized by environmental conditions. The key concepts are adaptation, vulnerability and adaptive capacity. These concepts are discussed and related to the factors which influence adaptation on community and household level. The focus of the analysis on local scale is adaptation of agro-silvo-pastoralist to rainfall variability and change. However, adaptation in Onkani does not operate independently from broader political, societal and environmental developments. Therefore, the interactions of external influences and stressors are also taken into consideration.

The second part of the analytical framework seeks to explain how the intervention project in Onkani contributes to building adaptive capacity. The analysis is framed by discourses on rural development. The adaptation project currently implemented by the community-based organization OIKE is financed by the Small Grants Programme and the Japan International Cooperation Agency (JICA). Therefore, it is assumed that the project is influenced by global development discourses to a certain degree. Even though this project is characterized by strong local involvement (and is not a typical intervention) it will be referred to as 'exogenous adaptation' or 'intervention adaptation' throughout the text. These terms were chosen to make a clear distinction between adaptation built by the project and adaptation built by endogenous practices.

The more recent debates on development and adaptation are used to analyze how global discourses have been translated to local activities in the joint proposal writing process of OIKE and the Small Grants Programme. Given the high dependency on rainfall in Onkani, it is assumed that adaptation to climate variability and change are integral components which need to be incorporated in development projects in the area. Scholars such as Klein, Schipper et al. (2005) have emphasized the need to mainstream climate change adaptation in development. As adaptation is an additional stressor to development, it needs extra consideration (Lemos, Boyd et al., 2007). These ideas are put to the test by means of the community-based adaptation project in Onkani. In Chapter 5.2, the theoretical assumptions are discussed in relevance to the local processes in the study area.

2.1.2. Local knowledge

Local knowledge is used to frame the analysis of endogenous adaptation practices in Onkani, and to assess the existing capacities to buffer rainfall variability. The concept of local knowledge differs from scientific knowledge in many aspects, mainly in regard to institutional settings and structures (Berkes, Colding et al., 2000). Both scientific and local knowledge are usually obtained empirically and systematically, and both generate new information by observing and experimenting. While local knowledge is produced by non-specialists and the results are particularistic for the given case, scientific knowledge is produced by experts and strives at universalistic results, i.e. such results that can be generalized (Sillitoe, 2007). Local knowledge usually has diffused institutions, transmission is informal, and the accountability horizontal. On the contrary, scientific bodies are institutionally centralized, transmission formalized, and accountability hierarchical. Further distinctions are in the way of teaching and spreading knowledge: while scientific knowledge generally uses didactic methods to teach and the written word to transmit it to a wider audience, local knowledge is taught by doing, and transmitted orally (Berkes, Colding et al., 2000). A common misperception is that local knowledge is seen as a static product rather than a continuously ongoing process.

There is not always a clear dichotomy of scientific and local knowledge, as the two potentially interact and mingle – in both directions (Agrawal, 1995). Even though local and scientific knowledge often take different standpoints, they are not mutually exclusive, but rather represent different viewpoints on the same phenomenon (Orlove, Chiang et al., 2002; Roncoli, 2006). Thus, the exchange of local and scientific knowledge can enrich both fields, and is a crucial premise for social learning processes. Especially concerning adaptation, the relevance of local knowledge is often emphasized (Roncoli, 2006). Local knowledge has also been ‘discovered’ by development practitioners and conservationists to support bottom-up approaches. It is argued that the integration of local knowledge in participatory development is more likely to facilitate successful interventions (Sillitoe, 2007).

Furthermore, local knowledge is a tool in adaptive practice (Sillitoe, 2007). In this case, the term ‘adaptive practice’ does not only relate to climate change, but to adaptation to environmental, social, and economic conditions in general. There are many cases around the globe where rich agricultural knowledge has been developed in relation to climate variability (Jennings, 2002; Orlove, 2005; Roncoli, 2006; Roncoli, Crane et al., 2009). One such example is given by a research conducted in the Andes by Orlove, Chiang et al. (2002). The authors of this research sought to explain indigenous techniques of forecasting El Niño by judging the brightness of a star constellation in a specific time of year. After a long trial-and-error process, the scientists could find a physical explanation for the high reliability of the forecasts. Thus, a local technique –which was initially considered a superstition by scientists – turned out to be provable.

Culture as such has often evolved as a means of adaptation to (changing) environmental conditions (Orlove, 2005). The assumption is that a similar phenomenon has occurred in Namibia’s NCRs. Therefore, it is expected that livelihood strategies have been developed to can buffer the huge climate variability encountered in the NCRs. For the analysis of past and present adaptation practices in Onkani, ‘traditional’ and ‘transitional’ adaptation practices are distinguished whenever possible. In this context, the term ‘traditional’ relates to adaptation practices

in the subsistence-based Ovambo society until Namibia's independence. During that time, Onkani was virtually excluded from markets. 'Transitional' adaptation in turn means activities related to an emerging free market economy on top of rural subsistence economies. Moreover, adaptation practices on micro and macro scale are analyzed. Micro scale refers to concrete technologies or institutional arrangements, while macro scale analysis takes a broader approach to explain the Ovambo lifestyle in relation to adaptation to climatic variability.

In remote communities with little access to technology, local knowledge on climate variability is the baseline on which future adaptation build on. However, aggravated climatic conditions can potentially devalue local knowledge systems and thereby overstrain the resilience of local communities in many developing countries (Schipper, 2006; Boyd, Osbahr et al., 2008). The theoretical framework is used to assess in how far the existing coping strategies can be expected to be effective with a changing climate in the future. The concept of culture is furthermore used to approach adaptation in Ovambo culture from a longer time perspective, and as an ongoing process rather than a state.

Richards (1993) has found that agriculture does not merely consist of knowledge, but is substantially the ability to perform. Agricultural performance may be much more internalized than knowledge, and therefore more difficult to put in words for local interviewees. This concept is crucial to understand the dimensions of agricultural knowledge and practices in Onkani. Besides the ability to perform, the capacity to improvise has been described as an essential feature of rural African livelihoods (Madge, 1995). Batterbury (1996) has furthermore stressed that African farmers have to consider technologies and ideas from different sources. Therefore, planning is also an integral part of their livelihoods. Based on these concepts, agricultural knowledge of Onkani residents is analyzed not only as intellectual capacity (i.e. knowledge in the narrower sense), but also as the ability to perform, plan ahead, and improvise to fluctuating conditions.

2.1.3. Vulnerability and adaptive capacity

The concept of vulnerability is used to assess how susceptible Onkani residents are to climate variability and change. Adaptive capacity is applied to analyze the potential of the community to cope with fluctuating and changing conditions. To clarify the meaning of vulnerability and adaptive capacity, the key elements within these concepts are discussed.

To begin with, the distinction between the terms 'weather' and 'climate' is elaborated. Weather is the current state of the atmosphere, while climate is the entity of atmospheric phenomena over a time period of a minimum of 30 years. Climate variability describes the inter- and intra-annual fluctuations of climatic phenomenon, such as precipitation and temperature. Such variations due to natural processes have existed throughout the history of the earth. Climate change, however, is referred to a process of change which is – with high certainty – fundamentally triggered by the increase in human greenhouse gas emissions since the 1750s (IPCC, 2007).

Vulnerability is the degree to which a society is susceptible to the impacts of climate change, e.g. weather extremes (IPCC, 2007). Following this rationale, the agricultural sector of an industrialized society with sophisticated irrigation and water management

is less vulnerable to drought than the agricultural sector of a subsistence-based society relying primarily on the continuous provision of rainwater and surface water bodies. The concept of vulnerability is central to analyze and assess the local impacts of climate variability and change in interaction with non-climatic stressors.

Adaptive capacity is the ability of societies to adapt to the adverse impacts of climate change and take advantage of possible benefits. The degree of vulnerability is strongly influenced by adaptive capacity – and vice versa (Smit and Wandel, 2006). The central role of local capacity is anything but new in development discourses; however, it is re-emerging in the unique context of climate change (Lemos, Boyd et al., 2007). Even though vulnerability and adaptive capacity are most commonly used in relation to climate change, these concepts can also be assessed in relation to other environmental or non-environmental stressors. In this context, vulnerability and adaptive capacity to climate variability are used as a first approximation to assess potential climate change impacts in the research area.

Adaptation is the process of adapting to climate change and variability. It is a process which takes place on technological, institutional, and ideological scale (Adger, Arnell et al., 2005; Boyd, Osbahr et al., 2008). As discussed in Chapter 2.1.2 on local knowledge, it is assumed that the large climate variability in the NCRs has given rise to manifold adaptation mechanisms. This thesis focuses on adaptation of the two main sectors in the research area – agriculture and animal husbandry – however, without being fully reductionist in terms of livelihoods. Most approaches measure vulnerability via a set of quantitative indicators like hazard occurrence, coping strategies, and risk level (Birkmann and Wisner, 2006; Villagrán de León, 2006; Birkmann, 2007). However, purely quantitative approaches bear the risk of neglecting the community-specific cultural and biophysical context of vulnerability. Additionally, the lack of reliability in downscaled climate change projections limits the possibilities for a quantitative vulnerability assessment of Onkani village. Even though the mentioned indicators are taken into consideration, this case study analyzes vulnerability and adaptive capacity predominantly based on qualitative data. Following this approach, the research strives for an in-depth understanding of proximate and underlying causes of vulnerability and adaptive capacity in one specific area.

2.1.4. Rural development

Rural development theories are used to analyze how specific discourses were translated in the project proposal in Onkani. The following paragraph gives a brief overview of the most relevant discourses. In early development theories, development was equalized with economic growth. Post-war theories relied largely on state-led development, while neoclassical theories (from the 1970s onwards) acknowledge the market as a potential problem in development. The dependency theory stresses the systematic and highly active role that industrialized countries play in impeding developing countries to advance. The structural adjustment theory in turn advocates a stronger involvement of markets and a weaker role of the state. Radical post-development thoughts question development as a whole, while more moderate forms promote decentralization and public participation as key ingredients for successful development (Rapley, 2007).

In rural development settings, the need for active participation of the target population of intervention projects was realized early. Participation is often seen as one of the key 'ingredients' of success in development (Blackburn, Chambers et al., 2000). As appealing as the term participation may sound to development practitioners, it can be somewhat vague due to its wide range of meanings: participation can be anything from informing a passive audience to self-mobilization and adaptive co-management. Additional to the level of input of citizens, the degree to which goals are set in advance determines the level of participation. Major challenges of participatory processes are the concealment of power, possibly conflicting interests of the different parties involved, and the long period it takes to develop such processes (Rapley, 2007). Power is a particularly delicate issue in participation. In some cases, participative processes such as adaptive co-management tend to get captured by the local elites rather than empowering the marginalized (Lemos, Boyd et al., 2007). These concepts provide a framework to analyze how participatory practices are applied in the project in Onkani.

As the rural population constitutes a large amount of the poor of the poor in many countries, they have frequently been the target of development initiatives. This pattern also applies for the community-based adaptation project which is the scope of this thesis. The geographical scope of this study is a single community. Concerning the notion of community in rural development, it has to be kept in mind that there may be considerable heterogeneity within one community. Even though rural communities have often been described as a homogeneous mass of people, there are frequently great disparities concerning aspects as ethnicity, power, wealth, or access to resources (Agrawal and Gibson, 1999).

Environmental considerations have not been of much concern of early development theories, but this was to change drastically from the 1970s onwards. Latest since the groundbreaking publications 'Limits to Growth' (Meadows, Meadows et al., 1972) and 'Our Common Future' (Brundtland and World Commission on Environment and Development, 1987), development is hardly seen as detached from the natural environment, which is the sustenance base of human societies. At least rhetorically, development has evolved to sustainable development over the past decades. However, the definition of the term has been interpreted in many different ways (Carruthers, 2001). In 'Our Common Future' (Brundtland and World Commission on Environment and Development, 1987), sustainable development is defined as such development that does not jeopardize the livelihoods of future generations. The economic considerations of the definition have been frequently overemphasized in order to justify economic growth (Carruthers, 2001).

This schematic overview shows that development theories have continuously undergone changes – and along with it development cooperation, which is largely subject to trends and evolution of these discourses and theories. Naturally, climate change adaptation and community-based adaptation policies and programs are no exception to this (Ellis and Biggs, 2001).

2.1.5. Development and adaptation

Theories on the interrelation of development and adaptation are used to analyze in how far climate change considerations are reflected in the project in Onkani. Even though the impacts of climate change on development are now widely acknowledged

by scholars and practitioners, climate considerations still lack integration in many development programs and policies. The UN's Millennium Development Goals are no exception to this (Ludwig, van Scheltinga et al., 2007). A growing body of academic literature furthermore questions the dichotomy which is commonly practiced between development and climate change adaptation projects. Given the linkages of development and climate change, Huq and Reid (2004) argue that it is indispensable to mainstream adaptation into development.

Adaptation is furthermore necessary on different institutional scales: local action needs to be supported by enabling institutional and political environments (Adger, Arnell et al., 2005). Lemos, Boyd et al. (2007) argue that adaptation furthermore needs to address the structural inequalities which cause vulnerabilities. As climate change can accentuate existing vulnerabilities, building adaptive capacity is suggested as a main development goal. Adaptation and development overlap largely, however, they are not to be mistaken as the same. The extent to which climate change needs to be integrated into development depends on the site-specific vulnerability to climate change, and the sector of scope (Adger, Arnell et al., 2005).

Given the high dependency of agro-silvo-pastoral livelihoods in the NCRs on precipitation, it is assumed that climate considerations – including climate change – are crucial to foster any kind of development in the study area. Even though climate change poses new challenges to development, adaptation does not have to start from scratch, but can build on the rich experience of development practice and local knowledge (Lemos, Boyd et al., 2007). Since climate change adaptation is a subject which has entered the development cooperation arena relatively recently, there is little experience with implementing these theoretical constructs on project level. The outlined theoretical concepts provide a framework to analyze how adaptation and development are balanced in the community-based project in Onkani.

Lemos, Boyd et al. (2007) stress the central role of building institutional capacity in adaptation projects. According to these authors, a key capacity of 'climate-proof' institutions is the ability to permit evolutionary change and foster learning processes. Armitage, Marschke et al. (2008) have furthermore stressed that learning needs to be explicitly integrated in management strategies. The concept of institutional capacity helps to frame the adaptive capacity of Onkani not only concerning the ability of adaptation activities to buffer climatic shocks, but also in regard to the ability of local institutions to learn to incorporate climate change considerations. Another challenge institutions face when coping with climate change is the uncertainty regarding what to adapt to. A concept specifically directed at dealing with changing and uncertain conditions is adaptive management. The concept is based on learning-by-doing processes and directed at policy and management modifications (Armitage, Marschke et al., 2008). Adaptive management is a process of continuous testing and revision of institutional arrangements. It is embedded in a social learning process, and seeks to be flexible enough to adjust to changing conditions (Folke, Carpenter et al., 2002). Therefore, this concept is very useful to frame the analysis of the institutional capacity that OIKE exhibits as implementing body of the community-based adaptation project.

2.2. Methodology

This research relies mostly on empirical data collected in the field and consists mainly of semi-structured interviews with local and, to a lesser extent, regional and national actors. The following section introduces the data collection process and the methods used, and specifies why the given methods are considered most appropriate in relation to the research objectives. To conclude this chapter, some reflexive remarks on the challenges of data collection in Namibia are made, with an emphasis on rural communities in the NCRs.

2.2.1. Field work

The field work in Namibia endowed a total of five months. The first two months were spent in Windhoek and different parts of the NCRs to get an overview of the topic and identify potential partners and research sites. During the third and fourth month, the field work was conducted in the local community, whereas the fifth month was spent in Windhoek again. Given the explorative character of the data collection, methods were adjusted according to the progress in knowledge and experience the course of field work. For the field work in the local community, the author stayed in Onkani village from late August 2009 – late October 2009. Research was carried out in association with the GEF Small Grants Programme (SGP) Namibia (hosted by UNDP) and the Integrated Environmental Consultants Namibia (IECN). The local partner was OIKE (see Chapter 1.7). In addition to data collection, technical support was provided to the local partners concerning project planning and implementation, climate change awareness, and participatory monitoring and evaluation. For the national partners, a report on the lessons learned of this technical support and in particular the work with the ‘Natse Otweya’ Community Toolkit on Adaptation was prepared (see Chapter 4 for details on the toolkit).

The first research question was mainly answered through interviews with local agro-silvo-pastoralists, and groups and individuals involved in agricultural development. Even though the research focus was to gather local knowledge of agro-silvo-pastoralists, other actors in the village were interviewed as well to gain a more holistic picture of the social and material realities.

Key informants included the headman, the water point committee, and the agricultural extension officers. Given the importance of cattle posts in the village economy, two two-day field visits were made and nine herders interviewed. In addition to interviews, a series of five participatory community workshops were held between 17 September and 15 October 2009. Six consultative meetings with OIKE took place between 29 July and 20 October 2009. Participant observation was practiced during interviews and workshops as well as during local routines of herding and water management.

The second research question partly relied on the same data as the first one. In addition, interviews with the management committee and members of OIKE were conducted. Other interviewees included development practitioners, civil servants and consultants. Secondary data sources such as policy papers and project proposals were also analyzed. In total, 57 interviews were conducted: 38 on local, ten on regional, and nine on local scale. A list of interviewees is found in Table 1.

Table 1: List of interviewed actors on local, regional, and national scale

Role / function of interviewee	Number of interviews
Local scale	
Agro-silvo-pastoralist	22
Herders at cattle posts	9
OIKE management committee	4
Agricultural extension technicians (two)	1
Local water point user	1
Nurse of Onkani clinic	1
Headman (respectively interim representatives)	1
Water Point Committee 'Onkani' members	1
Water Point Committee 'Peter Embanga' chairman	1
Regional scale	
Councilor of Otamanzi constituency	1
CCP-CCA project manager	1
Rural Water Supply Outapi head	1
Lands Office Outapi	1
MAWF Outapi: Directorate of Extension and Engineering Services (DEES) head	1
MAWF Outapi weather station	1
Directorate of Forestry (DOF)	1
MAWF Outapi: state veterinarian	1
Namibia Meteorological Service weather station Ondangwa: observer	1
Creative Entrepreneur Solutions (CES): managing director	1
National scale	
Directorate of Environmental Affairs (MET): head and Second National Communication project coordinator	2
MAWF: scientific staff	1
Namibia Meteorological Service: head data section	2
Hydrological Survey (MAWF): deputy director	1
Rural Water Supply: chief development planner	1
Independent consultant and scholar	1
Environmental Consultancy (Versacon): general manager	1

2.2.2. Methods

Semi-structured interviews

Interviews with local agro-silvo-pastoralists were administered via a questionnaire composed mainly of qualitative, open-ended questions on (1) general information on the interviewee and the living conditions in the village, (2) perceptions of weather and climate, (3) land and water management, (4) decision-making and coping strategies in agricultural practices, (5) perceived changes in climate patterns and livelihoods, and (6) constraints of livelihoods. The interviews with herders at the cattle posts and other key informants followed a similar thematic pattern, but enquired on additional information expected to be specifically held by the interviewee, e.g. land allocation (headman) or conflicts over tap water (water point committee).

An interview can be defined as a particular kind of conversation with a specific goal and role differentiation (Kumar, 2005). Semi-structured interviews were chosen as a tool for data collection for the following reasons: on the one hand, they grant sufficient flexibility to adjust the enquiry to unexpected facets of the given situations, on the other, they provide sufficient structure to allow comparability. Given the cultural challenge of the research in the local community, it was decided to ask open questions as much as possible. Interviews were exclusively held face to face and in most cases via a translator. Interviews were transcribed in key words (i.e. not in verbatim) and not recorded in order to avoid intimidation or reserve of the interviewee. Even though detailed questionnaires were composed for different actors, interviews were adjusted to the interviewee and resembled conversations rather than question-and-answer sessions. In many cases, interviews were highly interactive and included practical demonstrations by the interviewees, e.g. showing certain pest species on the crop field or jointly fetching water from the hand-dug well. Additionally, a record of observations was kept on during the interviews.

Semi-structured interviews with local agro-silvo-pastoralists compose the largest part of the locally collected data. Given the non-existence of a village map and the practicality of finding homesteads, households were not systematically sampled. Households were selected in a way that all areas of the village area were more or less equally covered. A total of 22 interviews with agro-silvo-pastoralists were conducted – approximately 18% of the households in Onkani. Therefore, the sampled households hold a reasonable representativeness for the community. On average, two to three interviews were conducted per day. Interviews lasted between 60 and 180 minutes with an average of 84 minutes. The average age of the interviewed agro-silvo-pastoralists was 50 years, ranging between 21 and 84. About 73% of the interviewees were female. Approximately 58% of the interviewees were household heads, and half of the household heads were female.

Community workshops and meetings

The six workshops held in Onkani were open to all residents of the area. They were announced on the local radio and during the village church service. The workshops took place on the premises of the Agricultural Extension Office in the village center. Free lunch and drinks were provided to the workshop participants to encourage participation and create an incentive, especially for those living far from the center.

The workshop methodology was based on the ‘Natse Otweya’ Community Toolkit on

Adaptation. This toolkit was developed in 2008 in consultation with twelve local communities in the NCRs. The aim of the toolkit is to support local communities in building adaptive capacity to climate change through participation and self-empowerment (IECN, 2008). As parts of the toolkit are designed to jointly develop an understanding of local livelihoods and their interaction with climatic pattern, the toolkit also functioned as a means to gather data in this specific case. The work with the toolkit included the following participatory exercises: (1) joint drawing of a village map, (2) preparation of a seasonal activity calendar, (3) resource inventory, (4) conceptualization of local knowledge on climatic events, (5) conceptualization of local knowledge on coping strategies on climate variability, (6) analysis of livelihood constraints, (7) appraisal of possible adaptation mechanisms, (8) raising climate change awareness, and (9) participatory monitoring and evaluation. Some of the workshop contents were more closely related to the cooperation with the Small Grants Programme and IECN than with research. Even though the toolkit was used as a guideline, but the exercises were adjusted to the responses of participants. Furthermore, several exercises were added to deepen the understanding of certain issues, e.g. local knowledge.

Workshops contributed in two ways to the body of data: firstly, via the direct outputs (e.g. village maps or seasonal calendars) and secondly, via the observations made during the workshops (e.g. in terms of group dynamic, power structures, gender relations, the capacity to grasp new concepts, and the ability to adapt and reflect traditional ways of knowledge). The six consultative meetings with OIKE served primarily to clarify their implementation plan, as well as the general functioning of the organization. In the framework of the researcher's cooperation with the Small Grants Programme and IECN, these consultative meetings also provided a basis to support OIKE in their project planning and implementation.

Participant observation

When conducting participant observation, the researcher is overtly watching and examining a situation. That is, the researcher can even actively take part in the situation and interact with the observed individuals. The strength of participant observation is that the researcher can – in addition to observations – enquire and thereby clarify unclear or possibly mistakable issues (Kumar, 2005). This makes it a valuable research tool, especially in situations where misunderstandings can easily arise due to cultural differences – such as during field work in Onkani village.

Participant observation was practiced in various situations, such as during daily routines of herding and farming, and the management of hand-dug wells. Given that research was carried out in the late dry season, which is the least busy time of the year for agro-silvo-pastoralists in the NCRs, participant observation was limited to the few activities practices at this time of year. As described above, participant observation was also an integral part of interviewing and conducting participatory workshops.

Other methods and data

In addition to the stated methods, literature research provided baseline knowledge on climate and climate change impacts in Namibia. Secondary literature also helped to put the local context in a wider historical and political context. In this context,

secondary literature does not exclusively refer to scientific sources, but also includes sources such as project reports, policy documents, government statistics, legal texts, and newspaper articles.

Birkmann and Wisner (2006), Birkmann (2007), and Villagrán de León (2006) have synthesized various tools to calculate vulnerability indices. These vulnerability indices were taken as a rough guideline, however, in this study, vulnerability was not be measured via quantitative indicators, but described on the basis of qualitative data. Additionally primary data was obtained from third parties. This data included precipitation records (for national, regional and local scale) and data on disease occurrences from the clinic in Onkani.

Triangulation of both methods and sources is an integral part of this research. While semi-structured interviews formed the foundation of the data, they were complimented, challenged, and juxtaposed with the information from the other primary and secondary sources mentioned above. Triangulation of data facilitates the understanding complex issues, because it includes different perspectives and thereby contributes to the generation of a holistic and less biased picture of the situation (Kumar, 2005).

2.2.3. Challenges and limitations of data collection and methods

During field work, fundamental challenges due to cultural and language were faced. A clear shortcoming was the work via a translator, which did not allow direct verbal communication with the individual community members (Burja, 2006). Furthermore, it appeared difficult to translate some concepts and terminology from English to Oshiwambo (the regional vernacular) and vice versa. Oshiwambo is rather poor in vocabulary compared with the English language. As a result, the interpreter needed to explain many terms which do not have an Oshiwambo equivalent, which may have hampered the comprehensiveness of the questions.

A common problem with interviews is the social desirability bias: interviewees may say what they think the researcher wants to hear instead of telling their true opinion (Kumar, 2005). Given the double role of researcher on the one hand, and technical support to OIKE on the other, it was felt that interviewees sometimes had certain expectations of the researcher, which possibly biased their answers. For example, many interviewees who initially declared not to have any income later on stated that they sold agricultural surplus, or received money from relatives working in the cities. This may have occurred because the interviewees were afraid that they would not benefit from the local development project (which the researcher advised) if they had an income.

Cultural barriers manifested themselves in many ways, e.g., in the strict hierarchies in the local community. These hierarchies required the interviewer to talk to the household head or the oldest member of the household. The 'cultural lens' of the European researcher furthermore limited the uptake and interpretation of data. As the translator also functioned as an ethnographic informant, misunderstandings and misinterpretations of answers and observations due to the 'cultural lens' were kept to a minimum. Living in the community for two months has furthermore provided the researcher a more holistic impression of the daily routines and local realities, and thereby sharpened the analytical view. The good relation and cooperation with OIKE

and the local authorities have contributed considerably to building trust with the interviewees and the community at large. This, in turn, has greatly facilitated the work in the community.

Semi-structured interviews, the key method applied, were an effective means of data collection. The questionnaire gave interviewees the opportunity to talk freely and choose their own focal points. Thereby, interviewees could express which issues are most central to them. Interviews were often extended to practical demonstrations of agricultural knowledge, and thereby complimented with observational data. Most parts of the 'Natse Otweya' Community Toolkit on Adaptation were an effective method to conduct baseline data on the community. The exercises and group discussions, which were part of the workshops, also complimented the interview data. During the workshops, not all participants spoke out equally – be it for cultural reasons, power relations, or personal disposition. To restrain this bias, the workshop facilitator made an effort to include and encourage the more reserved participants. The outcome of a workshop is greatly influenced by what participants do – or do not – attend (Borrini-Feyerabend, 2000). Even though the workshops were publicly announced and incentives (in form of a free lunch) given to join, there was a clear bias concerning workshop participation. The observed pattern was that villagers living far from the center were less likely to join, as this required a walk up to one and a half hours. Concerning gender, it has to be stated that on average more than 90% of the workshop participants were female. Thus, the workshop data contains a clear gender bias.

Another limitation was the specific time period spent in the community. As the research was conducted in the late dry season, participant observation was restricted to the few activities which are conducted at that time of year. As virtually no agricultural activities were ongoing at the time of research, the analysis of agricultural practices in Onkani is based on interview data and only complimented marginally with direct observation. This made it especially difficult to grasp the agricultural capacities which are performances rather than knowledge. A general problem with participant observation is the Hawthorne Effect, i.e. a change of group behavior due to the presence of an observer (Kumar, 2005). Another limitation of observation is the observer bias, which is especially delicate in cross-cultural situations. To reduce the observer bias, observations were often reflected together with the local partners from OIKE.

The triangulation of methods and sources was successfully applied to generate an analytical picture of adaptation in Onkani. For example, complementing local data with secondary literature on the history of Ovambo societies in Namibia's NCRs has helped to put adaptation in a broader temporal context, and put livelihoods in relation with fluctuating rainfall patterns. Triangulation with other sources, such as climate data and policy reports, was effective in providing additional insights to the local data. A shortcoming was that much of the primary data obtained from third parties has considerable data gaps and sometimes questionable quality. For example, the climatic data for the research area had to be puzzled together from three different locations. In conclusion, the highly empirical and integrative approach applied is effective to operationalize the given analytical scope. Local-scale interview and observation data is triangulated with various other primary and secondary sources. This approach contributes to a holistic picture of the complexity of local adaptation practices and their interaction with climate patterns, the broader socio-political environment, and the exogenous adaptation project.

3. Adaptation as an endogenous practice

The main goal of the chapter is to analyze the vulnerability to climate variability and change, and the local knowledge and techniques to cope with it. At first, risks and exposure of the community to climate variability and change are presented. An emphasis is put on the dependence of local livelihoods on moderate rainfall, including the intra-community differences between households. Local perceptions of weather and climate are presented and juxtaposed with historical climate data. Land and water management are analyzed for their ability to handle scarce resources under fluctuating climatic conditions. The interrelation of local livelihoods and climatic and environmental changes are dissected to see adaptation in a broader historical perspective. Based on this knowledge, local adaptation practices dealing with these environmental and socio-political dynamics are described in depth. The ability of local livelihoods to buffer crop failures is central. Lastly, the given chapters are assembled to assess the overall adaptive capacity of the community, and conclusions are drawn.

3.1. Vulnerability

3.1.1. Risk

The central role that precipitation plays in the livelihoods of Onkani's agro-silvo-pastoralists has been explained in Chapter 1.6. Here, the risks that the potential impacts of climate change pose to those livelihoods are presented. What is crucial to keep in mind is that empirically downscaled climate change projections for Namibia came to the sobering conclusions that it remains unclear what exactly Namibians will have to adapt to (Dirkx, Haeger et al., 2008).

Many interviewees stated that moderate rainfall is the single most relevant determinant of livelihoods in Onkani. Given the high natural variability in precipitation – and the potential magnification under climate change – the risk level for negative impacts on Onkani's agricultural and livestock output is very high. Floods and water locks can furthermore increase the occurrence of certain livestock diseases, such as verminosis, lumpy skin disease and ephemeral fever – which has reportedly happened in Omusati region during the 2008/09 flood (Directorate of Veterinary Services, 2009). Given the centrality of rainfall for local livelihoods, this risk assessment is mainly based on the scenario that variability of rainfall will furthermore increase in the future (Dirkx, Haeger et al., 2008).

A change in vegetation structure, and thus the availability of natural resources, is another possible risk. However, there is great uncertainty in the effects of climate change on the vegetation of the NCRs. At this point of time, models do not come to a consensus, but bush encroachment is a likely scenario (Newsham and Thomas, 2009). Increased temperatures are the parameter that climate models predict with the highest certainty. The past decade already showed a strong increase in days exceeding 34°C. A continuous increase in the occurrence of extreme temperatures is expected to affect both human and animal health (Ministry of Environment and Tourism, 2002; Boko, Niang et al., 2007). Many interviewees mentioned that extreme heat decreased fitness and labor force. Moreover, the reproductive rate and condition of livestock can considerably suffer from high temperatures (Dirkx, Haeger et al., 2008).

Risks are composed of a complex interplay of climatic and non-climatic stressors. In Onkani, this is best shown by the multiple stressors on rangelands. Besides irregular rainfall intensity, increased livestock populations (especially around water points) are a major pressure on rangelands. This in turn is caused by increased human population densities, mainly due to migration. A similar over-use pattern is shown for the forest area of Onkani. Thus, if migration to the area continues to increase, there is a substantial risk of exceeding the carrying capacity of the ecosystem – for livestock, forest and other natural resources.

Potential impacts of climate variability and change on human health have not received much attention up to this point. Here, these impacts shall be briefly summarized for the community-specific context of Onkani. Water shortage experienced in drought years often results in the necessity to walk long distances to water sources, and drink contaminated and saline water from hand-dug wells. Combined with food shortage following low yields, this was reported to lead to a decrease in fitness and an increase in susceptibility to diseases. Children are especially vulnerable in this context. Similarly to drought, floods are commonly associated with low harvests and hunger. Floods furthermore limit the mobility of locals, which impedes them from access to food and health services, and confines their social lives. Almost one fifth of respondents had property damaged by the 2008/09 flood, and a number of people in the region reportedly drowned.

The nurses at the Onkani clinic keep record of the most commonly occurring diseases in the area, namely gastro-intestinal infections, common cold, intestinal worms, HIV/AIDS, malaria, and malnutrition. Based on these data sets, health occurrences were analyzed. HIV/AIDS is treated separately in Chapter 3.1.3: A clear limitation of the local data is that it only includes those patients who came to the clinic. Since many villagers have to walk long distances to the clinic, it is assumed that the data only captures a fraction of all infections. Some locals may also be discouraged by the mandatory fee for the consultation. Furthermore, the data has only been recorded since 2001 (2006 for some diseases), so it only given a short-term view.

Between 2006 and 2009, there were 24 cases of malaria recorded in Onkani. Eleven of these cases occurred in 2007/8 and four in 2008/9. The low number of malaria cases during the 2008/9 flood shows that at this point of time, there is no evidence for increased malaria occurrence in the study area. Furthermore, the low malaria occurrences in 2008/9 do not exclude the risk of a long-term increase in the area if floods become more frequent – as expected for other parts of Southern Africa, including Zimbabwe (Boko, Niang et al., 2007). For the period of 2001 to 2009, an increase in gastro-intestinal diseases and intestinal worms, and a decrease in common cold were observed at Onkani clinic. The highest occurrences, however, were not necessarily in the flood year 2008/9. Correlation coefficients were calculated to analyze possible relations between disease occurrence and rainfall. Results showed a medium correlation between any of the diseases recorded at the clinic and rainfall. Negative values for correlation coefficients ranged between -0.52 for common cold and -0.42 for malnutrition. Positive values amounted to 0.48 for malaria, 0.56 for gastro-intestinal diseases, and 0.59 for intestinal worms. Thus, none of the diseases, showed a strong correlation with rainfall.

The livelihoods baseline in Chapter 1.6 has shown that there are considerable differences in wealth between households. As poor households have less diversified livelihoods (e.g. no livestock), they are expected to be particularly exposed to risk

occurrences, e.g. crop failure. The assumption of unequal division of resources – especially livestock – is underpinned by estimations from the 1990s, which approximate that up to 50% of the population of the NCRs does not own livestock at all (Werner, 2009). In Onkani, about 14% of the population does not own any livestock. On top of this, there is great disparity between households that do own livestock: while the average Onkani resident owns 23 pieces of livestock, there are herds of more than 60 animals in the village, and up to 250 at the cattle posts. As livestock was commonly characterized as a last resort in emergencies, households not owning any are seen as particularly vulnerable to risk occurrences.

3.1.2. Exposure to climatic stressors

According to two thirds of the respondents, livelihood constraints are mainly associated with rainfall patterns: irregular rain – both little and much – is a main limiting factor for agricultural and livestock output. A very common quote was that “good rain is all that farmers need here.” Thus, the main difficulty for Onkani’s agro-silvo-pastoralists is that their livelihoods are fully exposed to climatic fluctuations, because their crop and agricultural outputs strongly depend on moderate rainfall. The climatic records from the area show strong climatic fluctuations throughout 1917 – 2009 (Namibia Meteorological Service, 2009). Thus, exposure to climate variability is not a novel stressor for people in the NCRs. However, since climatic extremes (floods and droughts) may get more common under climate change, it is possible that the already high exposure will furthermore rise.

It has to be kept in mind that the situation in the upper Cuvelai Basin – where damages to infrastructure were devastating – looked completely different (OCHA Regional Office for Southern Africa, 2008). In comparison, the flood impacts for Onkani were relatively moderate, even in 2008/09.

While most climate change impacts are likely to have a negative effect on livelihoods in Onkani, possible positive impacts also have to be considered. There is a possibility that climate change may bring new livelihood opportunities in Onkani, e.g. fishing in the ephemeral river north of the village. Some regional climate models indicate the opportunity for longer planting windows to cultivate pearl millet in some areas of the NCRs (Dirkx, Haeger et al., 2008). This scenario would have a positive effect on the overall yields and thereby greatly benefit the community.

3.1.3. Exposure to non-climatic stressors

By far the biggest concerns of local agro-silvo-pastoralists were low agricultural and livestock output (mentioned by 91% and 84% of respondents, respectively). Poverty and lack of income were other commonly mentioned concerns. Even though agricultural outputs are mainly determined by seasonal precipitation, they are furthermore constrained by a limited technological input (such as machinery, seed material and fertilizer). One example for this is the irregular loss of yield due to infestations of the red-billed quelea bird (*Quelea quelea*) (33%) and army worm (*Spodoptera spp.*). Farmers stated that they had neither access to pesticides nor to other technical means to control the infestations. Therefore, crop losses in years where these pests occurred were huge.

On top of the mentioned climatic stressors, livestock output is constrained by the high stocking density in the area. Klintonberg, Seely et al. (2007) have argued that the carrying capacity is exceeded especially around water points. It has to be kept in mind that the biological carrying capacity of the savanna ecosystem is naturally low, so it cannot buffer a high-intensity use. The increased human population pressure is furthermore likely not only to affect grazing, but also the availability of other natural resources such as water and firewood. Other constraints concerning livestock mentioned by local breeders were diseases (24%), lack of veterinary care and labor (14%, respectively). The government pays for the vaccination of cattle, however, any veterinarian care on top of this is a fee-based service.

A factor reducing the exposure to human diseases is the clinic in Onkani, which was built in 1998. Presently, two nurses are employed, and there is no doctor. Medication is free, however, there is a fee of N\$ 3 (US\$ 0.37) per patient per visit. Patients who are not able to pay this fee are usually treated for free, but encouraged to pay later. Even though the clinic is an asset for Onkani, it is assumed that its presence is not sufficient to ensure appropriate medical care for the entire community. The lack of a doctor, medication and equipment limit the clinic's scope. Furthermore, the clinic is unable to treat patients unable to make their way to the village center. Traditional knowledge on healing coexists with 'Western' medicine. For example, there are a number of medicinal plants commonly used to treat cough, flu and intestinal worms.

Another major stressor in Onkani is the HIV/AIDS epidemic. Clinical tests of HIV/AIDS were first carried out in 2009. In that year, 25 individuals in the village were tested HIV positive. This amounts less than three percent of the total estimated population of the village. However, it is highly likely that the majority of cases have not been detected within the first year of testing. Thus, the number of HIV infected individuals is expected to be much higher. Specific estimates for the four health districts of Omusati range between 19.6% and 27.4% (Ministry of Health and Social Services, 2008), so it is assumed that the infection rate in Onkani is likely to be within this range. The estimations of HIV infection rates for the whole country range between 15 and 20% (UNICEF, 2004; Levine, 2007; WHO, 2008). There are no HIV/AIDS medicines available in Onkani. Therefore, patients have to go to the hospital in Oshakati or Oshikuku to get the medication. While the medication is free, the transportation costs to the hospital have to be covered by the patient. Given the magnitude of HIV/AIDS infection rates in the NCRs, it has the potential to substantially weaken social structures and decrease available labor force.

The total stress on the community is not only the sum of climatic and non-climatic stressors, but also their interplay. Non-climatic stressors make the community more vulnerable to climatic stressors. For example, in drought years, migration with livestock is no longer possible because of the increased population density in the region. Another example is the lack of market access, which is a major obstacle for generating income by selling livestock surplus in years with abundant production. Monetary income in turn, can ensure food security in times of drought and flood. The exposure to non-climatic stressors is mainly caused by a lack of access to technology, education and non-farm-based income. Firstly, the output of agriculture and animal husbandry is constrained by available technology and social organization aiming at improving the current practices. And secondly, the dependence on rainfall is worsened by the low involvement of income-generating activities in the area. Whereas some interviewees reported to buy additional food in times of crop losses, many locals are deprived of this possibility.

3.2. Perception of weather and climate

The perceptions of recent and historic climate patterns – including extreme events – are presented in this section. Perceived changes in aspects such as intensity, length and onset of rainy season are described – and how these changes affect livelihoods. Local perceptions are juxtaposed with climate data from the nearest weather station. It was found that the individual and collective memory on climatic patterns in the past is fragmented and does not always show a clear picture. The recently high precipitation has negatively affected livelihoods, but irregularly appearing floods and droughts have always been an integral part of the lives of Onkani's residents. Problems with both floods and droughts are commonly related to food shortage. Even though there is wide access to official SCFs broadcasted on the radio, the usefulness of these forecasts is doubtful (as discussed in Chapter 3.3). Main limitations are the unclear use of terminology and a very coarse spatial resolution. A large part of the local population observes different environmental patterns to forecast the rainy season. The reliability of these forecasts cannot be estimated. Furthermore, it remained unclear to which degree agricultural and livestock decisions are based on them. Climatic and related environmental conditions differ greatly from season to season, and local agro-silvo-pastoralists stated to react more or less spontaneously to them as they come.

For Onkani's agro-silvo-pastoralist, the perceptions of weather and climate are indivisible from their influence on local livelihoods. When asked about the weather of, e.g., last season, locals typically answered how the agricultural and livestock outputs in the given season were. For agriculture and livestock in Onkani, ideal rainy seasons are long, with constant and abundant – but not too heavy – rainfall. Both very high and very little amounts of rainfall (as well as irregular rainfall breaks) reduce yields and grazing availability. Above moderate wind and temperatures are also detrimental.

In the 2008/09 season, Ondangwa weather station recorded 855mm precipitation – which is 400mm above the seasonal mean. The agricultural extension office in Onkani recorded 643mm. The yield of the season was considered extremely low by 91% of the households. Concerning grazing, locals were divided: 61% considered it bad, 39% good. No spatial relation could be found between the location of the homestead and the perception of grazing quality. Neither was there a correlation between herd size and the perception of grazing quality. The two consecutive floods in 2007/08 and 2008/09 were mentioned by all of the interviewees. More than one fourth emphasized that human and livestock casualties were caused by this flood. Almost 80% of the interviewed households saw heavy rainfalls as a phenomenon which had manifested very strongly over the last few years. When looking at the further past, it is very difficult to reconstruct the climate pattern from the collective memory of Onkani's residents.

The locals perceived that the rainy season in the past lasted from January – April, but had shifted to November – April in the last two decades. Thus, the length of the rainy season has increased by approximately two month according to local perception. Local perception was compared with climate data from Ondangwa weather station. The average decadal precipitation per month was compared for the periods 1989 – 1990 and 1998 – 2009. This period was chosen because locals commonly gave Namibia's independence in 1990 as a point of reference. For each individual month from October to March, precipitation from 1999 – 2008 was higher than in the decade before. Thus, in accordance with local perceptions, the data supports evidence for an earlier onset of the rainy season in the last decade.

The local population perceived the total amount of rain to have increased from 1990s onward, however, this does not necessarily mean that it has gotten more favorable for agriculture. As there were two consecutive years with extremely high rainfall, the overall suitability of rainfall for agriculture (i.e. constant rainfall over a longer period of time) is considered to be lower than in the past. Extreme heat is perceived to start later in the season – and have gotten more moderate than in the past. Strong winds appear to have shifted from July – August to August – September. Army worm (*Spodoptera spp.*) infestations occurred several times from the mid 1990s to about 2004. The infestation of the red-billed quelea bird (*Quelea quelea*) was mentioned by one fourth on the interviewees. Even though army worm and red-billed quelea bird are said to have occurred earlier in the area, their large-scale infestation of crops is seen as a more recent phenomenon. However, analyzing whether bird and insect infestations correlate with changing climate patterns is beyond the scope of this thesis.

Outstanding climatic events mentioned by Onkani residents were droughts causing food shortages in the late 1970s to early 1980s and in the early to mid 1990s. About one third of the respondents stated hunger to be a common in the recent past as well. Pinpointing extreme climatic events for specific years was not possible, as written records in the village are scarce. The attempt to reconstruct specific years from interview and workshop data did not give clear patterns, neither. As the individual memories among Onkani residents divert greatly, there is not one collective image of past climate patterns and outstanding events exists.

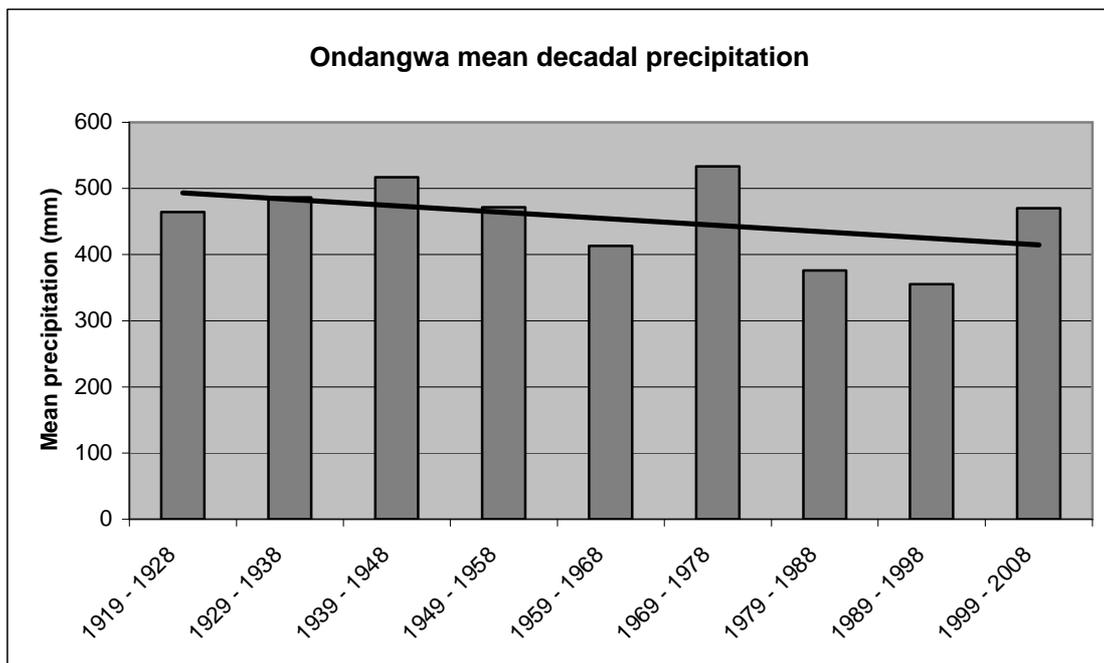


Figure 8: Ondangwa mean decadal precipitation 1919 - 1928 to 1999 - 2008

Based on the data from Ondangwa weather station, decadal rainfall from the 1920s to present shows a slight decrease (see Figure 8). Decadal rainfall in the 1990s was considerably lower (more than 100mm) than from 1999 – 2008. This is in live with local perceptions. Rainfall in the area has been particularly high since 2004/05. When considering at a longer time perspective, the decadal rainfall from 2000 – 2009 was

the highest since the 1960s, however, similarly high values per decade were recorded between the 1920s and the 1950s. It has to be kept in mind that except for the past decade, the climate data is from the weather stations of Ondangwa and Oniipa, located 60 - 70km from Onkani. Reliability of data is furthermore unclear as discussed in Chapter 1.4.1. What the climate data shows most clearly is that strong inter-annual variations in precipitation have occurred ever since the first climate records were taken in 1916. In conclusion, local perceptions of both rainy season onset and total precipitation are supported by climate data from the Meteorological Service and the Agricultural Extension.

More than 40% of the respondents had already heard of climate change (mainly on the radio). Even though the vast majority of interviewees and workshop participants did not have knowledge on the causes of climate change, there was a high awareness of its potential impacts. Most interviewees expected climate change to magnify climate variability – in particular floods, drought and strong winds were mentioned. All of the mentioned climatic phenomena were expected to be detrimental to yields and grazing availability, and thus as a threat to local livelihoods.

3.3. Use of weather forecasts

About 40% of interviewees listen to weather and seasonal climate forecasts (SCFs). Both are issued by the Namibia Meteorological Service (2009) and broadcasted on the radio. Radios are quite common in Onkani: more than half of the sampled households declared to have their own receiver. The SCF of the 2008/09 rainy season (found in the annex) separately predicts rainfall for October – December 2009 and January – March 2010. Probabilities of rainfall in the aforesaid periods are predicted to be either below, in line with, or above the baseline ‘normal rainfall.’ Furthermore, the SCFs distinguish rainfall patterns for two parts of the country. The parts are divided by different rainfall probabilities for the given period. For example, for region one, the 2008/09 SCF predicted rainfall for the period October – November 2009 to be “normal to below normal” (Namibia Meteorological Service, 2009). For Namibia, an area of 825,000 km², the rainfall patterns are only predicted for two distinct regions. Such a coarse spatial resolution is unlikely to do justice to a country as climatically diverse and variable as Namibia. Another point of criticism is the rainfall baseline: given the high climate variability, the term ‘normal rainfall’ is somewhat misleading. This leaves room for different interpretations of what, e.g., ‘below normal rainfall’ means, and in turn, what rainfall can be expected for the coming season. Given these limitations, the usefulness of the SCF for local agro-silvo-pastoralists is questionable. Nonetheless, locals commonly stated that the information of the weather and SCFs was useful to them. There may be different explanations for this answer, including a courtesy bias. Based on the collected data, it is not possible to describe how the information from weather and SCFs is incorporated in decision-making on agricultural or livestock practices.

About 60% of respondents forecast the rainy season by observing specific environmental parameters. The indicators are presented in Table 2. The most frequent nominations were the observation of wind direction, appearance of clouds, and flowering patterns of mopane trees. The remaining indicators were seldom mentioned and are therefore expected to be less commonly applied. Empirically verifying the reliability of different methods of folk forecasting is beyond the scope of this research.

However, as discussed in Chapter 2.1.2, there are various examples around the world where local knowledge on SCFs has showed to have strong predictive capability (Jennings, 2002; Orlove, Chiang et al., 2002; Orlove, 2005; Roncoli, 2006; Roncoli, Crane et al., 2009). Similar to the findings on official weather and SCFs, the data does not provide a basis to explain how local forecasting methods contribute to informing agricultural decisions.

Table 2: Local indicators to forecast rainy season

Category	Indicator	Indication
Wind	Strong wind from West to East	Good rainy season
Clouds	Appearance of clouds	Soon onset of rainy season
Stars	No stars within 'Oipale' circle	Good rainy season
Soil	Cracks in specific type of bare soil	Good rainy season
Plant	Abundance of flowers of mopane tree	Low rainfall (few flowers) Good rainy season (abundant flowers) Extremely high rainfall (very abundant flowers)
	High abundance of fruit and leaves of 'omuhadu' tree	Good rainy season
	Large grains of wild grass 'ombidangolo'	Good harvest
Animal	Termites' way of carrying blades of grass	Good rainy season (carry grass vertically in their mouth) Low rainfall (carry grass horizontally in their mouth)
	Nest-building of insect 'okakuuthile'	Good rainy season (nest in form of a traditional grain storage container) Bad rainy season (nest in the ground)

3.4. Land and water management

Throughout history, access to land and water has played a fundamental role Namibia (Newsham, 2007). In Onkani, land and water management can be interpreted as a form of coping with scarce resources with fluctuating availability. Therefore, this sub-chapter scrutinized tenure, allocation, and use are of land and water in Onkani. Use conflicts and resource scarcity were analyzed in relation to climate variability. Even though resource scarcity and competition are material realities for most Onkani

residents, mechanisms to regulate their use have been found to be sparse. At present, there are no approaches in place to seek solutions to the land issue. Water scarcity is partly mitigated by tap water provision. However, due to the limited technical reliability of the system, and the denied access of low-income families, tap water provides only a partly solution.

3.4.1. Land allocation and tenure

In Namibia's communal areas, legal allocation of land is only possible for agricultural land and businesses. Grazing land is communal and not allocated to individuals, groups, or communities. Land is allocated via the village headman. Applicants approach the headman and may choose between different plots. A maximum of 20 hectares of agricultural land can be allocated to an individual. This area may be fenced to exclude other users.

Namibia's legal system has created a framework for the registration of customary land rights. This means that rural dwellers are encouraged to register their land not only with the village headman, but with the government authorities. According to the government, this official registration gives rural dwellers tenurial security, e.g. when there are land claims from newly migrating families. In this context it has to be stated that a relative tenurial security was also granted under customary rights, i.e. before the land registration via government authorities came into force. The official land registration is a fee-based service. It amounts N\$ 75 (US\$ 9.2) plus an annual fee of N\$ 10 (US\$ 1.2). These fees are considered affordable. Many headmen, who are not remunerated by the government, claim an additional land registration service fee of N\$ 600 (US\$ 73.6). There is no legal basis for charging this fee, but it is tolerated by the government. Tenure is granted for 99 years. There are different mechanisms of land allocation after the tenant's death in Ovambo culture. The traditional pattern was that the tenant was male and his widow was not given any of the land. This forced many widows to return to live with their parents after their husband's death. In present-day Namibia, however, this pattern is broken up. Via the official registrations, both men and women can be tenants of land. The registration certificate also specifies which individual will be given the land after the tenant's death.

Officially, the headman is required to consult the community and let citizens voice their potential concerns before allowing the establishment of new homesteads. These consultations take place informally. Community members have the right to veto. Thus, there is a legal possibility to limit migration to an area beyond carrying capacity of the sustenance base of the natural environment. However, even though increased population pressure is a commonly expressed concern by Onkani citizens, the veto right has not been practiced so far.

While land allocation and tenure is regulated both by traditional authorities and the government, there are very few regulations on land use itself. De jure, headmen have the right to limit the amount of homesteads established in their village, if there is a risk of over-use of natural resources due to high population densities. However, this right is not exercised in Onkani. Up to this point of time, the headman of Onkani has given land to every migrant to the area. Thus, even though this right has been granted by the national government, in the NCRs, there is usually no concept of limiting allocation by the headmen (Werner, 2009). Grazing and many other natural resources

remain open access regimes with very little legal regulations. The local institutional capacity to manage scarce grazing resources is addressed in more detail in Chapter 3.7.

The Land Reform Act gives the village headmen the legal authority to issue maximum herd sizes per household, however, traditional authorities have never – and still do not – exercised control over livestock. In Onkani, where the headman uttered concerns on overstocking of livestock, he does not try to influence the herd sizes of the community members. It is assumed that given the low population density in the NCRs until the mid-1950s, it was not necessary to establish strict natural resource use regulations in the past. The government is aware of overgrazing of large parts of Namibia's communal land. However, given the cultural and political sensitivity of the issue, there are no plans to tackle it through institutionalizing regulations. Locals stated that it was necessary to keep large herds as an emergency for drought years. From this perspective, regulations would interfere with the local's safety nets. Ironically, as pressure on land is likely to increase (both through rising population pressure and possible aggravation of climatic stressors), it is highly questionable whether the current regulations will be able to avoid degradation – and thereby enable the local population to sustain livestock herds for emergencies.

3.4.2. Water supply

There are three main water sources in Onkani: rain and flood water from open water bodies, groundwater from hand-dug wells, and chlorinated water from the tap. Tap water is piped to the village from the Etaka canal, and available at five public water points in Onkani – most of them in the vicinity of the village center. The public water points in Onkani are managed by voluntary local committees. Water fees amount N\$ 0.01 per liter, plus an annual membership and a monthly maintenance fee. Three quarters of the interviewees use tap water for household consumption, and more than one fourth have a private tap. Most respondents who did not use tap water stated that they were not able to afford it. Distance to the nearest water point also plays a role, as some of the more remote homesteads are more than one and a half hours walking distance from the closest tap. In most cases, tap water is used as a supplementary source when water in the ponds and hand-dug wells gets saline, which is usually the case in drought years or toward the end of the dry season. About 40% take their livestock to the water points in times of water shortage, but throughout the year, natural ponds are the main water source for livestock. Virtually all respondents use hand-dug wells – shallow wells between two and four meters. Firstly, these wells function as rainwater catchments, and when the rainwater is used up, locals dig deeper and deeper to reach the ground water. Given the salinity of the groundwater, it is used as a last resort when rainwater is used up. Livestock and humans often use the same wells. Wells are commonly shared with several households. This means that these households share the labor of digging and maintenance, and the use right of the given well. Furthermore, households usually sustain several wells to ensure water availability in drought years. Rainwater harvesting is not practiced in the area. Using tap water and digging wells are the only coping strategies to deal with water shortage.

3.4.3. Conflicts on land and water

About 60% of respondents stated that there are conflicts over grazing land in the community. The conflicts mentioned include the decline in grazing availability due to increased livestock numbers, and the fencing of large areas. Legally, one household is allowed to fence a maximum of 20 hectares, but several violations have been reported in Onkani. Since fencing material is relatively expensive, it said to be the better-off villagers who unlawfully fence large areas. Following complaints, the headman has intervened in some cases. Another commonly mentioned conflict was livestock damage to crops. In theory, livestock owners are obliged to herd their animals until harvest is finished, and pay compensation in case of damage.

Three quarters of respondents claim not to have sufficient water throughout the year. The unreliability of tap water is a common disturbance. Water breaks of several weeks are a common phenomenon. In a few cases over the past years, Onkani's tap water provision was cut for several months. As the technical problems for the water breaks in Onkani are further up in the supply chain, there is little that the local water point committee can do about it. The inability to pay water bills is another major problem in the community. Firstly, the pricing excludes many potential users from the resource. Secondly, the local water point committee is held accountable if some community members do not pay their water bills. In Onkani, there already have been several threats by NamWater (the Namibian public-private partnership managing water supply) to close the community taps if bills continue not to be paid. The inability to pay one's water bill can lead to exclusion, but as the water point committee members are regular citizens, this is socially delicate and rarely practiced. Water stress in the community is especially severe in drought years. Given the limited capacities to store rainwater, a flood occurrence does not necessarily ensure water availability until the onset of the next rainy season. Thus, increased rainfall variability (a likely climate change scenario) is expected to aggravate the conflicts over water resources.

3.5. Livelihood-environment dynamics

3.5.1. Seasonality of labor

The livelihood activities of local agro-silvo-pastoralists are strongly determined by the temporal and spatial availability of rainfall in the given season. The length and intensity of the rainy season are the main determinants of seasonal activities in Onkani, and the busiest time for the locals. Thus, livelihoods are highly flexible to inter and intra-annual fluctuations in rainfall.

Agricultural activities (ploughing, sowing, weeding and harvesting) are practically limited to the rainy season, as shown in Table 3. Given the risk of livestock to damage crops, it has to be herded during the entire period in which agricultural activities take place. If livestock causes damage to crops, compensations may be asked from its owner. Most livestock breeders do not herd their animals outside of the rainy season – only in the evening, animals are driven to an enclosure near the homestead. As water gets short toward the end of the rainy season, livestock is accompanied to water points or ponds.

Table 3: Seasonal activity calendar of Onkani's agro-silvo-pastoralists

Activity	October	November	December	January	February	March	April	May	June	July	August	September
Agriculture												
Ploug												
Weed												
Harvest marula												
Prepare harvesting site												
Harvest and thresh millet												
Clear crop field												
Harvest millet stems												
Livestock												
Take cattle to cattle post												
Water livestock from wells												
Collection of manure												
Milk cows												
Herd livestock												
Forest / natural resource use												
Harvest grass												
Fetch salt from salt pan												
Gather mopane worms												
Fishing												
Harvest wild cabbage												
Food processing												
Cook watermelon seeds												
Ferment milk												
Prepare marula drinks												
Prepare watermelon seeds												
Produce marula oil												
Crafts production												
Weave grainery												
Basket weaving												
Pottery production												
Construction and maintenance												
Dig wells												
Maintain homesteads												
Maintain fences												
Average rainy season												

Some owners also take their animals to the cattle posts in the dry season, but this is estimated to be a small fraction of the livestock owners only. In years with abundant rain, many locals fish as long as there is water in the ponds. The role of fish in local safety nets is analyzed in depth in Chapter 3.6. The availability of natural resources

from the wild, such as mopane worms (*Gonimbrasia belina*) and wild cabbage often coincide with the availability of water. As the rainy season is the busiest time of year for Onkani's agro-silvo-pastoralists, natural resources are collected outside of this period as far as possible. This is commonly practiced with resources such as wood, grass for thatched roofs, and salt (fetched from the salt pan near the fence of Etosha National Park). The production of crafts, utensils and tools is mainly carried out during the dry season. The same accounts for construction and maintenance works in and around the homesteads.

3.5.2. Changes in environment and livelihoods practices

This sub-section analyzes livelihoods in a historical context, i.e. how practices in relation to climate variability and other stressors have developed to their current state. The technical details of current adaptation practices are elaborated in Chapter 3.6.

Not only are there large inter-annual and intra-annual changes in activities, but livelihood practices as whole have altered with environmental and socio-political changes. Increased population and livestock pressure has caused social and environmental change, such as forest loss and degradation, and increased competition for grazing land. This, in turn, has triggered new adaptation mechanism, such as non-farm-based sources of income (e.g. shops and migrant labor). Moreover, some adaptation mechanisms are no longer suitable for the changed environmental and social conditions (e.g. transhumance). Individual narratives on environment and livelihoods in Onkani differ in many aspects, especially concerning the agricultural and livestock outputs in the past and present. This may be attributed to several factors, such as the subjectivity of answers and the lack of written records in Onkani. It is furthermore assumed that livelihoods and wealth have always strongly differed between households. Not only practices as such have changed over time, but also the composition of livelihoods as a whole. In post-colonial times, cattle in the NCRs has been marketed much more than today. It is furthermore expected that the use of natural resources from the wild has decreased due forest loss. Forest loss was commonly associated with the disappearance of large wildlife from the area. Wild foods, including wildlife, played an important role in Ovambo societies in the past (Kreike, 2004).

Among the interviewed Onkani residents, there is a clear consensus that population pressure has increased, and forest area decreased from the early 1990s onward. Wildlife (including predators) has decreased along with forest area loss. Due to the construction of water infrastructure, water availability has improved, and walking distances to fetch water decreased. The availability of tap water has also drawn more people to settle in the area.

About 80% of respondents agreed that agriculture had undergone considerable changes in the past decades. The most commonly mentioned changes and innovations are ploughs (63%), tractors (57%), drought-tolerant seeds (25%), artificial fertilizer (19%), and animal-drawn weeding machinery (19%). Ploughs have enabled to cultivate larger crop fields, however, more than 40% stated that the labor availability in their households had decreased. So on the one hand, ploughing technology has improved, on the other labor force has decreased for many families. Thus, it remains unclear if there has been a considerable change in cultivated area per household. The decrease of labor force can be associated to different factors, such as fewer children

per family, compulsory schooling and migration to cities. Access to education has increased in Onkani, and according to the locals, the vast majority of children in the village attend at least elementary school nowadays. According to the 2001 Population and Housing Census, at least 90% of children between seven 16 in Omusati region attend school. In Otamanzi constituency, the literacy rate of individuals above 15 years is estimated to be 84.4% for males and 81.9% for females (Central Bureau of Statistics, 2005). Migrant labor is not a recent phenomenon in the NCRs. In fact, under South African rule, many Ovambos worked as wage laborers in Namibia's mines and on commercial farms (Kreike, 2009). Thus, already in colonial times, some rural households in Onkani got financial support from family members living outside of the community. However, according to the locals, there are more migrant workers today than in the past.

In the past, crop fields were moved every few years. This practice was prohibited by the colonial government in the 1960s (Newsham, 2007). According to the locals, shifting cultivation has become a rare practice in the village. Decreased soil fertility was a commonly mentioned problem. It is possible that this is associated with the abandoning of shifting cultivation. This would furthermore explain why there is little knowledge on the management of soil fertility in Onkani. Ploughs are relatively common these days, but still there are many households who do not own one. The households without a plough either borrow one from family members or neighbors, or they till their field with a hoe. Before the introduction of animal-drawn ploughs, hoes were used to plough fields by all farmers in the area. Even though tractors were commonly mentioned innovations, it has to be stated that no farmer in Onkani owns a tractor. During the rainy season, tractor owner from outside the area come to Onkani and the surrounding villages and can be rented to plough crop fields. The saving of labor time by using a tractor is enormous, however, according to local income structures, the costs (up to N\$ 300 (US\$ 40) per hour), are high and not affordable for most community members.

Since the establishment of the agricultural extension office in the mid-1990s, local farmers have the opportunity to consult the extension technicians, attend workshops, borrow tools and machinery, and buy seeds and fertilizer. Workshops and trainings are held on a variety of topics, such as management of livestock diseases and application of artificial fertilizer. Seeds sold at the extension office are heavily subsidized by the government. Pearl millet seeds sell at N\$ 3.5 (US\$ 0.45) per kilogram, whereas 4.5 kilograms are recommended per hectare.

A newly emerging livelihoods practice in Onkani is home gardening of vegetables and fruit trees. There are no estimations on the amount of households with home gardens at this point. However, under the patronage of OIKE, an initiative to share knowledge and experience on home gardening was launched. This shows that there is a certain demand by the local population. Home gardens are commonly irrigated with tap or flood water. As described earlier, cattle were a major market commodity in pre-colonial times. In was not before selling cattle was restricted by colonial regimes that animal husbandry became limited to subsistence use (Kreike, 2009). Along with changes in natural resource availability, livelihoods practices have been adapted. This is shown by the change in grazing availability. More than one third of the respondents stated that grazing availability has declined in the recent past. According to those respondents, grazing in the village was so abundant in the past that livestock was only taken to the cattle posts in drought years. Today, grazing pressure in the village has reached a point where many livestock owners keep their animals at the cattle posts

year-round. This pattern is congruent with the observations of Newsham and Thomas (2009), who found that leaving one's livestock at the cattle posts year-round was a more recent phenomenon related to increased human population and livestock densities in the NCRs. Cattle posts as such have been existing for a long time in Ovambo culture, however, they were mostly used for a few months during the rainy season. This way, grazing resources in the villages were spared for the dry season (Kreike, 2009). In the past, Ovambo culture was more strongly characterized by transhumance, thus, livestock herds were moved to wherever water and grazing resources were available. With increased population densities in the NCRs, there are few sparsely populated areas left for cattle herders to go. Concerning the amount of animals kept, it does not seem possible to identify a general pattern, as herd sizes were said to have always differed greatly between households. However, livestock mortality decreased as the colonial government introduced vaccinations of cattle (Kreike, 2009).

Fishing is not a newly emerging livelihoods practice, however, the two consecutive flood years have constituted outstandingly good conditions. The fishing tools and techniques described in Chapter 3.6 were reported to have long been a part of Ovambo culture. Only a few natural resources from the wild were ranked as highly important, especially wood and grass for thatched roofs. Wild foods and medicinal plants were only marginally mentioned. Thus, the important role of natural resources from the wild described by Kreike (2006) appears to have sharply declined.

The sometimes contrary perceptions of different households are exemplified by the following responses: 24% said to have lower yields than in the past, while 19% spoke of higher agricultural yields. This reinforces the observation that livelihoods (including vulnerability and adaptive capacity) differ greatly between households. Thus, even though climate variability is a crucial factor of agricultural production, there are arguably other (non-climatic) factors determining vulnerability on a household scale.

Overgrazing is a common concern in the NCRs. However, the narrative of overuse of natural resources in the NCRs is not always consistent and contested in some parts. At least until the 1990s, there were no severe signs of bush encroachment or desertification – even though this had been propagated by the colonial regime (Kreike, 2009). Today, the biggest pressure on the grazing resources at the cattle posts appears not to be livestock owners from the NCRs, but urban entrepreneurs.

3.6. Adaptation practices

As the two main climatic extremes in the area are either the lack of rain (i.e. drought) or highly abundant rain coupled with influx from the upper Cuvelai Basin (i.e. flood), coping mechanisms were analyzed with a focus on these events.

Looking at the coping strategies from a macro perspective, it is striking that the risks of shortage of resources are substantially spread among different livelihoods. Traditionally, these livelihoods were spread on agriculture, animal husbandry and forest use (Kreike, 2004). When one of these livelihood components gave little output in a certain year, there were always others to rely on. This is a macro adaptation mechanism to the harsh environment and the highly variable rainfall of the NCRs.

Other adaptation mechanisms found in Onkani are market involvement, governmental disaster relief and migrant labor.

Besides technological adaptation, there is a strong social net supporting disadvantaged families in times of food shortage. In drought and flood years, the government also intervenes by providing free food packages. This is an example of how external influences on adaptation find their way in the community. However, locals frequently reported that the emergency supplies of the government were unreliable. Therefore, they play a subordinate role in local safety nets. At large, endogenous adaptation practices are dominantly practiced on a household and village community level. Other informal or formal institutions play a surprisingly little role. Even though the value of cattle exceeds material benefits (Kreike, 2009), the high livestock densities in Onkani were frequently pointed out as problematic. Many interviewees expressed their discontent about the high pressure on rangelands, which caused generally low fitness in livestock. This problem was said to be accentuated in years with extremely high or low rainfall. Although interviewees expressed that such estimations were difficult to make, the herd size per household is said not to have considerably changed over the past decade. Thus, livestock densities have mainly risen because of the increase in the amount of households in the area, not because of an increase in numbers of livestock per household.

3.6.1. Drought

Water availability is the main limiting factor for agricultural production in drought years. Nonetheless, agriculture is rain-fed and there are few mechanisms to capture and store rain or flood water. The cultivated crop types are well adapted to the harsh environmental conditions of the NCRs. The risk of crop failure is furthermore spread by intercropping and using a variety of crop types. Traditional hand-dug wells are used along with tap water. Livestock was traditionally moved to more remote areas in times of drought, but this coping strategy is no longer valid given the increased population densities in Onkani and the surrounding area.

Pearl millet, the main staple food in the NCRs, is highly adapted to little water availability, high temperatures and low soil fertility. The crop performs up to seasonal precipitation as low as 300mm (Matanyaire, 1998). Furthermore, pearl millet shows high tolerance to soil salinity, as encountered in many parts of the NCRs. In order to reduce the high risk of crop failure, pearl millet is commonly intercropped with cowpea (Hillyer, McDonagh et al., 2006). As all interviewees cultivated pearl millet and more than 80% cowpeas, this finding is supported for the research area. Most Onkani residents furthermore spread the risk of crop failure by cultivating a variety of agricultural plants such as sorghum, maize, groundnuts and watermelon (shown in Figure 6). The prevalent cattle breed used in the NCRs is called Sanga. Even though it is considerably smaller and lighter than cattle breeds used by commercial farmers in Namibia, Sanga is highly adapted to the warm and dry conditions in the NCRs (Kreike, 2009).

Agriculture is exclusively rain-fed in Onkani. The only exception is irrigation of small home gardens, which is practiced only by a small fraction of residents. These home gardens are either irrigated with tap water or water from natural ponds. The latter is only possible in years with abundant rainfall. The topographical exposure of the crop field is considered when choosing a plot. However, here farmers face a dilemma

whether to choose a plot in a depression or on an elevation. A plot in a depression receives more afflux water, which is beneficial in years with low rainfall, but detrimental in flood years. An elevated plot avoids a water lock in flood years, but receives little afflux – which can result in drying-out of crops in years with little precipitation.

At this point of time, digging wells is the most common mechanism to abate water shortage in the dry season (mentioned by 71%). In drought years, well water tends to get saline, but for those without access to tap water, there are no alternatives. Water from wells is usually consumed unfiltered or treated. The clinic in Onkani freely provides powder for chemical water treatment, but this the provided amounts are reported to fall short of the demand. Chlorinated tap water has only eased water shortage for those families who have access to it. However, given the unreliability of tap water, this is neither the single source to rely on in Onkani. Therefore, even those villagers with access to tap water usually maintain their own hand-dug wells. There were no mechanisms to collect rain or flood water when the research was initiated.

At the cattle posts, the most common coping strategy to deal with drought is migration to more remote grazing areas or water points. Herders at the cattle post also dug a surface water catchment, which is deeper than the natural ponds and therefore preserves water longer during the dry season. There are at least two such surface water catchments at the cattle posts. The downside of this strategy is that areas around water points have been proved to be the most overgrazed ones in the area, which causes soil degradation and erosion (Klintenberg and Verlinden, 2008). In Onkani itself, there are no artificial surface water catchments, but herders drive their livestock to natural ponds outside of the village when necessary. As discussed before, transhumance was a stronger element of Ovambo culture in the past, but higher population densities made this more and more difficult in the recent past. As food availability is a major constraint for livestock in drought years, crop residues are used as livestock fodder. Apart from crop residues, the storage of animal fodder is rarely practiced in the community. An exception is watermelons, whose seeds are used as chickenfeed in the dry season. Crop residues are furthermore used as building material for fences and homesteads.

3.6.2. Flood

For floods, there appear to be fewer coping mechanisms than for droughts. More than one fourth of the respondents fish to compensate the low yields that usually go along with floods. The economically most relevant species include different species of catfish (order Siluriformes) and Tilapia genera. The total amount of fish species in the Cuvelai and Etosha Pan are estimated to be 49 (Curtis, Roberts et al., 1998). More than 13% of the interviewees sell fish, mainly on local informal markets. As discussed in Chapter 1.6.2, waterfowl is also commonly hunted in flood years. Fishing is mainly practiced in the North of the village, where the largest ponds and ephemeral rivers form. In the southern part of the village, natural ponds are scarcer and fishing opportunities very limited even in flood years. However, some of the households located farther away from ephemeral rivers reported to stock fish in the small natural ponds near their homesteads. Fishing is commonly practiced with groups of ten or more people using wooden scoop nets. The group of fishermen forms a line and drives the fish by wading from one end of the pond to the other. Fish are then removed from

the pond with the scoop nets. Some villagers also stated to catch fish and stock them in natural ponds near their homesteads. Even though the stocked fish are not fed, this is a simple form of aquaculture. In flood years, fishing can be practiced until very late in the dry season. In 2009, some villagers in Onkani still caught fish in October.

During the 2008/09 flood, more than one fourth of respondents had to relocate (parts of) their homesteads. Most frequently, the cooking and sleeping areas were moved to an adjacent area. Drainage was also dug to keep the water outside of the homestead as much as possible. During the extreme flood in 2008/9, the government sent helicopters to Onkani to drop food packages, ensure the provision of medicines, and evacuate severely sick individuals to the hospital of Oshakati.

Food is stored when yields are abundant, but in consecutive years of drought or flood (as experienced in 2007/8 and 2008/9), many residents of Onkani are not able to put any aside for times of need. Three quarters of the interviewed villagers store food for subsistence. The most commonly stored foods are pearl millet, sorghum and cowpeas. Many of those respondents not storing food stated that their low yield does not permit them to put anything aside. Sharing food and water with neighbors and family members is very common in times of need. This social net ensures the support of poorer community members. A more recent approach to adaptation is buying staple food to supplement low yields, which is practiced by 20% of the interviewed households. About 15% sell livestock to buy staple food in times of need. Pension money was also said to be commonly used to buy supplementary food. About one third of respondents receive so-called 'drought relief' from the government – 20 kg bags of maize flour. The 'drought relief' is provided by the government and distributed via the headman to the neediest families in the village.

3.7. Adaptive capacity

Assessing the adaptive capacity of Onkani basically means in how far the adaptation practices can buffer the exposure to potential risks. There is a certain technological ability to buffer irregular drought and flood occurrences. There are relatively few mechanisms to ensure sound agricultural and livestock outputs in years with climatic extremes. Some traditional adaptation mechanisms, such as migration, have become invalid due to higher population densities in the NCRs. What increases adaptive capacity, however, is the risk spreading over different livelihood components – all of which strongly dependent on sufficient precipitation. For example, while more than 90% of interviewees had low yields in 2008/9, still about 40% were satisfied with the grazing availability in the given year. But even though the spread livelihoods may have the ability to buffer one year of disturbance, they certainly reach their limit when extreme disturbances occur in consecutive years. Onkani residents also have shown the ability to react to benefits of disturbances, e.g. using fishing as an additional livelihood in flood years. The provision of tap water is another factor mitigating pressure on water sources.

Adaptive capacity in Onkani is also built on institutional scale. A factor contributing to adaptive capacity is the extensive safety net, both within the community and the extended family network outside. The governmental infrastructure furthermore contributes to adaptive capacity, especially in the water and health sector. A factor weakening adaptive capacity is the prevalent common property regime of grazing, water and other natural resources. This system does not have effective mechanisms to

avoid the excess of the area's carrying capacity. Kreike (2009) found that the common property regimes in Ovambo culture had been able to avoid overuse of grazing lands until the late 1980s. However, the experiences from Onkani lead to the assumption that the local arrangements are likely not to be able to buffer the additional stressor added by the increasing population densities in the area. Thus, the local institutional capacity to adapt to this stressor is considered low.

The high livestock densities contribute to land degradation. This insight arises both from local narratives (see Chapter 3.6) and scientific research in the area (Klintenberg and Verlinden, 2008). The increasing population pressure furthermore magnifies the pressure on grazing lands. However, given the great importance of cattle both in social status and networks (Kreike, 2009) and safety nets, the willingness of the households to reduce stocks appeared low.

The transitional process from subsistence-based livelihoods to market-based economies is starting slowly in Onkani. The extent and impact of this process is not predictable. In this context, it has to be recalled that pre-colonial Ovambo cultures were strongly drawn in commerce, especially regarding cattle (Kreike, 2009). Thus, market involvement is not a completely new phenomenon in Ovambo societies. Arguably, the strong dependence on natural resources makes the community greatly vulnerable to climatic extremes. Even though livelihoods diversification (in particular toward livelihoods detached from precipitation patterns) could furthermore spread risks in the community, this is surely no panacea. For example, an increase in commercial activities is likely to bring novel challenges to the community, such as dependence on market fluctuations. In conclusion, even though there is substantial local knowledge and skill to adapt to climatic fluctuations, it remains unclear whether climate change and additional non-climatic stressors may be buffered beyond a certain extent. What is clearly shown is that the vulnerability of the community is not exclusively composed of climatic stressors, but of a complex interplay with other pressures. The example of increased population pressure in the area leads to the assumption that adaptive capacity to cope with climatic stressors is higher than to deal with novel non-climatic external stressors.

3.8. Conclusions

This chapter sums up the findings on vulnerability to climatic and non-climatic stressors. The findings from Onkani show that there is certainly a rich experience and large body of local knowledge on adaptation to climate variability. Local knowledge has also been exposed to technology and scientific knowledge from outside the community, especially through agricultural extension services in the area. Thus, scientific knowledge has, through 'imported' technologies, already found its way into local practices. Local knowledge was developed mainly in relation to rainfall variability, and has shown to be a major tool in adaptive practice. Arguably, the livelihood practices in Onkani have not been constant over time, but been adapted to changing environmental and socio-political conditions. Given that Ovambo societies have always been confronted with climatic fluctuations and extremes, their way of life as a whole is highly adapted to these. This also means that the composition of livelihoods has been adapted to changing circumstances. For example, wild foods appear to have decreased in significance to livelihoods contribution in the past decades, whereas the importance of fish has considerably increased.

As livelihoods traditionally rely on three pillars, risks are substantially spread. While all three livelihood components depend on rainfall, it is unlikely that all of them fail in the same season. Rather than adapting a single livelihood to climatic shocks, adaptive capacity in Onkani is built by sustaining a variety of livelihoods as a safety net. While different livelihoods are practiced parallel, the emphasis shifts depending on the rainy season. Both in drought and flood years, livestock tends to gain in importance concerning food security. Adaptive capacity in the community is furthermore built on different scales. Besides a wide variety of technological adaptation, there are (mainly informal) institutions forming a safety net in case of shocks. The strong social nets include the extended families living in urban areas.

The example of Onkani shows how vulnerability can result from a complex interplay of climatic and non-climatic factors. An overall assessment of the community's vulnerability is extremely difficult. On the one hand, there are many findings supporting a strong adaptive capacity to climatic and non-climatic stressors. On the other, some findings leave strong doubts whether the community will be able to buffer increased climatic stress in combination with other stressors in the future. A factor alleviating the community-specific vulnerability of Onkani is the provision of tap water in the village. However, it has to be kept in mind that tap water provision is neither fully reliable nor affordable for all community members.

A major factor contributing to vulnerability in Onkani is the high dependence of livelihoods on moderate precipitation. There are very few economic activities in the area which are not related to climatic factors. At this point of time, there are virtually no meaningful alternatives to subsistence agro-silvo-pastoral livelihoods. Therefore, the ability to buffer crop and livestock failures through alternative sources on income is very low. Vulnerability is unequally spread in the community. Poor households are frequently deprived of livestock and tap water access. Therefore, their ability to spread risks is considerably lower compared to better-off households. This is why they are considered most vulnerable to climate change.

The high livestock densities in the area make grazing lands vulnerable to degradation. Farming and livestock keeping are very central to the identity of the locals. There are major social assets related to cattle ownership. Cattle are used to enhance social relations, and distributing one's herd to different locations is a fundamental component of risk spreading. Cattle are also used as a last resort to draw on in emergencies in the research area. Thus, cattle do have a tangible value in Ovambo societies, which goes far beyond what is frequently simplified as the social status associated with its ownership. Apart from the discussion on the use value of cattle, there is a broad consensus among villagers that the area is overstocked. This, in turn, is said to increase competition for grazing lands, and substantially limit the productivity of livestock. In particular the combination of high stocking densities and migration to the area was held accountable for this issue. As grazing land is communal, there are no use restrictions in place. Independent of the role livestock plays in Ovambo culture, the current regime of rangeland management is widely perceived as problematic in the community. The scenario is similar to the one outlined in Hardin's (1968) 'Tragedy of the Commons'. Technological adaptation may mitigate the problem, but beyond a certain point, the land will not be able to sustain livestock densities. In order to avoid land degradation and a decline in the benefits derived from livestock, the current institutional mechanisms around rangeland management may have to be revised.

An indicator for social change in Onkani is the increasing recognition of women in the community. While household heads in Ovambo societies are traditionally male, half of the surveyed households in Onkani were lead by females. This pattern is likely to be (at least partly) related to male migrant labor, which has drawn many males to the cities. This gives rise to the assumption that there is an ongoing process of social change in the research area.

In conclusion, the ability of local livelihoods practices to cope with climate change in combination with non-climatic stressors remains ambiguous. Even though endogenous knowledge and practices showed to be highly dynamic to changing environmental and socio-political conditions, the local institutional arrangements exhibited a lacking capacity to manage the increasing competition and scarcity of some common pool resources in the area.

4. Adaptation as an intervention

Chapter 3 has exemplified how adaptive capacity is built endogenously. In contrast, the main objective of this chapter is to analyze the approach of the ongoing community-based adaptation project in Onkani. As there is relatively little experience with adaptation projects, this case study seeks to gain insights in how the overlapping concepts of adaptation and development are combined on the ground. The project in Onkani is implemented by OIKE, a community-based organization. OIKE has written the project proposal in cooperation with one of the donors, the Small Grants Programme. Thus, the adaptation project in Onkani is not an intervention project in the narrower sense. To a great extent, the project is planned and implemented by a community-based organization, but it is financed and backed up by an international development institution. Firstly, the cooperation in the proposal writing process is analyzed. The translation of international donor agendas to local practices is the central point of analysis. Then, the ongoing and planned project activities are presented. The activities are divided in technological, educational and institutional aspects. The view which OIKE members have of adaptation and development (and how this perception shapes the project approach and activities) is analyzed. It is then examined in which aspects the adaptation project differs from a rural development approach. Lastly, the institutional capacity of OIKE is discussed, and how the adaptation project contributes to building adaptive capacity to climate change in the community.

4.1. Project proposal writing process

The national framework of community-based adaptation was presented in Chapter 1.7. It was discussed that the background on Namibia's climate change context is provided by the Initial National Communication to the UNFCCC. Community-based adaptation stresses the need to incorporate climate change considerations in bottom-up development. The Small Grants Programme has issued guidelines for community-based adaptation, and financially supports pilot projects in different developing countries. OIKE is the first organization which started such a pilot project in Namibia.

The proposal for the ongoing adaptation project was written by OIKE, but received support from the staff from the Small Grants Programme. It is crucial to note that the first impulse to write the proposal came from OIKE. The community-based organization had initiated a project outline focusing on rangeland management. This outline was taken as a basis for the first draft of the community-based adaptation proposal. However, the rangeland management component of OIKE's original project ideas was no longer followed in the proposal for the community-based adaptation project. In fact, none of the activities addressed in the initial and the final proposal relate to rangeland management. As the original project idea had not been compiled in a document, this analysis is limited to the process from the first to the final project proposal.

Supporting local organizations in the proposal writing process is an idea established in the Community-based Adaptation Country Programme Strategy (SGP, 2008). The process was furthermore guided by a so-called Vulnerability Reduction Assessment (VRA) – a rapid appraisal of climate change risks and adaptation needs in the community. This assessment is a tool propagated by the UNDP community-based

adaptation program. In Onkani, the VRA was held in September 2008 in cooperation with staff from the Small Grants Programme. Public meetings were held by OIKE in two of the four communities taking part in the pilot project. The main objective of the meetings was to get input from different community members and hear their needs and concerns in regard to adaptation. Based on the outcomes of these meetings, OIKE wrote a project concept. Even though OIKE members have repeatedly stressed that the proposal is a product of the ideas of all members, the coordinator of the organization played a key role in this writing process. The final proposal states that after initial community meetings, the “(...) OIKE Committee requested the coordinator (...) to compile the draft concept as well as the overall concept.” The coordinator worked as ‘extension community support officer’ under an earlier project by the Desert Research Foundation Namibia (DRFN), and has functioned as a link between OIKE and external institutions ever since. Even though she has moved to the community comparatively late (in the mid 1990s), she is a well-respected individual in the community. She is the only OIKE member with a higher education degree, and one of the few who speak English. These capacities give her a special status in the community-based organization. Firstly, she can communicate directly with the staff of the project support from the Small Grants Programme, and secondly she is the only local person able to formulate the proposal in English.

After OIKE’s project concept was accepted by the Small Grants Programme, they received a planning grant of US\$ 2,000 to arrange the project in more detail. OIKE issued a first draft in May 2008 and sent it for revision to the Small Grant Programme’s National Steering Committee and the UN Office for Project Services (UNOPS). The further process cannot be clearly reconstructed based on the data. Since the proposal was written in cooperation with the Small Grants Programme from an early stage, it is extremely difficult to state which ideas came from OIKE in the first place, and which ones were suggested to them. However, comparing the two versions, it is clearly shown that the first draft proposal issued by OIKE underwent major revisions before it was approved. This results from a comparison of the first draft and the final proposal. Both drafts contain activities on rainwater harvesting, maintenance of hand-dug wells, and soil and conservation. The first draft, however, also included environmental education in schools, and targeted young villagers to implement specific project activities (Amaambo, 2008). These aspects are not found in the final proposal. Instead, the final proposal included activities on climate change awareness and sharing lessons learned (Kalenga, Amakutsi et al., 2009). Both the draft and the final proposal state the key goal as follows: “The objective (...) is to increase community-level capacity to be able to adapt to climate change through implementation of sustainable agricultural practices (...)” (Amaambo, 2008; Kalenga, Amakutsi et al., 2009). In the final version, many activities are elaborated and the climate change ‘angle’ is emphasized to an increased degree. For example, the first draft describes the local perceptions of climate change, namely increased stress on livelihoods by frequent droughts since the 1980s and floods since 2007. In the final version of the proposal, this local perception is complimented by a section which adds scientific knowledge, and puts climate change in a national and global perspective. Furthermore, the language, style and lay-out of the draft were substantially adjusted for the final version.

Many ideas of the Community-based Adaptation Country Programme Strategy (outlined in Chapter 1.7) are clearly reflected in the project proposal. First of all, the geographical and sectoral focus on smallholder agriculture in the NCRs was set by

this paper. This may explain why the original rangeland management focus did not enter the proposal. Moreover, some of the priority activities suggested by the paper are part of the proposal – in particular rainwater harvesting and climate change awareness campaigns. The strategy paper furthermore suggests to link livelihoods with land degradation risks. In the proposal, this is addressed through soil conservation and forest protection. Two aspects of the strategy paper are addressed less explicitly by OIKE: linking adaptation to poverty reduction, and adaptive management. Income generation is only marginally addressed in the proposal, however, poverty reduction is indirectly tackled by activities such as improving water access. OIKE members stated to be unfamiliar with these guidelines of the Country Programme Strategy, however, the proposal writing was conducted in cooperation with the institution who issued them. This explains how the ideas of the strategy paper have found their way in the proposal.

In conclusion, the joint proposal writing process described above shows that the Small Grants Programme functioned as a mediator between local perceptions and ideas around adaptation and global adaptation discourses. The role of OIKE was to compile local perceptions and concerns, which were issued by the community in public meetings, in a project outline. In principle, the Small Grants Programme assisted OIKE in translating these local perceptions and concerns, and refined the project proposal. In the translation process, the conceptual ideas of the Small Grants Programme on community-based adaptation were integrated as well. Without the assistance of the Small Grants Programme, OIKE would have hardly been able to write a proposal eligible to the standards of international funding bodies.

4.2. Project outline and activities

An overview of the CBA activities in the proposal was given in Chapter 1.7. Here, the planned activities are described in depth – based on the proposal and group interviews with the OIKE management committee and members. The activities were categorized in technological, institutional and educational aspects. The two ongoing activities, i.e. rainwater harvesting and climate change awareness, are described and analyzed in depth. The remaining activities had not been started when this research was conducted. Therefore, the description of these activities is based on the way they are planned rather than on observation of their implementation.

4.2.1. Technological aspects

In the first project phase, rainwater harvesting is the main activity. It also serves as an umbrella for other activities which depend on water availability, e.g. home gardening. Rainwater harvesting activities were started in September 2009 in Onkani. In the first year of the CBA project, rainwater harvesting has been planned to be conducted at several pilot sites. With the technique used, rainwater from a corrugated tin roof is channeled to a plastic container via gutters and pipes. As a corrugated tin roof is a prerequisite for the pilot sites, there are few private households who are able to take part in the piloting. To avoid the overreaching of wealthy households – which are usually the ones who can afford brick houses with corrugated tin roofs – OIKE pilots mostly at public sites, e.g. the school in Onkani. Until October 2009, water containers of 5,000 liters for rooftop rainwater harvesting were delivered at four schools – one

per pilot community. The installation of the containers was the responsibility of the schools.

OIKE also plans to harvest surface runoff rainwater at two pilot sites. The idea is similar to the catchments found at the cattle post: to enlarge a natural depression and thereby enhancing the water inflow and storage capacity. The planned runoff rainwater harvesting sites are designated to benefit the individuals engaged in home gardening. Irrigated home gardens are planned as an income-generating activity. As rainwater harvesting just started as a pilot project when this research was conducted, it is not possible to make an assessment of its success in contributing to overall water availability in Onkani at the given point of time.

The other main technological aspects are soil conservation, improvement of the hand-dug well infrastructure, and forest conservation. The main goal of soil conservation is to combat erosion by planting trees. Erosion occurs mainly in flood years. Furthermore, soil fertility and soil management shall be improved. OIKE is considering conservation tillage as a possible technology. The project seeks to maintain hand-dug wells and improve the current well infrastructure by developing new techniques (e.g. minimizing evaporation by covering wells). Since tap water is neither accessible to everyone, nor always available, hand-dug wells are safety resorts for virtually all citizens of Onkani. In order to avoid further degradation of forest resources, OIKE wants to cooperate with the Directorate of Forestry. At this point of time, it is unclear whether they want to protect shrublands or reforest degraded sites.

All of the described technologies are piloted within the project. The idea of piloting is to experiment with possible solutions, and let households adapt these technologies according to their needs and abilities. The project proposal does not elaborate ideas on the adopting of piloted technologies in the post-project phase. This means that locals have to adopt the piloted technologies without further assistance. While some activities – such as runoff rainwater harvesting and hand-dug wells – rely on locally available technologies, rooftop rainwater harvesting requires materials which are not locally available. These materials include water containers, gutters, and corrugated iron roofs, and are relatively costly according to local standards. The 5,000 liter water containers bought for the project cost N\$ 4,000 (US\$ 543). As a comparison: the minimum monthly wage for farm workers in Namibia amounts N\$ 860 (US\$ 107) (Shejvali, 2009). As discussed in Chapter 1.6.1, most of the herders at the cattle posts receive only a fraction of this. The project does not intend to make the piloted technologies affordable after the project intervention. Given the local income level, such constructions are a high – if not unattainable – investment for most citizens of Onkani.

4.2.2. Institutional aspects

The final proposal stresses the need to build “(...) capacity of OIKE to continue to lead the community in terms of managing water and soil (...)” (Kalenga, Amakutsi et al., 2009). In the first project phase, OIKE seeks to improve their institutional structures and working environment. As a first step, they want to equip their office with writing supplies. This shall facilitate their capacities in project planning and reporting. The acquisition of a cell phone shall facilitate communication with external partners. Due to lack of electricity, computer literacy, and funds, computing is out of reach for OIKE at this point of time. In September 2009, several OIKE members

received a two-day training on accounting. As financial administration is a key task of OIKE, its members stated that it was crucial to improve their capacities in this respect. Even though OIKE receives the funding step by step over a two-year period, they did not handle monetary amounts of such dimensions before. OIKE also received a workshop on participatory monitoring and evaluation in October 2009. To get new ideas for possibilities to develop agricultural practices, three OIKE members went on a one-day exposure trip to different commercial farms along the Etunda Canal in the north-western part of the region. In the course of the project, more such activities are planned. OIKE members uttered that before tackling certain activities (e.g. soil conservation) they want to exchange ideas with other projects who experiment with it.

By sharing lessons learned with policy-makers, OIKE seeks to raise awareness on the need for adaptation in rural poverty reduction programs. Moreover, an exchange of experiences and practices with other community-based projects is planned to support a learning process on adaptation in the NCRs. The meetings with OIKE revealed that at present, the members do not have a clear idea of how some of the planned activities will be implemented in the future. Neither was there a definite view or consensus on which goals were pursued with certain activities. For example, when enquiring about the goals of soil conservation, OIKE members did not agree whether the primary objective was to prevent erosion, increase soil fertility, or to enhance forest cover. This may be partly explained by the fact that they were supported by the Small Grants Programme in the proposal writing process. Another aspect is that OIKE roughly outlined the activities in the proposal, but develops a detailed implementation plan in the course of the project. Thus, the approach of OIKE is rather to learn by doing than extensively planning ahead. In summary, improving OIKE's institutional capacities to conduct the project is planned to be an integral part of the project.

4.2.3. Educational aspects

Raising community awareness on climate change and the need for adaptation has been a key concern expressed by OIKE. In cooperation with external support, OIKE also wants to develop an awareness package for schools in the area. The 'Natse Otweya' Community Toolkit plays a major role in this context. The toolkit is a workbook to communicate climate change and its potential impacts on livelihoods to subsistence users in the NCRs (IECN, 2008). It consists of a set of community 'tools' to conduct a baseline assessment of climatic and non-climatic stressors. Not all of the tools specifically relate to climate change. However, as part of the toolkit, the outcomes of these tools are discussed in a climate change context in order to determine which stressors experienced in the community are related to climatic patterns. The toolkit was applied in five community workshops in Onkani from September – October 2009. The workshops were facilitated by the author and a translator. To compliment the workshop outcomes and observations, an evaluation of the toolkit was held together with the community in September 2009.

The basic message of the toolkit is that future rainfall will be more irregular than in the present. The toolkit gives examples for possible adaptation technologies (e.g. rainwater harvesting and aquaculture), and stresses the need for community organization (e.g. collective land use planning) (IECN, 2008). Thus, the toolkit propagates both the need for adaptive technologies and institutional arrangements to facilitate adaptation. As an introduction to the climate change thematic, the toolkit

suggests a ‘community – expert exchange discussion’. Concerning the climate change awareness training, the toolkit does not seek to strongly include the perceptions of locals. The remaining part of the toolkit aims at fostering a community process to find out about the specific context and problems of the community. Thus, this section strongly integrates local perceptions. The biggest section of the toolkit is dedicated to climate change awareness. This section outlines the causes of climate change, as well as its most likely scenarios (i.e. rising temperatures and increased occurrence of droughts and floods). The uncertainty of climate change events is mentioned, but not particularly stressed. Participants stated that the training was a rare opportunity to access such information in the remote village. However, it was also shown that some participants had unrealistic expectations of the impact the toolkit can make. At the beginning of the workshop, one participant stated the following: “I am very happy that we receive this workshop, so we know how we have to adapt our livelihoods to climate change.” This statement revealed that some villagers expected the awareness workshop to present ready solutions to adapt to climatic stressors in the area. Since adaptation has to be fit to local scale (Adger, Arnell et al., 2005) and the regional climate projections of the area are highly uncertain (Dirkx, Haeger et al., 2008), the toolkit cannot live up to these expectations. The statement does, however, lead to the assumption that a part of the community relies on expert knowledge to solve the local problems. From this background, participants may have perceived that the toolkit did present solutions to the local concerns. This assumption is fueled by the fact that there was a wide consensus among participants that the climate change awareness training was the most useful part of the toolkit.

The exercises to establish common ground on the community context (such as preparing a village map and a seasonal calendar) were evaluated positively. The exercises were well understood, and performed in lively interaction of the participants. Parts of the toolkit which were perceived less useful had been an analysis of underlying causes of vulnerability, and an appraisal of possible ways to overcome these vulnerabilities. The observation and outcomes of these exercises showed that the complexity was inappropriate for the locals. In particular working with relatively abstract terms such as ‘primary and secondary causes’ and ‘effects’ showed to be difficult and therefore did not produce meaningful results. For example, when conducting this exercise, participants mixed up the following terms: causes, effects, problems and solutions. For example, one group chose to work on the problem “lack of livestock medicines” for this exercise. The underlying causes of this problem were specified as “need of a vaccination point” and “need for trainings on vaccinating livestock”. Thus, the participants specified needs to solve the problem rather than analyzing aspects underlying the problem. Even though the results gave some insights in what problems and needs participants perceive in the area, it provided very limited insight in the chain of underlying causes and effects of the problems encountered. Participants also stated that they did not see how these exercises related to climate change and adapting their livelihoods, and thus how they could benefit from them. This perception may have been boosted by the fact that the workshop facilitator was a researcher at the same time. Therefore, participants may have thought that the ‘Community Toolkit on Adaptation’ was a research tool.

The public evaluation revealed some other shortcomings of the toolkit application. For example, some workshop participants complained that it was not properly clarified how to assemble the information collected and use it to build concrete adaptation strategies and activities. OIKE members stated that they did not clearly

understand how to use the gathered information as input for their adaptation project. This means that there were difficulties linking theoretical findings on the problems experienced in the community with possible adaptation strategies. This leads to the assumption that the didactical methods of the toolkit are not optimally suited to the realities and demands of rural dwellers. Since many OIKE members (who have experience with development projects) had difficulties to grasp some of the tools, it is likely that other communities will experience similar difficulties – or more.

4.3. OIKE's view of adaptation and development

In Chapter 3.2, it was discussed that many interviewees had expressed concerns about detrimental impacts of climate change on their livelihoods. OIKE members stated that there is a strong need to improve local livelihoods in the area, and decrease the susceptibility to climatic shocks. They see climate change as one of the many stressors Onkani residents are confronted with. In Chapter 3.1.3, it was discussed that there is a wide variety of climatic and non-climatic stressors which impact livelihoods in Onkani. From the discussions with the OIKE management committee, it can be stated that climate change is considered an additional stressor on top of the already high exposure to fluctuating rainfalls and other stressors. As OIKE's main objective is development (Kalenga, Amakutsi et al., 2009), adapting local livelihoods to increased climate variability is considered an indispensable component of development – but not the only one.

OIKE certainly does not have a strong theoretical background on adaptation policies or the scientific concepts of adaptation and rural development. Neither do OIKE members know details of possible climate change scenarios and the state-of-the-art of climate science. However, they have a different access to climate change impacts, as the exposure to climatic stressors is a key influence on the livelihoods of every citizen of Onkani – as discussed in Chapter 3. Besides technological improvement of current livelihoods, the project also shows to be open to new livelihoods options, e.g. selling agricultural products via the combined home gardening and rainwater harvesting project. Thus, there is awareness that adaptation is not necessarily limited to adjusting current livelihoods to new climatic conditions, but may also imply a shift to new ways of income or subsistence.

When enquiring on concrete project activities, OIKE members often said that they did not know how they were supposed to be implemented in detail, because the community had to decide what they wanted. So, basically OIKE decided on a rough set of adaptation activities, but leaves the elaboration and implementation to the group of people who take charge of certain parts of the project. Thus, OIKE leaves its members room to interpret adaptation within the project: the organization strongly relies on the input and efforts of the community members to realize the project objectives. An example shall clarify this procedure. In the initial project stage, OIKE decided to pilot runoff rainwater harvesting. An OIKE member from Onkankaa village (which is not connected to the tap water infrastructure) uttered the need for improved water availability in the dry season. OIKE agreed to designate this site as one of the pilot areas. The techniques of runoff rainwater harvesting were discussed at an OIKE meeting, however, without going into much detail. The implementation has been entrusted to the given OIKE member residing near the designated pilot site. This member will implement runoff rainwater harvesting in Onkankaa in cooperation with

other residents of this village, while OIKE is not directly interfering in the project activities. Thus, concerning runoff rainwater harvesting, OIKE seeks to find technological solutions by experimenting.

4.4. Climate change adaptation specific aspects of the project

Most of the planned adaptation activities discussed above could also be framed within a sustainable development project. Given the high climate variability in the area, climatic stressors need to be taken into account by any kind of rural development project. Therefore, activities as rainwater harvesting or soil conservation can be framed as contributors to development in Onkani – be it in a climate change context or not. It also has to be kept in mind that adaptation and development are overlapping concepts in many aspects (Lemos, Boyd et al., 2007). Here, it shall be examined which activities clearly incorporate clear climate change consideration.

Especially the first draft of the proposal resembles a rural development project with rudimentary relation to climate change. This can (at least partly) be explained by the fact that even though locals have observed changing rainfall patterns, there is a low awareness of the existence of a global phenomenon called climate change. This finding was presented and discussed in Chapter 3.2. Given that rainfall is the most important determinant of livelihoods in the area, another possible explanation may be that locals perceive fluctuations of rainfall so obvious that they automatically assume it is considered in the activities. The project does not plan to make use of climate change scenarios or seasonal climate forecasts. The baseline for what to adapt to is established in the proposal, and further information is provided by the toolkit. The scenarios that OIKE prepares for is flood and drought occurrences – which is, as discussed in Chapter 3, what Ovambos have always had to cope with.

The relation of the project activities to climate change was weaker in the first draft of the proposal. Rhetorically, climate change aspects are strongly integrated in the final proposal, especially in the project framing. When looking at the concrete activities, however, the adaptation aspects of the project are not particularly striking. Rainfall variability (and how to deal with it) is a central theme of the project, however, as discussed earlier, this is a natural phenomenon in the NCRs. Rainwater harvesting can be clearly linked to coping with water scarcity, a phenomenon which is likely to exacerbate under climate change. The same accounts for the maintenance of the hand-dug well infrastructure. According to the OIKE management committee, the awareness training with the ‘Natse Otweya’ toolkit aims at understanding the implications of climate change, and thereby fostering an understanding of the need for adaptation in the community. As the activities of soil and forest conservation have not been clearly defined in the project, it is not possible to determine their relation to climate change. In the proposal, soil conservation is framed in relation to soil erosion. Since an increased frequency in floods is a likely climate change scenario, soil conservation could have also been framed as an activity to build adaptive capacity.

Development agents such as UNDP put great emphasis on cooperation and sharing knowledge and practices on adaptation. This was also strengthened by the fourth Conference on Community-based Adaptation in February 2010 in Dar es Salaam (IIED, 2010). Even though this may be relevant for any rural development project, it is argued to be especially important to adaptation, which has been on the agenda of development cooperation for a relatively short period of time. OIKE members stated

that learning from other projects and awareness raising among policy-makers is the most important aspects of sharing their lessons learned (Kalenga, Amakutsi et al., 2009).

4.5. Building adaptive capacity within the project

This section analyzes how the project cooperation of OIKE and the Small Grants Programme contributes to building adaptive capacity in Onkani. OIKE as the implementing institution is the focus of the analysis.

The overall ability of the project to contribute to building adaptive capacity in the community is ambiguous. Strong points of OIKE as an implementing institution are the trust they enjoy in the community, and the many years of experience they have in working with development projects. Basic institutional structures have been established, e.g. the role of the management committee, or decision-making procedures. OIKE is not shaped by a rigid set of rules, but by the commitment of its members. Even though OIKE has many years of experience in development projects, their role in the current venture is more essential than before. On local scale, they are the key decision-makers, implementers and financial administrators of the community-based adaptation project. Therefore, adaptation to OIKE also means developing capacities as an institution to be able to run such a project. As OIKE is the implementing body, the members need novel skills, e.g. accounting and reporting. Such trainings are given via the Small Grants Programme when requested by OIKE. The institutional capacities built will remain available to OIKE after the support from the Small Grants Programme and the Japan International Cooperation Agency (JICA) ceases. The cooperation with the Small Grants Programme furthermore is a learning process for OIKE, e.g. in terms of project planning and implementation. The Small Grants Programme, in turn, benefits from the lessons learned which are generated by the project. This knowledge can be used to improve the conceptual framing and technical support of other adaptation projects.

Most OIKE members are females in their forties and above. The community workshops were frequented by approximately 90% women. Based on the collected data, it is not possible to give a clear explanation for this. Some community members stated that development projects are frequently perceived as targeting especially women. Even though there is no evidence that the past intervention projects in Onkani focused particularly on women, this belief has made its way to the community. Apart from the fact that there may be other possible explanations for this phenomenon, the gender distribution of OIKE is likely to have implications on the institution as such. As women are deeply rooted with their children and families in Onkani, the risk of a 'brain drain' caused by the gain of capacities is considered to be relatively low. Thus, the capacities that OIKE develops in relation to project management will most likely be available in the community after the external financing ceased.

The OIKE management committee consists mainly of the more educated or well-off citizens of Onkani. A possible explanation for this is that the poorer community members have to struggle harder to sustain their livelihoods – and thus less time for other activities, such as participating with OIKE. Another explanation could be that the higher educated citizens are also more aware of the opportunity and value of participating in a community project. However, as argued before, any citizen is allowed to become a member of OIKE. There are no signs that individuals or groups

who wanted to become members have ever been discouraged or not allowed to do so. Therefore, the risk of a ‘tyranny of participation’ (Ribot, 1999) is assumed to be relatively low. The traditional authorities furthermore have a say in any far-reaching decisions made within the community. This furthermore limits the possibilities of a certain group to gain disproportional influence in Onkani. Nonetheless, the fact that the project does not specifically target poor households bears the risk of neglecting equity issues in building adaptive capacity. Incorporating the heterogeneity of a community was identified a crucial aspect to ensure equity in rural development projects by Agrawal and Gibson (1999).

Even though the project is approved by the traditional and governmental authorities, it does not explicitly link up with existing institutions and structures, e.g. the agricultural extension and the water point committees. The agricultural extension offers different trainings, but according to the extension technicians, the attendance is low, and most workshops are held with low participant numbers. Most of the interviewed households know about the existence of the agricultural extension office, and those who had attended trainings usually stated that they had been useful. There may be manifold explanations why the services offered by the agricultural extension receive so little attention. It has to be kept in mind that agricultural extension services mediate between science and political interests. Thus, they do not convey value-free knowledge, but frequently represent the government’s interests, e.g. in regard to the desired agricultural development (Cash, 2001). What is most relevant in relation to the adaptation project is that there is potential in cooperating with the agricultural extension. As many project activities relate to agriculture, an interactive exchange with the extension could be beneficial. For example concerning home gardening, OIKE could benefit from the trainings on the topic given by the extension technicians.

Sharing lessons learned from the project in Onkani may contribute to raising awareness among policy-makers and thereby putting adaptation on the political agendas in the long run. Even though awareness as such does not guarantee ‘right’ actions, it is a first step toward addressing the broader societal inequalities underlying vulnerabilities. To sum up, it has to be acknowledged that within a two-year community project, only a number of issues can be addressed. Therefore, there are major risks in the area which are not tackled by the current project (e.g. decrease in livestock productivity caused by overgrazing).

4.6. Conclusions

Even though OIKE originally intended to initiate a rangeland management project, this aspect was left out of the project proposal. This shows that the agenda of the Small Grants Programme (which earmarked grants for agricultural projects) has shaped the contents of the adaptation project in Onkani. This finding supports the assumption that broader development theories influence adaptation projects on the ground. During the implementation phase, however, OIKE operates without direct intervention of the Small Grants Programme. Besides the obligation to regularly report to the donor organization, OIKE decides in which aspects they require technical support.

As the activities include adaptive technologies and broader capacity building, the project seeks to build capacity on different scales. A considerable part of the project consists of institutional capacity building. Even though it may appear to relate less

directly to adaptation, it is considered a crucial component in building adaptive capacity to climate variability and change in the long run. Through improved institutional capacities, OIKE is expected to be able to continue playing a meaningful role in community-based adaptation and development Onkani after the intervention project ceases in 2011.

The piloting approach of the project is based on the 'Community-based Adaptation Country Programme Strategy'. As the piloting does not take into account how technologies can be made affordable for community members after the two-year intervention, the long-term sustainability appears questionable. In this respect, runoff rainwater harvesting seems much more promising than rooftop rainwater harvesting, because it relies on technologies which are available locally. Since rooftop rainwater harvesting includes costly materials which have to be purchased outside of the community, it appears unrealistic that a large group of people will be able to adopt this technology independently.

Climate change awareness in the community is raised with the help of the toolkit. Without a doubt, being aware of climate change is a crucial baseline to comprehend the need for adaptation. However, the workshop experiences described in Chapter 4.2.3 lead to the assumption that the project equalizes awareness with the ability to adapt. Awareness is a climate baseline for adaptive capacity, but it has to be channeled into local action before it becomes adaptive capacity. Furthermore, rural dwellers in the NCRs were shown to have developed livelihoods as a means to adapt to changing social and environmental conditions (as discussed in Chapter 3). Therefore, it is expected that there is a high local level of awareness on the need to adapt to extreme climatic conditions. Even though the toolkit has enabled the communication of climate change science to the local community, OIKE was not able to 'assemble' the information collected on the community context in a way to benefit their adaptation project. Thus, in order to make a meaningful contribution to building adaptive capacity, the toolkit needed to be didactically adjusted and streamlined with local knowledge systems.

Based on the experiences from Onkani, it is impossible to distinguish adaptation from rural development in the NCRs. Thus, for the research area, the need to mainstream adaptation into development can be strongly supported. For the agro-silvo-pastoralists in Onkani, building adaptive capacity means primarily being prepared to deal with extreme weather events. To enable a planning process which integrates future climatic conditions, it may be beneficial to include seasonal climate forecasts and climate change models in the project. However, as a prerequisite, predictions need to be available with a higher reliability and spatial resolution. Given the limitations of the current seasonal climate forecasts (as discussed in Chapter 3.3), they needed to be adjusted to local needs to be useful for rural communities in the NCRs.

Up to this point, endogenous and exogenous adaptation have been discussed as separate entities. While operating in the same community, it appears highly likely that the two distinct forms of adaptation interact. The following chapter seeks to discuss this interface.

5. Discussion and conclusions

5.1. Discussion

The final chapter aims at bringing the findings of Chapter 3 ('Adaptation as an endogenous practice') and Chapter 4 ('Adaptation as an intervention') together. Adaptation in the study area is built both as an endogenous practice and an intervention. While these two forms of adaptation interact, there are synergies and tensions. In some aspects, endogenous and exogenous adaptation integrate well, in others they clash. The main differences were found concerning the following issues: technological innovation, sectors of scope, information input, and institutional and social embedding. Based on these aspects, the integration of local knowledge and perspectives in the project is discussed.

5.1.1. Technological innovation

As discussed in Chapter 3, the endogenous adaptation practices have been mainly developed on a household level. The development of endogenous adaptation is furthermore informal: none of the interviewed agro-silvo pastoralists had attended a formal vocational training in agriculture. The knowledge was passed on from generation to generation. On the contrary, the project puts technological innovation in a more formal context, e.g. through trainings. OIKE is furthermore required to deliver project progress reports. While endogenous adaptation practices were found to be a complex mix of planning and improvising, exogenous adaptation relies much more on the planning component. However, as discussed in Chapter 4.2, the project outlines activities rather than planning them in detail beforehand. Thus, there is a certain improvisational component included in exogenous adaptation as well.

As discussed earlier, local knowledge has already been merging with external knowledge and technologies for decades. The provision of tap water and the introduction of ploughs are examples of technologies which were 'imported' to the community – as opposed to local technologies which are developed in the communities themselves. Different aspects of the adaptation project link differently with the existing local knowledge. For example, the maintenance of hand-dug wells clearly builds on local knowledge, as this activity basically 'revives' an existing practice. Other aspects of the project, such as rooftop rainwater harvesting, introduce novel technologies. Thus, the project uses 'imported' technologies for some activities, and builds on existing local technologies for others. What is newly introduced by the project is the formal sharing of technological innovations within and beyond the community. Endogenous practices, on the contrary, are commonly shared informally and within a smaller geographical range.

As shown in Chapter 3, adaptation practices in Onkani (and possibly in many Ovambo communities) have been developed over long time periods. This clashes somewhat with the short time frames of intervention projects. The two-year financing from the Small Grants Programme is an extremely short period of time when considering the pace of developing endogenous adaptation practices in the community. The piloting idea seeks to overcome this problem by using the project as an impulse for further community mobilization. However, as discussed in Chapter 4.2.1, it is questionable in how far the piloted activities can be adopted independently in the post-project phase.

5.1.2. Sectors of scope

Since a single sector is not able to buffer the droughts and floods already experienced in the research area, spreading risks is a substantial aspect of local practices. The current community-based adaptation project in Onkani has a sectoral focus on agriculture and water. Thus, compared to endogenous adaptation practices, the project is more reductionist. Given the sectoral focus, spreading risks on different livelihoods is only marginally addressed by the project. As discussed in Chapter 3.5.2, Ovambo societies have strongly adapted to changing socio-cultural conditions. In recent years, this was especially shown by the strong contribution of fishing to local livelihoods. The only project component aiming at the establishment of additional livelihoods is home gardening in combination with rainwater harvesting. Naturally, a project with a limited budget and timeline has to set an achievable focus on specific aspects. However, the project approach to tackle specific sectors and activities differs greatly from the broad approach Ovambo societies have taken to cope with risks. Nonetheless, strengthening a specific livelihood sector in an intervention project can complement endogenous risk spreading practices and thereby contribute to decreasing vulnerability.

5.1.3. Information input

As shown in Chapter 3.3, there are local methods to forecast rainfall. In the more recent past, the government has introduced new sources of information, such as weather forecasts and seasonal climate forecasts. As discussed in Chapter 3.3, radios are a commonly used medium in Onkani. In addition, the agricultural extension services provide information on agriculture. Even though this research could not elaborate the links between information input and decision-making on local scale, it supports the assumption that endogenous adaptation incorporates and combines complex information from different sources. This finding is in line with Batterbury (1996), who described dryland farmers as a consciously planned practice using the input from different sources of information. The adaptation project brings global and regional climate models into the community. However, given the great uncertainty of climate models project for the NCRs, the key message is the need to adapt to uncertainty (Dirkx, Haeger et al., 2008). Adapting to uncertainty – especially concerning rainfall – is what Ovambo societies have been doing for centuries (Kreike, 2006). Thus, concerning what to adapt to, endogenous and exogenous adaptation cope with a similar baseline. A difference exists in how information is accessed and shared. Since there are no written records of local forecasting methods, this knowledge is passed orally from generation to generation. On the contrary, the adaptation project spreads information in a formal way, e.g. with the climate change awareness workshop.

5.1.4. Institutional and social embedding

The local arrangements on managing water and land are inherently embedded in local culture. In Chapter 3.4, it was discussed how many of these arrangements deal with scarce resources, which, in turn, are heavily influenced by climate variability. As discussed in Chapter 3.4, commons underlie very few regulations. Both the headman and the counselor have the right to intervene and issue penalties when existing rules and regulations are violated, however, this is reported to occur very rarely. The

interim representatives of the headman described its role as a mediator rather than a ruler. The interview data underpins this perception of the role of the headman. This traditional role may explain why the headman does not interfere in the issue of land degradation through overstocking of livestock. This furthermore leads to the assumption that the current institutional arrangements on common pool natural resources are not likely to cope with the depletion caused by climatic and non-climatic stressors combined.

OIKE is, to some degree, socially embedded in the local community. The community-based organization was established by locals, and all of its members are locals. Nonetheless, OIKE is a comparatively young institution. The Small Grants Programme is a formal institution completely detached from the community. However, the national coordinator of the Small Grants Programme has cooperated with OIKE on earlier development interventions in the area. Thus, the cooperation of OIKE and the Small Grants Programme has a basis of mutual acquaintance and trust to build on. Furthermore, the Small Grants Programme does not interfere directly in the community, as all activities on the ground are conducted by OIKE.

While endogenous adaptation is embedded in every day practices, the project activities follow an additional work schedule. In this context, it has to be considered that all OIKE members are subsistence agro-silvo-pastoralists, thus, the project endeavors are undertaken in addition to these time-intensive livelihoods. This means that the opportunity costs for OIKE members to commit time to project activities are high. A final point worth highlighting in this section is the question in how far OIKE can be considered a boundary organization. Boundary organizations mediate between the shifting domains of science and policy (Cash, 2001). In particular during the project proposal writing, OIKE mediated between national development discourses and local concerns. In order to make local communities optimally benefit from exogenous adaptation, the ability of the boundary organization is considered a key factor.

5.2. Conclusions

In the final chapter, overall conclusions are drawn on how the combination of endogenous and exogenous adaptation in Onkani contributes to building adaptive capacity in the study area. In addition, the contribution of this research to the theoretical concepts and methods is presented. Needs for research are elaborated. The research is closed by giving recommendation to how the generated knowledge can be used to contribute to adaptation research and practice in Namibia and beyond.

5.2.1. Endogenous and exogenous adaptation

In this section, the empirical information on endogenous and exogenous adaptation is used to conclude on the research questions. Concerning adaptation as an endogenous practice, it has been found that the research area is highly exposed to climatic risks, especially extremely high or low precipitation. The overall exposure to risks is characterized by a complex interplay of climatic and non-climatic stressors. The local population of the research area has perceived both an earlier onset of the rainy season, and an increase in total precipitation over the last decade. These local perceptions are in line with climatic records of the region. While higher rainfall is generally

considered beneficial to local livelihoods, the floods of 2007/08 and 2008/09 had strong negative impacts on agricultural outputs in the area. There are local institutional arrangements in place to manage scarce resources such as water. However, grazing land is a common pool resource with very little regulation. The increasing livestock density in the area (mainly caused by human migration) is expected to contribute to land degradation – unless mechanisms to regulate livestock are introduced.

Throughout history, Ovambo societies have been highly flexible in adapting to socio-political and environmental changes. The animal breeds and crop varieties used in the area are highly adapted to extremely arid conditions. Spreading risks on different livelihood components is the main coping strategy in the research areas. Furthermore, livestock is distributed to different areas, including cattle post outside of the village. The traditional agro-silvo-pastoralism tends to get supplemented by commercial activities by a part of the population. Fishing has played an increasingly important role in the past years. Besides relying on different livelihood sectors, social nets form a main component of risk spreading. Social nets consist of the extended family network (within and outside of the region) and neighborly aid, and are particularly drawn on when bottlenecks of food and water supply arise.

Endogenous adaptation provides an ambiguous picture of the overall vulnerability and adaptive capacity to climate variability and change. There are both a lot of strengths, (such as elaborate risk spreading mechanisms and coping strategies) and weaknesses (e.g. structural limitations and strong dependence of livelihoods on moderate rainfall).

Exogenous adaptation in the research area is practiced as an interactive cooperation of an international donor organization and a community-based organization. Conceptual agendas of the donor have shown to have influenced the approach and contents of the project proposal. Nonetheless, the local implementing body and the community at large were actively involved in the proposal writing process. The donor agency has functioned as a translator between global agendas and local concerns. OIKE does not only mediate between the project assistance and the local community, but also implements the project activities on local scale. In that phase, there is little direct interference of the donor organization, however, technical support is provided where demanded. The project seeks to address adaptation by building adaptive capacity concerning technologies, institutional development, and awareness raising. A limitation identified is that the long-term effectiveness beyond intervention time frames is not considered sufficiently in the project planning.

As there is naturally high climate variability in Namibia's NCRs, the climate change specific aspects of the project are difficult to pinpoint. Therefore, building adaptive capacity to climate change or climate variability is barely distinguishable. In the context of areas with a naturally high susceptibility to climatic extremes, building adaptive capacity to climate variability and change both imply the need to develop institutions and strategies to cope with weather extremes.

A risk of adaptation interventions – even when they are facilitated by local organizations – is that they function parallel to endogenous practices without directly complementing them. Such a lack of integrating intervention activities in local practices is likely to cause an efficiency loss and even a mismatch.

It furthermore appears difficult to match the expectations of international donor organizations to deliver within a relatively short time frame with the necessity of

communities to develop adaptation at their own pace. As endogenous adaptation practices have been developed over long periods of time, short time frames of intervention projects are expected to be greatly limited in effectiveness.

Adaptive technologies which are piloted in intervention projects can only be effective when the adoption pathway after the project is considered. With ‘imported’ technologies, this means that it has to be considered how they can be produced locally, or made affordable for the local population. Incorporating local knowledge to develop adaptive technologies is considered most effective, because it suits the context and links with local knowledge systems.

Incorporating local knowledge systems in intervention projects also implies building on the extensive social and material safety nets maintained by local communities in northern central Namibia. These safety nets provide an effective structure that intervention projects can build on. It is expected that that exogenous adaptation has a limited efficiency unless it builds on local endogenous knowledge and practices. Even though climate change awareness is a crucial baseline for adaptation, it does not necessarily lead to adaptive capacity as such. Awareness is not a catalyst of change unless it is taken one step further and incorporated into building adaptive capacity in terms of technological and institutional development. Community-based organizations can function as boundary organizations who mediate between policy, science and local communities. In this regard, building adaptive capacity may mean to considerably strengthen the abilities of boundary organizations to manage uncertainties and moderate adaptation processes on different scales. Thus, climate change is expected to require an adaptation of local institutions. Concerning endogenous adaptation, this may imply revising and re-negotiating current arrangements on issues such as resource use. Exogenous adaptation should consider strengthening the role of local institutions and knowledge. Given the global nature of climate change, exogenous adaptation poses a considerable challenge concerning the translation of global policies and programs to local practices, and – from the opposite perspective – the translation of local concerns into global policies and research. Community-based boundary organizations are considered most suitable to mediate such a process on local scale.

5.2.2. Contribution to methodologies and literature

When analyzing local knowledge to cope with climate variability and change, it is considered extremely useful to take a broad approach and address the collectivity of livelihoods practices. Addressing a single sector bears the risk of neglecting the material and social safety nets in place to cope with climatic extremes. Since local knowledge on adaptation may be unexpected, hidden or difficult to access and understand for outsiders, ethnographic approaches and ‘being there’ (i.e. spending sufficient time to get to know the community context) are considered very useful for data collection. Following the theory that culture as such is an adaptive tool, it is considered beneficial to include historical data on the evolution of livelihoods practices of the given ethnic group. This follows the ideas of Orlove (2005), who described culture as an adaptive tool. Such analysis can facilitate the comprehension of adaptation as a dynamic process. Furthermore, an idea of the time spans of endogenous adaptation processes can be developed.

Many remote communities have experienced the ‘import’ of technological innovations, such as ploughs or fertilizers. In this regard, local knowledge and technologies strongly interact with global science – which exemplifies the ideas put forward by Agrawal (1995). The way these technologies were adopted by the community members may give insights on how non-local technologies are locally adopted and adjusted to local needs. Furthermore, the way such technologies have found their way in the communities (e.g. through trade or agricultural extension services) can provide important insights on enabling factors and pathways of technology adoption.

Local knowledge to cope with climatic extremes can be used as a proxy to assess adaptive capacity in the future. Empirically downscaled climate models at fine resolutions can provide some baseline knowledge to assess the future performance of existing coping strategies. Even though climate change projections do not enable local communities to adapt as such, they can provide some baseline support toward what to adapt to. This way, the risk of devaluation of local knowledge presented by Schipper (2006) can be approximated. However, due to the great uncertainties of future socio-economic and political states in the country or region, such assessments can only be approximations of future vulnerability and adaptive capacity.

Dividing adaptation and development can prove very difficult, in particular in areas where climate variability is already high without the additional pressure of climate change. In such areas, climatic patterns can be so entwined with livelihoods provision that it is virtually impossible to tell adaptation and development apart. Thus, for specific geographic regions, the need for mainstreaming development into adaptation proposed by Huq and Reid (2004) can be taken one step further. In areas with strong dependence on specific climate patterns (e.g. precipitation), both adaptation and development mean building adaptive capacity to multiple stressors – whether these stressors are climatic or non-climatic.

When analyzing both endogenous and exogenous adaptation, it is crucial to gain in-depth knowledge on the role of local institutions which manage such processes. Climate change may not only bring new challenges in terms of changing climatic conditions as such, but also new challenges to local institutions to incorporate additional information. Therefore, the ability of institutions to conduct adaptive management is a useful concept to approximate capacities to manage the novel challenges of climate change. This strengthens the arguments put forward by Lemos, Boyd et al. (2007) who emphasized the need to build appropriate institutions in the unique context of climate change. When exogenous adaptation comes into play, local institutions may additionally be challenged by the interaction and cooperation with the donor organization. Such challenges are not of climatic nature. Therefore, institutional abilities to build adaptive capacity may be, in some way, detached from what adaptation practices in the narrower sense imply. This adds a new consideration to what institutional capacities in relation to adaptation are. The abilities of local institutions to manage intervention projects on adaptation can be analyzed similarly to the way boundary organizations have been dissected. Since exogenous adaptation requires a translation process between science, policy, and local communities, it may be useful to look at local facilitating bodies as boundary organizations. This research exemplifies that it is not only necessary to build adaptive capacity across institutional scales, as put forward by Adger, Arnell et al.(2005), but also to mediate between the scales.

5.2.3. Research needs

In this section, the most urgent research needs identified in this thesis are presented. As there are few case studies analyzing how adaptation is practiced by local communities and intervention projects, a larger body of knowledge is required. In particular the interaction of endogenous practices and intervention projects is a critical research need, as this can provide knowledge on how these domains can cooperate to build adaptive capacity. With a rising number of adaptation projects, it will be beneficial to analyze the entire time frame of the intervention.

To back up adaptation projects, empirically downscaled climate change models are needed to provide more clarity to local communities concerning what future climatic state to adapt to. In this context, there is also a strong need to improve the quality of SCFs, as this could greatly facilitate agricultural decisions of local farmers. To render SCFs useful for local communities, it is necessary to determine which characteristics are needed, both in terms of scientific content and manner of communication. This research should furthermore be backed up by studies on how rural dwellers interpret SCFs, and how this information is incorporated in agricultural and other livelihoods practices. This leads to the broader research need to analyze how information systems such as SCFs are linked to decision-making practices in rural communities.

Since climate change may require novel livelihoods options, there is a need to research on feasible options for the biogeographic region of interest. Such assessments should go beyond climate scenarios, and include non-climatic patterns and projection, such as demographic development. A useful baseline to develop adaptation technologies could be to increase the understanding of how technological innovation is built endogenously in local communities. This knowledge could be used to choose technologies for piloting which fit to local realities, and have realistic potential to be adopted after the intervention ceases.

Community-based organizations have been identified as potential boundary organizations. Therefore, it is crucial to research which institutional characteristics are most central to mediate between science, policy, and local communities. As boundary organizations in an adaptation context facilitate between global and local science and policies, there may be specific challenges to consider.

5.2.4. Recommendations

The final section of this thesis presents the practical implications of the research, and gives recommendations on how the findings can be used to support further research and development practice. There are ample possibilities to improve community-based adaptation projects toward greater social equity and environmental sustainability. First of all, the 'social safety nets' which have been developed in many remote communities are strongly recommended to be used as baselines for intervention projects. For example, the existing social nets could be enhanced by establishing community insurance schemes or emergency funds to buffer extreme climatic events. In order to counteract land degradation and thus overall vulnerability, it is recommended to address adaptation in an integrated sustainable land management context. Single adaptation activities bear the risk to be ineffective if adaptive capacity is not built in a broader context. Livelihoods diversification (especially income-generating activities) is furthermore recommended to be a major consideration in this

context. As risk spreading and livelihoods diversification are key mechanisms of endogenous adaptation in Namibia's NCRs, building on this knowledge can substantially contribute to strengthening local safety nets.

It is strongly recommended to establish longer project phases for adaptation projects. When intervention projects are given in the hands of community-based organization, it cannot be expected that they run at the same pace as projects which are run by full-time staff. There are considerable opportunity costs for the local population which have to be considered in project phases. Piloting is considered a useful approach, but it is recommended to give some guidance or support in the post-project phase – e.g. subsidized technologies or community platforms to exchange experiences with technology). When piloting 'imported' technologies, it is crucial to work toward making them affordable in the post-project phase – or enable local production. As adaptation often needs solutions carefully fit to local scale, participatory technology development may have considerable potential. The strength of participatory technology development is that the process focuses on creating local solutions to the locally encountered problems.

Many African regions are characterized by high climate variability – even without the additional impacts of climate change. For such regions, it is often difficult – and possibly irrelevant – to separate adaptation from development. Fostering development for such regions means building adaptive capacity to climatic and non-climatic stressors. Even though it is important to incorporate climate change scenarios as far as available, non-climatic stressors need to be considered likewise to meet local concerns. Even though awareness raising on climate change is an important baseline, it is considered crucial to clearly link information dissemination to practice. Remote rural communities often have different, less intellectualized approaches to incorporating information in decision-making. Therefore, awareness on climate change may not necessarily lead to an improvement of adaptive practices. It is recommended to explicitly work on linking climate change awareness to developing adaptation practices.

Given the potential of community-based organizations to take the role of a boundary organization, it is recommended to target such institutions, and build on their existing capacities. Exogenous adaptation can benefit from the local organization's knowledge, networks, and embedding in the community. Therefore, building institutional capacity toward adaptation includes is recommended to be a key goal of exogenous adaptation. As climate change poses additional challenges on development, it is necessary to allocate grants on top of the existing Overseas Development Aid funds.

Given the little experience with adaptation projects, sharing knowledge is considered crucial. Therefore, it is strongly recommended to foster a regular exchange of different adaptation projects. Even though adaptive technologies which work in one community may not necessarily be suitable for another one, a lively exchange of project ideas can be greatly stimulating and avoid the continuous 'reinvention of the wheel'. Regional and national platforms on community-based adaptation could facilitate such knowledge exchange. Such platforms could be furthermore used to enable a dialogue between local communities, policy-makers, and scientists. This, in turn, can serve as a first step toward improving the enabling conditions for community-based adaptation projects.

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Annex

Namibia rainy season outlook 2009/2010 (Namibia Meteorological Service, 2009)



REPUBLIC OF NAMIBIA
MINISTRY OF WORKS TRANSPORT & COMMUNICATION
METEOROLOGICAL SERVICE DIVISION

NAMIBIA RAINY SEASON OUTLOOK FOR OCTOBER TO DECEMBER 2009 AND JANUARY TO MARCH 2010

Highlights: The outlook for Namibia for the period October to December (OND) 2009 region 1 is expected to receive normal to below normal rainfall while region 2 is expected to receive below normal rainfall. January to March 2010 indicates below normal rainfall over Namibia (see maps below).

SUMMARY: October to December 2009 most of the western parts of Southern Africa Development Community (SADC) will have an increased chance of receiving normal to below-normal rainfall with the exception of extreme west of Angola, northern Mozambique, bulk of Malawi and eastern parts of Zambia which are expected to receive above-normal rainfall. The eastern part of SADC is likely to have an increased chance of normal to above-normal rainfall. Eastern Madagascar and Mauritius have an increased chance of normal to below-normal rainfall.

January to March 2010 most of continental SADC, Madagascar and Mauritius are expected to receive normal to above normal rainfall. Southern parts of continental SADC is expected to receive normal to below normal rainfall.

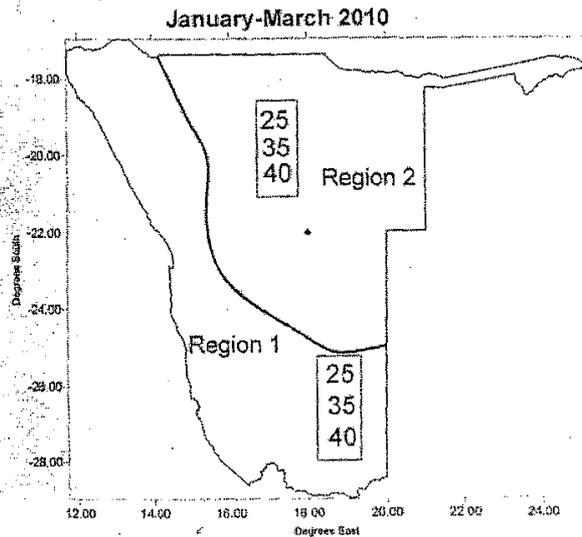
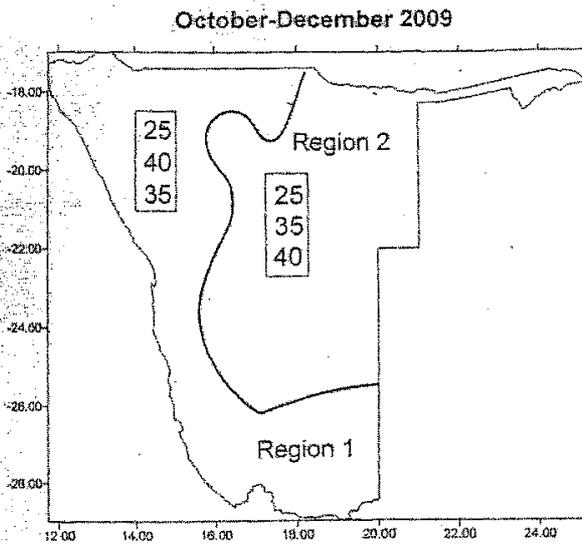


FIGURE CAPTION

It is emphasized that boundaries between regions should be considered as transition areas. Forecast information is provided only for countries that comprise the Southern Africa Development Community (SADC) region. The numbers for each region indicate the probabilities of rainfall in each of the three categories: below-normal, normal and above-normal. The top number indicates the probability of rainfall occurring in the above-normal category, the middle number is for normal, and the bottom number is for below-normal. For example in the case Figure 1, for Region 1, there is a 25% probability of rainfall occurring in the above-normal category; a 40% probability in the normal category; and 35% probability in the below-normal category. The total of the three categories used in the probabilities is always equal to 100%.