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ADAPTING TO CLIMATE CHANGE

A Tool to Support Water Supply Planning

WATER RESEARCH COMMISSION

ABOUT THIS PUBLICATION

This publication is compiled from the Water Research Commission (WRC) Research Report entitled *THE ROLE OF LOCAL COMMUNITY INSTITUTIONS IN THE ADAPTATION OF RURAL AND URBAN COMMUNITIES TO THE IMPACTS OF CLIMATE CHANGE ON WATER ACCESS AND USE* (WRC Report No. 1963/1/14) by R Dube, B Maphosa and J Scott-Goldman.

It is written primarily for Water Services Authorities (WSAs) and Water Services Providers (WSPs) – those who take responsibility for water access and use within their areas of jurisdiction – to give them a vision for planning for climate change within their water services development plans (WSDPs) and the integrated development planning (IDP) process.

The document provides an understanding of climate change and its expected impact on water access and use, showcases the Hydrosoft Climate Change Adaptation Framework (HCCAF) developed through the course of the research for use by WSAs and WSPs, and provides results from a piloting of the HCCAF in four case study areas. The HCCAF software accompanies the Report.

To obtain the full WRC Report No. 1963/1/14 and / or the HCCAF software contact:
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ACRONYMS

CCAM	Cubic Conformal Atmospheric Model
CSIR	Council for Scientific and Industrial Research
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DWA	Department of Water Affairs [now DWS]
DWS	Department of Water and Sanitation
GCM	Global Climate Model
GIS	Geographical Information Systems
HCCAF	Hydrosoft Climate Change Adaptation Framework
IDP	integrated development plan
IPCC	Intergovernmental Panel on Climate Change
LHWP	Lesotho Highlands Water Project
NGO	non-governmental organisation
SAWS	South Africa Weather Services
WRC	Water Research Commission
WSA	water services authority
WSDP	water services development plan
WSP	water services provider
UN	United Nations
UNFCCC	United Nations Framework Convention on Climate Change

1 INTRODUCTION: CLIMATE CHANGE AND THE RESEARCH

There is indisputable evidence that the global climate is changing (Arnell, 1996). While mitigation of climate change is vital, the reality is that all countries are already affected, and developing countries are experiencing the worst impacts This calls for urgent adaptation. Even if Greenhouse Gas concentrations stabilise in years to come, some impacts from climate change are unavoidable, with such impacts mainly occurring through water (UN, 2009). Despite the resolve by many nations to mitigate further climate change, there is evidence that our climate will become hotter and more variable long before we are able to slow down or reverse the current trend.

Climate change is expected to increase the incidence of droughts and floods. Both of these extreme events are known to lead to loss of life, damage to private property and public infrastructure, as well as disruption of people's livelihoods.

There is consensus among scientific bodies that the average surface air temperature of the earth increased over the last century, and that it will continue to do so over the current century by between 1.1°C and 6.4°C (IPCC, 2007a). The finer details of climate change, however, remain uncertain since there are a number of factors that still cloud the certainty of climate change data and information.

Climate change over future decades is predicted through the use of Global Climate Models (GCMs). These atmospheric and oceanic models analyse the global circulation of air masses and ocean currents as they respond to solar and thermal energy input.

The purpose of the research was to investigate the capacity and role of local government and others in the adaptation of rural and urban communities to climate change impacts on water access and use. Then to develop and pilot in four case study areas a generic framework (tool) for institutional support to communities to adapt to climate change. The Hydrosoft Climate Change Adaptation Framework (HCCAF) was developed through engagement with case study communities and institutions to check their understanding of climate change, and the nature of their water access and use. It was then tested in the case study areas for usefulness and applicability across different contexts.

2 EXPECTED CLIMATE CHANGE IMPACTS

The IPCC fourth assessment report (IPCC, 2007a) states that the entire African continent is projected to warm up during the 21st century, in all seasons, and faster than the global average.

Investigations of projected temperature changes using various GCMs and applying the Cubic Conformal Atmospheric Model (CCAM) (a variable resolution GCM) showed that the temperature for southern Africa will generally increase. The magnitude of increases will range from zero to as much as 6°C by the year 2100.

Climate change in South Africa is expected to cause temperature increases all over, with the lowest increases along the south and east coastal areas. The CCAM projections using various GCMs further indicate that higher rates of temperature increases of up to 4°C could possibly be experienced in the north-eastern parts of South Africa.

Climate change is projected to cause significantly increased precipitation in areas receiving orographic rainfall in the north-east and south-eastern coastal areas. In the rest of the country comprising the interior and western coastal part of the country largely receiving convective rainfall, however, the increases due to orographic rainfall will not occur. Impact of climate change on stream flow is also expected to vary in response to changing rainfall.

The South African Risk and Vulnerability Atlas (Department of Science and Technology, 2010) states that climate change poses three major risks to our nation's water resources:

- Increased incidence of drought due to extreme rainfall incidences.
- Increased incidence of floods due to the high incidence of very heavy downpours.
- Increased risk of water pollution linked to erosion, disasters and algal blooms.

3 ADAPTATION TO CLIMATE CHANGE

3.1 Adaptation as part of ongoing water resource management

Population growth, urbanisation and industrialisation have increased water consumption and now demand ever more sophisticated water resource management. It follows then that, whereas mitigation of climate change is new, adaptation is an extension of on-going processes which include rainwater and fog water harvesting, and reduced water demand.

Poor communities will suffer the worst impacts of climate change, and yet have the least potential to cause or influence it. The focus in such communities should, therefore, be adaptation rather than mitigation.

Adaptation decisions are made at various levels, with the lowest level of adaptation being the household level, followed by the community. Other levels at which decisions are made include governmental and non-governmental entities at various levels.

3.2 Approaches being developed in South Africa

South Africa, already a semi-arid country, has been identified as one of the countries that could experience chronic water stress by 2025 (IPCC, 2007b). Several initiatives are used in South Africa to deal with climate change and variability. Rainwater harvesting is being used in most provinces to deal with highly variable water availability. Strategies and rainwater harvesting implementation programmes put in place by the government seek to develop rainwater harvesting for identified households, schools and other community groupings around the country, but more especially for rural areas. The programmes, started in 2005, include the installation of tanks to harvest rainfall from roofs, as well as underground tanks to harvest surface runoff for small-scale irrigation.

There is also a drive towards alternative livelihoods less reliant on high volumes of water resources, including the present initiatives for promoting wildlife management and tourism as a source of income for communities in rural areas. Compared to subsistence agriculture, tourism and wildlife are less susceptible to climate change (Ashley and Jones, 2001).

In urban areas, water demand management is practised by all major water boards and municipalities, with a nationwide drive to promote and implement water demand management driven by the Department of Water and Sanitation (DWS). The demand management programme is intended to restrict demand and utilise available resources more efficiently without needlessly requiring more.

South Africa also uses an intricate water conveyance and transfer system to connect all catchments with high water yields. This system of canals, dams, tunnels and large capacity pipes is used to connect catchments across the whole country, and is of major strategic importance in adaptation and coping in regions with very different water availability and use capacities. By means of various treaties South Africa has further improved water availability by using water resources from other countries. In one major example, the Lesotho Highlands Water Project (LHWP) is directly connected to the Vaal River System through a network of tunnels, pipes and pumped water storage facilities. A major asset of the Vaal River System is that it is connected to water supplies for most cities and communities where points for potable water provision and return flows stretch across several catchment areas and river systems.

4 INSTITUTIONAL ROLES IN CLIMATE CHANGE ADAPTATION

4.1 National framework

Adaptation is a development issue that should be taken into account by various ministries and national state departments, as well as by a number of different sectors (e.g. private sector, associations, private institutions and nongovernmental organisations, etc.). Development at the community level usually takes place as a result of development strategies and plans at the national level and, in many cases, the national budget makes provision for such development. Among other functions, local institutions support communities in providing them with or linking them to channels where development can take place. Climate change adaptation in developing countries must always be linked to development initiatives.

4.2 WSAs and WSPs

Institutions such as local and district municipalities responsible for water access and use are considered to be the drivers in using the HCCAF. Each metropolitan and district municipality is already responsible for establishing and implementing a framework for disaster management in their municipalities.

Climate change mitigation and adaptation are issues that are considered under disaster management programmes in municipalities. Local municipalities share the responsibility for water services with district municipalities, DWS, water boards and other private entities such as mines. District municipalities take on more responsibility in rural areas more remote from metros, or when local municipalities have been found to be lacking in capacity.

Municipalities are required to produce IDPs in consultation with all stakeholders in the municipal area. These plans ensure the logical inter-relationship of the plans for different sectors and, through the planning process, priorities are agreed from all the competing demands. IDPs are reviewed on an annual basis and substantially revised every five years. WSDPs are one chapter in the IDP.

The next level of local government is the ward. The Municipal Structures Act (1998) requires wards to have ward committees, whose functions are:

- To ensure and improve community input and participation in governance processes.
- To build partnerships for service delivery.
- To disseminate information to communities from municipalities.
- To identify problems in the ward, and through this structure to bring these problems to the attention of the municipality.

The Local Government Municipal Systems Act (2000) requires that municipalities facilitate community participation in putting together their IDPs and budgets.

Municipalities are also required to carry out vulnerability assessments, and to determine and implement proactive measures before envisaged disasters strike. The vulnerabilities of both rural and urban communities to climate change are widely varied and still poorly understood. Municipalities are generally under-capacitated and not ready to take on the additional burden of supporting climate change adaptation measures. Institutional support for community adaptation to climate change could be delivered with little need to expend additional resources if the adaptation initiatives are built into planned and on-going programmes – specifically through the development of the WSDPs and IDPs.

4.3 Other institutions

4.3.1 NGOs

A number of non-governmental organisations (NGOs) in South Africa are engaged in sustainability, conservation and climate change adaptation work. NGOs' strengths lie in raising awareness, encouraging civil society debate, participation and action. South African environmental NGOs are involved in research, analysis, information dissemination, dialogues, media campaigns and seminars. A number of NGOs are working with communities in practical ways to implement changes to farming methods that anticipate climate change impacts such as reduced rainfall and higher temperatures. Government must harness the skills of these NGOs in supporting local communities with regard to adaptation.

4.3.2 Local civil society organisations

These include rural producer organisations, cooperatives, stokvels, savings and loans groups, and burial societies. A review of 118 cases of adaptation in 46 countries in the United Nations Framework Convention on Climate Change (UNFCCC) database on adaptation shows that most local civil society organisations involved in climate change adaptation tend to be informal institutions rarely recognised or supported by government (Agrawal et al., 2008). It is suggested that external interventions should build on informal processes and recognise them within formal institutions.

4.3.3 Traditional institutions

There are approximately 800 traditional leaders assisted by 10 000 traditional councillors in the country, with over 16.5 million rural people living under the jurisdiction of traditional leaders. The place and role of traditional leaders in South Africa's new democratic political system have not been clearly defined in the Constitution (1996), but traditional leaders fulfill a variety of functions in rural society, including those of presiding officer in customary courts, mediator of disputes, advisor in agricultural and family matters, and guardian of the young, old, infirm and abandoned. Most of all, traditional leaders consider the control of land to be their primary responsibility. Just as traditional leaders have been called on to raise awareness and motivate for behavioural change in relation to HIV/AIDS (Palitza, 2012), so the government could call on traditional leaders to communicate key messages relating to climate change, land use and adaptation.

4.3.4 Private sector

The roles that can be and are being played by the private sector in respect of climate change adaptation for the water sector in South Africa include:

- Undertaking risk and vulnerability assessments on behalf of particular sectors and special interest areas.
- Educating and working with suppliers and consumers to promote sustainable practices.
- Entrepreneurs innovating and developing new technologies required for adaptation.
- Changing engineering and building regulations and specifications.
- Providing venture capital for new climate change adaptation technologies.
- Offering market instruments for managing risk.

5 THE HYDROSOFT CLIMATE CHANGE ADAPTATION FRAMEWORK (HCCAF)

5.1 Defining climate change vulnerability

In developing coping mechanisms and responses to climate variability, communities learn to adapt when some of these changes become permanent as a result of climate change. Over the years communities have managed to deal with disasters, some of which are consistent with the nature of impacts associated with climate change.

An adaptation process requires a full understanding of what vulnerability is and what it entails. In essence, vulnerability relates to an inclination or tendency to be badly affected in risky or hazardous environments (Lavell et al., 2012).

In rural areas communities are most likely to have alternative water sources such as rivers or boreholes, while urban communities generally do not have such alternative sources, which may make them more vulnerable. At the same time, urban communities are almost certainly in a better position to access financial resources and employment opportunities enabling further water provision through private vendors, thus to some extent mitigating their own vulnerability. Vulnerability is thus a complex matter involving an array of variables, and it measures the capacity to manage risks without serious or irreversible losses (UNDP, 2007).

According to IPCC (2001), vulnerability to climate change is defined by three elements: exposure, and sensitivity (which relate to potential impact), and adaptive capacity. Figure 2 below provides the listing of the indicators considered in the Research.

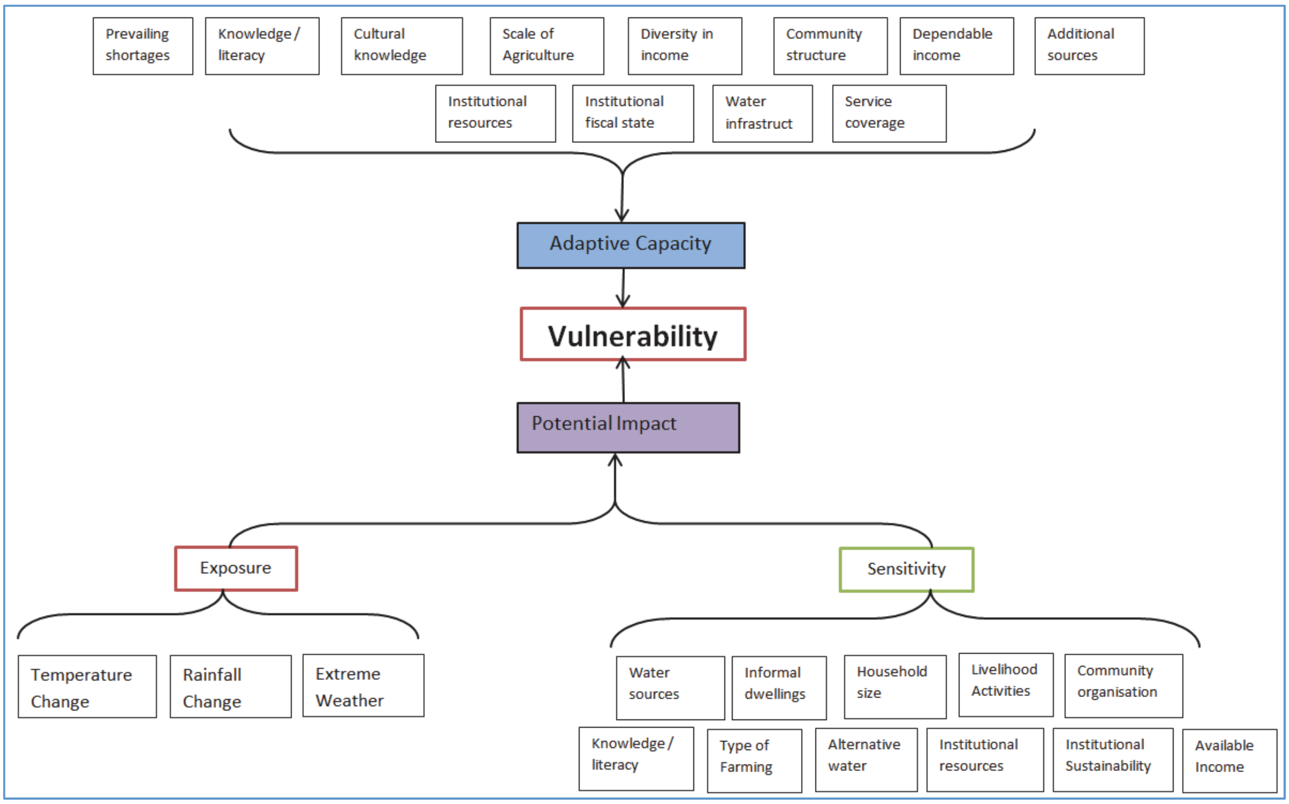

Figure 1: Aggregation of vulnerability indicators (Source: WRC Report)

Exposure

Exposure is a type of direct danger (i.e. the stressor), and the nature and extent of changes to a region's climate variables (e.g. temperature, precipitation, likelihood of extreme weather events) (Gbetibouo and Ringler, 2009). In general terms, exposure relates to the risk associated with the dangers of drought occurrences and extreme events.

<u>Sensitivity</u>

In respect of sensitivity to climate change, the IPCC (2007b) ascertained that this is the degree to which a system is affected, either adversely or beneficially, by climate-related stimuli. Sensitivity to the impacts of climate change plays a major role in society's adaptive capacity, and an understanding of vulnerability alone is thus inadequate as adaptive capacity intertwines with both vulnerability and adaptation (Smit and Wandel, 2006).

<u>Adaptive capacity</u>

Adaptive capacity is intrinsic to the ability of a system to adjust to climate change (including climate variability and extremes), to moderate potential damages, to take advantage of opportunities, or to cope with the consequences. It also represents the potential to implement adaptation measures to help avert potential impacts.

5.2 Development of the HCCAF by the Research Team

5.2.1 Conceptualisation and development

Communities facing increasing water access challenges due to a number of stressing factors, including climate change, need institutional support with well-founded plans. Ideally, these plans have to be based on community needs, vulnerability, nature of challenges, and capacity to deliver, along with many other variables. Quantification of community vulnerability provides the basis for decisions to be made in providing water access support.

Community vulnerability quantification involves identifying the exposure and sensitivities causing vulnerability to climate change impacts, and then converting those stressors to figures which are in turn used to map out the ranges of vulnerability by stressor, per community. Vulnerability mapping encourages improved communication of risks as well as the knowledge of what is being threatened by climate change. The maps improve understanding of the risks and vulnerabilities so that decision-makers and other stakeholders can identify where resources are needed for adaptation. Corrective action can be taken before the impacts escalate into disastrous scenarios.

The quantification of vulnerability is derived from the relationship between the three main variables: exposure, sensitivity and adaptive capacity.

5.2.2 HCCAF software

The HCCAF was developed as a GIS-based tool where the state of water of several communities within an environment of climate change is analysed as a single integrated scenario. In each scenario, the objective is to determine the community vulnerabilities and the nature of adaptation responses suitable for each community. The current state of water, as well as planned water-related developments, is used to measure the vulnerability of each community to climate change impacts with respect to community water access and use.

Determination of <u>exposure</u> is based on three measures of impact. These are changes in temperature, changes in average rainfall, and a measure of extreme events due to climate change. The exposure measurement is based on the Cubic Conformal Atmospheric Model-Commonwealth Scientific and Industrial Research Organization (CCAM-CSIRO) climate change data obtained from the CSIR's environmental group in 2010. Since there are many climate change data models giving varied outputs, the framework allows for the user to change the climate change dataset from which the exposure indicators are derived to generate other scenarios.

The quantification of sensitivity is based on 11 sensitivity indicators derived from various sources, starting at community and municipality levels. The framework allows the user to extend the use to other local municipalities.

Adaptive capacity is described using 12 indicators. Adaptive capacity measurement took into account the capacity of the communities and that of the municipalities responsible for their water access.

The three quantified values are set to be used as the basis to plan and implement adaptation responses for impacts of climate change on water access.

6 THE FOUR CASE STUDIES

6.1 The four areas

Four case study areas were used by the Research Project to gather data to construct the HCCAF, and then to pilot the HCCAF. They were chosen to ensure representivity in terms of the different types of water access opportunities available to local communities, in both rural and urban settings, and in different parts of the country. Other factors considered included ensuring they were in different climatic regions, and had different settlement patterns, livelihoods and population densities.

The four case study areas were:

- Thulamela Local Municipality (within the Vhembe District, Limpopo).
- Msunduzi Local Municipality (within the uMgungundlovu District, KwaZulu-Natal).
- Letsemeng Local Municipality (within Xhariep District, Free State)
- Madibeng Local Municipality (within the Bojanalo District, North West).

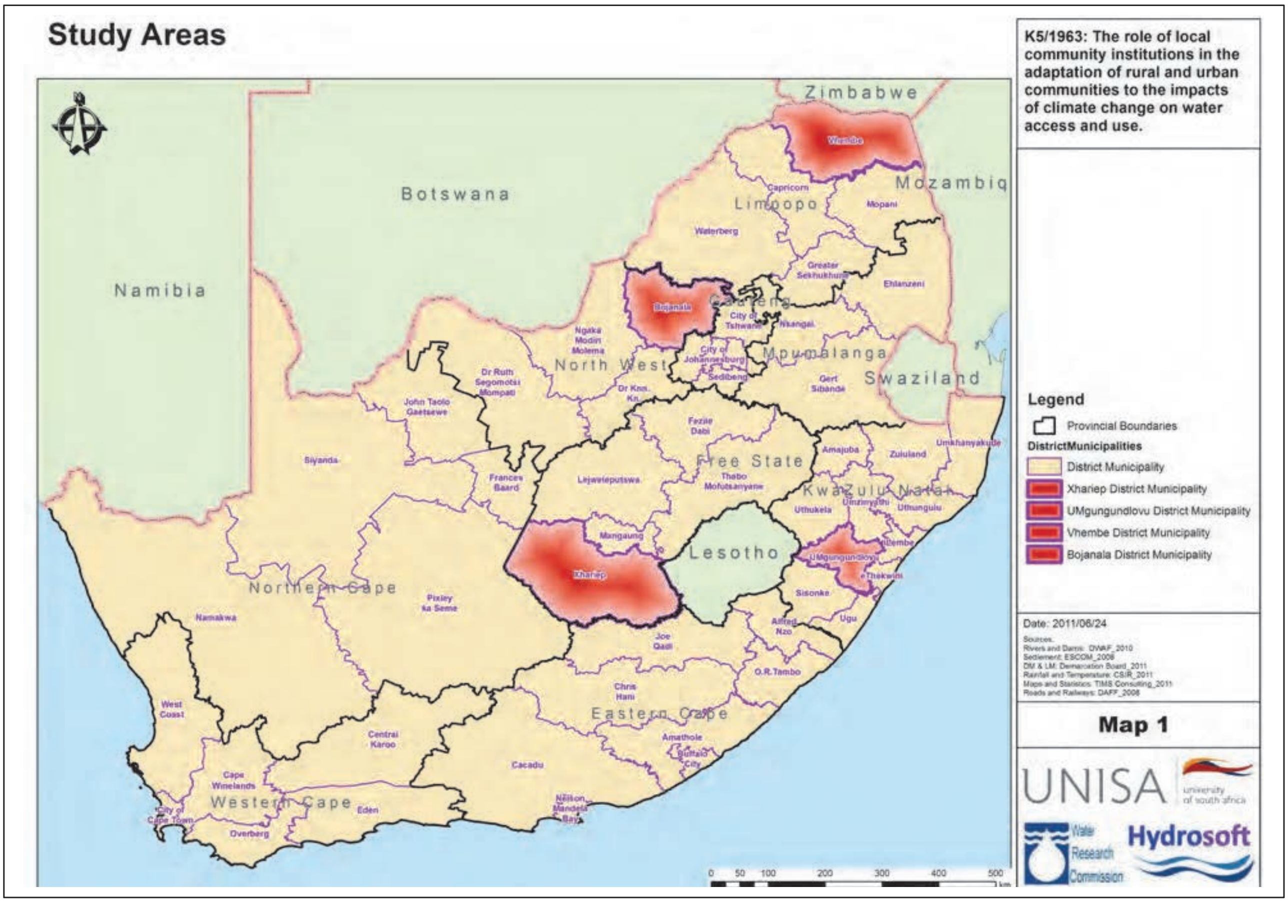

Figure 2: Location of four case study areas

6.2 Location and geography

The Vhembe District is the northern-most district, and borders on two other countries: Zimbabwe to the north and Mozambique to the east. The study focused on Thulamela Local Municipality in the north-east of the district, a mountainous area bordered to the east by the Kruger National Park. The seat of the municipality is the town of Thohoyandou, which is also the seat of the district and the political, administrative and commercial centre of the area. A large percentage of households in the municipality live in formal houses, although the road network is under-developed, with many communities residing far from surfaced roads. Inaccessibility is one of the reasons given for slow progress in the development of water services. The area was historically part of the Venda homeland, and about 90% of its municipal land is still under tribal ownership. About 6% is exclusively owned by the state, with only 4% being privately owned (Thulamela, 2012). Thulamela has a few informal settlements.

uMgungundlovu District Municipality is situated in the far east of the country. It is a mountainous area and remains relatively green all year round as a result of good rainfalls. The study focused on Msunduzi Local Municipality, the seat of which is in Pietermaritzburg, also the capital and the second largest city of KwaZulu-Natal. During apartheid the city was segregated into various sections, with almost the entire Indian population residing in the suburb of Northdale, while most of its Zulu inhabitants were forced to reside in the township of Edendale, where the majority of the population (60%) still live in low-income townships. This municipal area has the highest population density of the four case study areas, with 935 people per square kilometre.

Xhariep District Municipality is just east of the centre of the country and bordering Lesotho. Xhariep is the southernmost district of the province. The study focused on Letsemeng Local Municipality in the southwest of the district. This municipality consists of extensive commercial farmland and five small towns that exist mainly to serve the surrounding agricultural areas. The seat of the municipality is the small town of Koffiefontein. Although most people in Letsemeng live in formal brick houses, there are a few informal settlements in the towns and on several farms. With less than four people per square kilometre, this municipal area has the lowest population density of the four case study areas.

Bojanala District is the eastern most area of the four district municipalities. It borders Botswana on its western border. Bojanala District covers areas which were part of the former Bophuthatswana homeland. The Magaliesberg, a distinct large mountain range, is located to the south with flat bushveld extending northwards. The study focused on Madibeng Local Municipality in the east of the district. A large percentage of the population in Madibeng is located in dormitory towns, historically set up to provide a large pool of labour to the economically active Pretoria-Witwatersrand-Vereeniging area. Given its history as a grouping of dormitory towns, Madibeng, with a population of at least 477 381, does not have urban centres commensurate with its large population.

6.3 Current climate

The case study areas are very different in terms of annual rainfall and winter minimum temperatures, while maximum temperatures have significantly lower differences. Table 1 below shows the winter and summer temperature range for the district municipalities and the current annual rainfall for key towns in the case study areas.

Table 1: Climate of four case study areas (SAWS, 2011)

	Thulamela LM Vhembe DM	Msunduzi LM uMgungundlovu DM	Letsemeng LM Xhariep DM	Madibeng LM Bojanala DM
Winter temperature range	10°C to 23°C	6°C to 23°C	1°C to 20°C	3°C to 22°C
Summer temperature range	20°C to 32°C	19°C to 31°C	17°C to 33°C	17°C to 31°C
Current annual rainfall	608 mm	840 mm	274 mm	685 mm

6.4 Water access, uses and needs

Thulamela suffers from multiple deprivation factors as a legacy of apartheid, and these are undermining socio-economic growth. Water access is but one of those factors. The chief constraint is not water resources, but rather underdeveloped infrastructure to supply bulk and reticulation water. In this municipality, water access is a challenge for a high percentage of the population. To supplement the poor water provision from the municipality, many rural communities are dependent on those few neighbours who have boreholes and are willing to provide them with water at a reasonable cost. The current state of water provision and the state of infrastructure in Thulamela determines the potential of the municipality to deal with climate change, including the support of communities in adapting to those impacts.

Msunduzi seems to have the highest levels of service delivery in terms of sufficient quantity supplied to the greatest percentage of the population. Msunduzi also has the best water quality of the four case study areas. The current capacity of water provision in the municipality of Msunduzi, however, is not adequate and is expected to worsen over time. Early development of the large planned additional water sources and water conveyance systems to supplement water availability in the uMgeni System, or to reduce the need to use water from this system, are key to long-term adequate water access.

Letsemeng, despite its low rainfall, has well-developed bulk water supplies and surface reticulation which adequately serve the extensive commercial farming needs and small domestic needs in the area. The municipality, however, is not managing the water treatment plants effectively, and as a result water quality is not assured. A typical example is Petrusburg, which relies on groundwater and is experiencing periodic water shortages. Letsemeng's future water provision and community access to water depends on the sustainability of water transfers from the Orange River system to Letsemeng communities.

Despite Madibeng having adequate water resources, widespread water infrastructure problems create water access difficulties for many communities using water for domestic use. The municipality is overwhelmed by service backlogs, a maintenance backlog and a backlog in upgrading infrastructure to keep pace with development and population growth. Nevertheless, farmers who participate in water schemes feel that their needs are adequately met. A major problem exists in that water sources within Madibeng suffer from very high levels of pollution. Water provision from Rand Water, and its sustainability in the long term, will reduce the burden of water provision on the otherwise poorly functioning local municipality.

7 IMPACT MAPPING AND FINDINGS IN THE CASE STUDY AREAS

7.1 Introduction

The climate data used was obtained through the Council for Scientific and Industrial Research (CSIR) after being generated by the CSIRO in Australia. This climate change data scenario is referred to as CCAM-CSIRO Mk3.5. It was used to determine the nature of impacts due to climate change. In assessing the changes, the climate data from the period 1961 to 1990 was compared with projected climate data for the period 2071 to 2100.

Over the whole of South Africa, the CCAM-CSIRO Mk3.5 climate change data showed that the temperature in the country will generally increase by about 2°C (Figure 3).

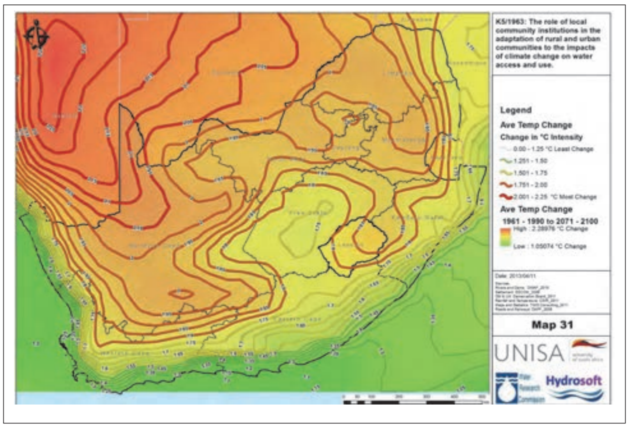

Figure 3: Average temperature increase in degrees Celsius for the period 1961-1990 to 2071-2100

Rainfall is expected to increase over most of the country, with the exception of the south and south-west coastal areas, where a decrease was predicted. This is shown in Figure 4 below.

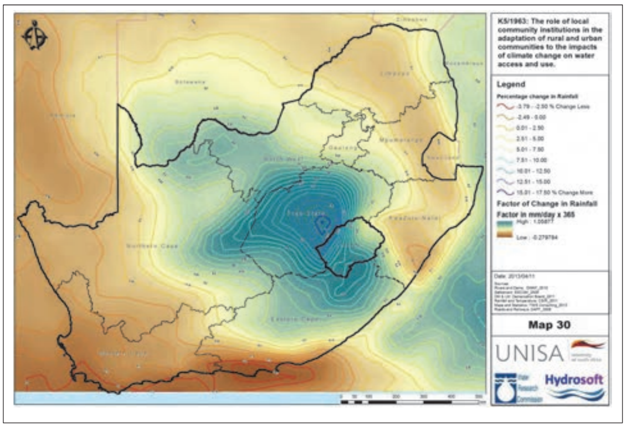

Figure 4: Percentage change in rainfall between 1961-1990 and 2071-2100

The increased rainfall in the Drakensberg mountain peaks will generate more runoff in the Vaal and Orange systems. These river systems, which originate in the Drakensberg highlands, will generate even more water and supplement current usage in the provinces of Gauteng, Free Sate, North West, Mpumalanga, Northern Cape, Eastern Cape and KwaZulu-Natal.

7.2 Findings per case study area

7.2.1 Vhembe: Thulamela

The temperature over the period investigated using the CCAM-CSIRO data set will increase by up to 2°C from the north-east to the south-west of Vhembe district. The increase will represent up to a 7% increase in average temperature for this area, with the implications to water resources being increased evapo-transpiration and evaporation. Rainfall in the Vhembe district is expected to increase by up to 12% over the period investigated. The increase in rainfall will be lowest in the south-west, where overall increase in average rainfall based on daily rainfall predictions will be approximately 6%.

In the analysis Thulamela showed the weakest adaptive capacity. A low adaptive capacity is generally due to low incomes and a poorly staffed local municipality, which serves as the main water provision institution. For the institution to support the local community with water access both presently and in the future, a strong institutional establishment is required. In Thulamela, the municipal institution lacks both administrative and technical human resources, while the need for infrastructure is huge. Additionally, the population is large and dispersed, making it difficult to develop water access infrastructure and connect all the people within this area. All areas in Thulamela are vulnerable to climate change impacts and are subject to problematic water access.

7.2.2 uMgungundlovu: Msunduzi

In the uMgungundlovu District Municipality, temperatures are expected to increase from the southeastern areas to the north-west, with temperatures increasing by as much as 2°C in the north-west. The changes are expected to be generally moderate with a common trend of slight increases along the north-westerly direction. Changes in rainfall seem to be affected by two factors, namely the Lesotho Highlands Project and the movement of ocean currents from the east. Somewhere in the middle of uMgungundlovu, these two factors tend to converge and create areas where there is no change in rainfall. The general trend of rainfall increase tends to suggest that the highest rainfall increases will be experienced in the west of the District Municipality, where increases of up to 6% over the considered period are expected. The areas to the east, where rainfall will increase, are also the areas in which most rivers originate. There is a good chance that the area will experience increased yield in the river systems originating in the eastern to the south-eastern parts of uMgungundlovu.

Msunduzi is an urbanised area with a well established water services infrastructure. However, access to water services is defined by the inequalities of past water provision systems where large areas of Msunduzi Local Municipality, Imbali and Edendale still have poor water provision infrastructure. The majority of Msunduzi’s population reside in Edendale and Imbali, which are historically poorer townships. The analysis showed that while Msunduzi’s water access indicators were on average better than in Madibeng and Thulamela, wards in Pietermaritzburg with a majority of white and Indian inhabitants were much better off compared to township residents. These areas have a high adaptive capacity and low sensitivity to exposure to climate change impacts. The settlement patterns and the concentration of people in this municipality mean that water access issues now and in the future are best addressed by institutions, especially the municipality, uMgeni Water and to some extent the DWS. The area has a small rural community in some wards where access to water is a greater challenge compared to other areas.

7.2.3 Xhariep: Letsemeng

The Xhariep area already experiences low average temperatures compared to the other study areas. The increases in temperature in this area also range up to 2°C. These increases, however, will take place over much lower average temperatures, in which case the percentage increase will be much higher, with up to 15% temperature increase being experienced in the cooler south-western areas. Xhariep district is expected to experience the highest rainfall increases over the period investigated, with increases of up to 17% in the eastern areas and 7% in the west. The largest rainfall increases are expected to take place in areas that include the LHWP. The implications to water resources are that the prospects for higher runoff in the headwaters of the Orange-River system are most likely in the long-term future. As such, there will be more water available for the canal system.

While water provision coverage is generally good in Letsemeng, the study revealed that there were gaps in water provision for informal and low-income settlements. It was noted in the analysis that Letsemeng was the most susceptible area to extreme weather events, especially flooding, due to the nature of the rivers passing through it. Nevertheless, the study also determined that Letsemeng performed well on adaptive capacity and sensitivity. The location of Letsemeng is such that a great deal of water has been made available to communities through developed canal systems. This factor obviously makes it easy to improve water access and achieve service delivery targets. In this area Petrusburg is the most vulnerable town to impacts on water access. The future supply for Petrusburg, however, should be the surface water supplies from the established water conveyance canals.

7.2.4 Bojanala: Madibeng:

The temperature is expected to increase by up to 2°C over the whole of the Xhariep district, but with no discernible trend in the rate of increases in temperature. However, the general temperature at any one time is higher in the north-west than it is in the south-east. The cooler areas closer to Gauteng are usually 2°C to 3°C lower. The rate of rainfall increase shows that the highest increases will be in the north-west, with increases of up to 8% projected between the 1961-1990 and the 2071-2100 periods. In the eastern areas, rainfall will be subject to a smaller average increase of approximately 6%.

The analysis showed that Madibeng suffered from the worst overall exposure and very high sensitivity to climate change impacts. Madibeng communities have few available resources to supplement water provision on their own or other land in order to develop gardens and improve their livelihoods. The HCCAF showed that areas in Madibeng had the poorest scores in a number of water access and adaptation indicators. All communities in the municipality are vulnerable, with a great need for external support from relevant institutions. Townships demonstrated a high prevalence of illegal water connections, which has negative financial water system pressure implications. This has caused tension and unrest within affected communities.

8 CONCLUSION

The issues of climate change and adaptation are only starting to become part of institutional plans and water services delivery. South Africa developed its first national document on climate change only in 2004 (Department of Environmental Affairs, 2004). This document was developed after South Africa ratified the Kyoto Protocol and became a party to the UNFCCC (Department of Environmental Affairs, 2012). A strategy for climate change response in the water sector is, however, being developed by DWS (DWA, 2013).

The HCCAF was developed for capturing detailed information on water access and use, the impacts of climate change on a local community, analysing the sensitivity and adaptive capacity of the community to climate change impacts, and ultimately to derive the vulnerability of the community in question. With the developed understanding of the local community, the framework is used as the platform for determining the most appropriate climate change adaptation options for the community.

It was also developed with the household as the point of first level inputs. As such, the representation of adaptation options is set to target local scales first before aggregating these to broader or more global scales. The adaptation interface allows the user to evaluate the provided adaptation options for a settlement or village, and identify the geographical location of the settlement/village or suburb, including the ward number. At localised scales, some of the adaptation options may not require direct institutional support, while many others will undoubtedly require such support. Adaptation options available for each community have to be appreciated holistically to ensure that the best possible approaches are pursued. This is possible in the adaptation framework, where all possible options are captured and can be presented to communities. This includes sharing the information on adaptation options between communities.

The conceptualisation and functions of HCCAF were based on the premise that adaptation in water access is built on the current state of water services provisions. The HCCAF is designed to present an opportunity to interrogate how climate change adaptation can be part of water services development planning. It was developed to be the link between communities exposed to climate change impacts and local institutions that help them to adapt.

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The WIN-SA lesson series aims to capture the innovative work of people tackling real service delivery challenges. It also aims to stimulate learning and sharing around these challenges to support creative solutions. To achieve this, the lessons series is supported by ancillary learning opportunities facilitated by WIN-SA to strengthen people-to-people learning.

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This document hopes to encourage ongoing discussion, debate and lesson sharing. To comment, make additions or give further input, please visit www.win-sa.org.za or send an email to info@win-sa.org.za.

Our mission is to ensure the body of knowledge in the sector is well managed, readily accessible and applied, leading to improved decision-making and performance, especially of local government.

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