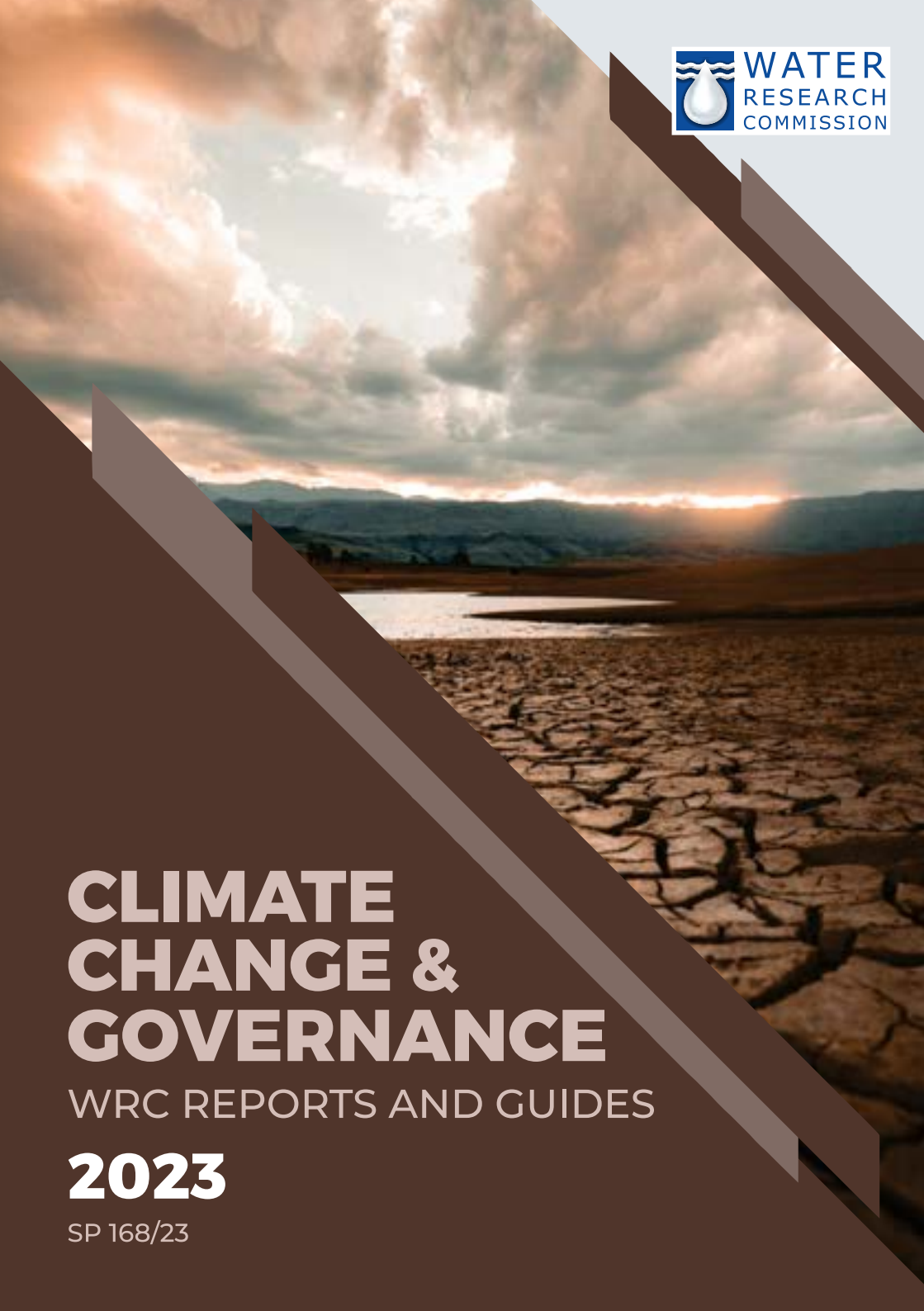

WATER RESEARCH COMMISSION

CLIMATE CHANGE & GOVERNANCE

WRC REPORTS AND GUIDES

2023

SP 168/23

Obtainable from:
Water Research Commission
Private Bag X03
Gezina
0031

SP 168/23
Printed in the Republic of South Africa

INTRODUCTION

Around the world there is growing evidence that the climate is changing and will continue to change, affecting societies mainly through water. Climate change will affect the availability, quantity and quality of water for basic human needs, food and energy production, human health, economic development and poverty reduction, thus seriously jeopardising the achievement of the Sustainable Development Goals.

Climate is already highly variable in South Africa, impacting on both the availability water resources and the reliability of water services. Climate change adds an 'additional layer' of change and complexity and uncertainty to an already challenging environment. Dealing with the challenges of climate change requires increasing the adaptive capacity of water governance regimes. Required are robust strategies that perform satisfactorily under a range of initially uncertain but possible future developments.

The WRC has funded research into the phenomenon of climate change and its impact since its establishment in 1970. In the latter decade, the emphasis has shifted from climate modelling and researching the potential impact of climate change to developing tools and strategies to enhance the country's resilience to the anticipated changes associated with climate change. This booklet focuses on those guides and tools aimed at governance in the era of climate change.

USING CLIMATE DATA TO HELP SOUTH AFRICAN WATER SERVICES INSTITUTIONS IMPROVE WATER SAFETY AND WASTEWATER RISK ABATEMENT PLANNING AND ENHANCE RESILIENCE TO CLIMATE CHANGE AT LOCAL AND CATCHMENT LEVEL

WRC report no. TT 876/1/22 and TT 876/2/22

It is well known that South Africa is facing a long-term water crisis, with recent droughts experienced in the Western Cape and recent floods experienced in KwaZulu-Natal making it particularly challenging for water services institutions (WSIs) – notably municipalities and water utilities to reliably deliver sustainable drinking water and sanitation/wastewater services. WSIs, however, struggle to interpret and incorporate climate data/information into their planning activities as in some cases data/information is not available at a local scale. Additionally, there is very little guidance on accessing, interpreting, and incorporating climate data/information in planning activities. Given the urgency of climate change impacts to South Africa, it is an ideal opportunity to develop and implement an easy-to-use and robust methodology that can empower WSIs to take the necessary first steps to build climate resilience. This is the first of two reports. The second report is ***Integrating climate information in water safety planning and wastewater risk abatement planning: A guidance note.***

Click here to download TT 876/1/22
Click here to download TT 876/2/22

FEASIBILITY ASSESSMENT AND SUSTAINABILITY EVALUATION OF WATER SUPPLY OPTIONS FOR IMPLEMENTATION IN DROUGHT AFFECTED AREAS OF GIYANI: ENABLING RESILIENCE TO CLIMATE CHANGE

WRC report no. 3039/1/22

South Africa is extremely vulnerable and exposed to the impacts of climate change both within its socio-economic and environmental settings. The marginalised and poor are particularly affected by the impacts of climate change. This advocates for a balanced planning and response to climate change while adapting to the new normal. In the South African context, where water resources are fully allocated in most catchments, shallow groundwater and alluvial aquifers of ephemeral (or dry sand bed) rivers are potentially alternative sources of water. This project responded to the primary WRC objective of augmenting drinking water supply, national food security, improving the livelihoods of people in rural communities, and the sustainable utilisation and development of water resources.

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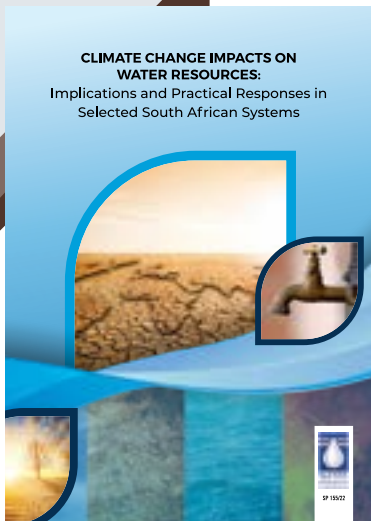

CLIMATE CHANGE IMPACTS ON WATER RESOURCES: IMPLICATIONS AND PRACTICAL RESPONSES IN SELECTED SOUTH AFRICAN SYSTEMS

WRC report no. SP 155/22

The WRC's climate change research programme regularly assesses the role and impact of climate on water resources while also characterising its contribution to climate induced disasters. This programme is implemented through a flagship programme (the so-called Climate Change Lighthouse) which has operationalised collaborative research on priority water-related climate issues with partnerships forged along the innovation value-chain to enhance water research and development to address the water sector challenges in light of the changing climate. The ultimate goal is to ensure empowerment of people and communities to increase resilience, and to develop the knowledge base for climate adaptation and decision support tools, together with guidance and building a framework for sectoral response. Water is critical for development, economic growth and a better life. It is a key factor for inter-sectoral linkages and forms a basis for development. Therefore, climate change impacts on water resources and development cannot be underestimated. The role of this lighthouse in climate change response is embedded within adaptive capacity, resilience, improvement of early warning systems, reduced vulnerability and an improved ability to respond, coupled with proactive planning.

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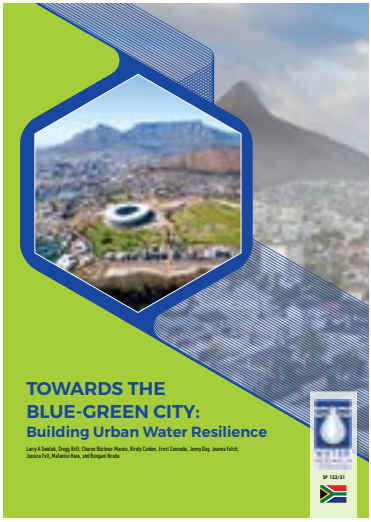

TOWARDS THE BLUE-GREEN CITY: BUILDING URBAN WATER RESILIENCE

WRC report no. SP 153/21

Water lies at the heart of urban well-being, prosperity, sustainability and survival. The most significant urban challenges are a function of water availability: ensuring that a diverse set of users have access to the right amount of water of the right quality delivered at the right time in an affordable and sustainable way is no small feat even for the most well-resourced municipality. Building the water sensitive city requires a collective effort that marshals the insights, interests and resources of all stakeholders. It requires a significant behaviour change at all levels in the value and use of water. Given that water is valued in many ways – as a factor of production, a source of joy and spirituality, a component of leisure, a threat and an indispensable household necessity – reaching appropriate decisions in the service of all requires integrative, reflexive and flexible processes.

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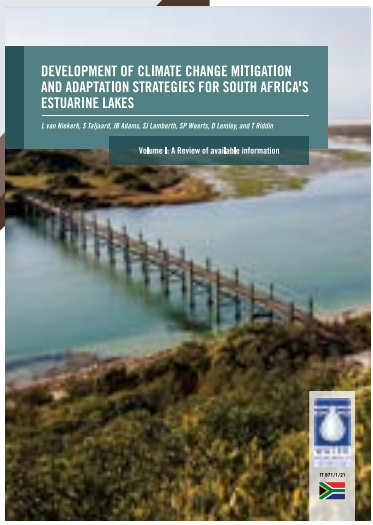

DEVELOPMENT OF CLIMATE CHANGE MITIGATION AND ADAPTATION STRATEGIES FOR SOUTH AFRICA'S ESTUARINE LAKES

WRC report no. TT 871/1-3/21

Estuaries form an interface between the land and sea and are strongly influenced by climatic, hydrological, and oceanic processes. Approximately 90% of South Africa's 290 estuaries are small, dynamic temporarily closed estuaries or seasonally driven predominantly open systems. However, a small percentage (< 4%) are large estuarine lake systems. Ever-increasing anthropogenic impacts on estuarine systems already pose serious threats to the biodiversity and ecosystem services we derive from these ecosystems (e.g. carbon sequestration, flood attenuation, fisheries, provision of sustainable livelihoods, and eco-tourism). Climate change is likely to add to, and possibly exacerbate existing pressures, accelerating the degradation of estuaries. Climate change is a measurable reality and South Africa is especially vulnerable to its impacts. Key drivers of change have been identified as: modification of terrestrial climatic (e.g. temperature and rainfall) and hydrological processes; changes in the oceanic circulation; ocean acidification; sea-level rise; increased sea storminess. However, this study focused specifically on the critical terrestrial climatic and hydrological vectors associated with climate change, and their anticipated effects on the key processes in the estuarine lakes of South Africa, as well as the key biotic responses, and their consequences on the ecological health of these valuable systems.

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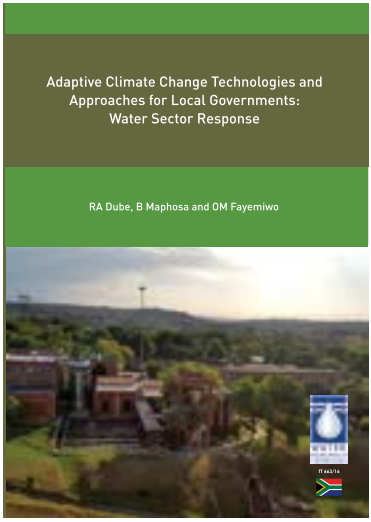

ADAPTIVE CLIMATE CHANGE TECHNOLOGIES AND APPROACHES FOR LOCAL GOVERNMENTS: WATER SECTOR RESPONSE

WRC report no. TT 663/16

Currently, the water sector institutions in the country are overwhelmed with dealing with immediate challenges such as providing potable water of acceptable quality, and extending sanitation provision to unserved communities. However, issues surrounding climate change impacts that will become more pressing in the future are usually not accounted for in municipal plans. Local government institutions, and especially municipalities, are currently looking at how they can address the impacts of climate change as part of their business process. There is very little guidance, however, regarding how this can be achieved, and less so, guidance that is directly linked to their business, location, existing infrastructure, resources and other unique factors. In this research, a water sector adaptation guide was developed. The guide deals with the selection of relevant water sector adaptation technologies and approaches for specific climate change impacts over the short, medium and long term.

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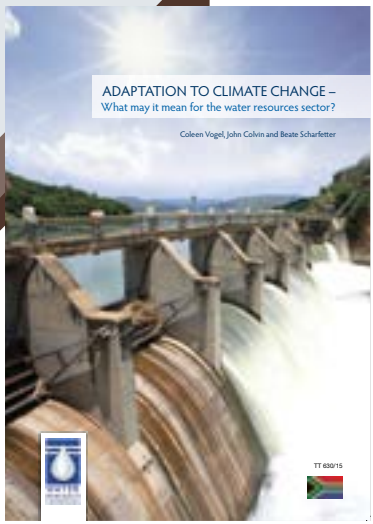

ADAPTATION TO CLIMATE CHANGE – WHAT MAY IT MEAN FOR THE WATER RESOURCES SECTOR?

WRC report no. TT 630/15

Water managers and water users are used to dealing with change (e.g. political change, changing economic conditions and a changing climate, land use and other challenges). Anthropogenic climate change, both in its variability from year to year and in terms of change over the longer term, is now an 'additional factor' that they have to contend with. In this booklet, we illustrate some of the thinking and research that has been undertaken both internationally and locally to enable us to better live with climate risks in the water resources sector in South Africa. This booklet is intended for a range of readers, but with a primary focus on those who broker innovation in the water resources sector. The intention in this booklet is not to provide 'answers' to the wide range of issues confronting the water sector, including dealing with the challenges of climate change. Rather, we wish to stimulate personal reflection and learning as well as wider debate in the sector, by offering thinking and approaches that may add value.

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OTHER REPORTS

CLIMATE CHANGE AND WATER SECURITY: DEVELOPMENTAL PERSPECTIVES FOR WATER-LINKED SECTORS IN A FUTURE CLIMATE FOR AFRICA

The project aimed to conduct a comparative analysis of climate change impacts on future development and economic growth for priority water-linked sectors in the Limpopo River Basin (LRB), South Africa, and the Mau Forest Catchment Basin (MFCB), Kenya. In addition, the project aimed to develop a framework that will guide developmental perspectives for water-linked sectors in South Africa and Kenya under a changing climate.

WRC report no. 3068/1/23

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A NATIONAL ASSESSMENT OF POTENTIAL CLIMATE CHANGE IMPACTS ON THE HYDROLOGICAL YIELD OF DIFFERENT HYDRO-CLIMATIC ZONES OF SOUTH AFRICA

Climate change is likely to severely exacerbate risks and impacts on the hydrological system, the socio-economic system, the ecosystem and livelihoods. In light of these issues, a study was undertaken that entails the assessment of potential climate change impacts on the hydrological yield. This assessment included climate change scenarios for the short-, medium- and long term, their impacts on the hydrological yield and on hydrological responses (e.g. resultant changes in local runoff, accumulated streamflows and recharge), as well as adaptation strategies.

WRC report no. 2833/1/22-2833-3-22

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POST-DROUGHT AND EMERGENCY INTERVENTIONS: TOWARDS HIGHER WATER SECURITY

Despite the frequency of droughts in South Africa, the responses to drought are mostly reactive dealing with drought in an emergency mode rather than it being a normal, recurrent feature. The aims of the project were: identify and review lessons and initiatives from past and ongoing drought periods and major disturbances; verify and test sustainability of implemented initiatives; provide a framework for developing strategic water resilience initiatives at all levels. The case study areas included Nelson Mandela Bay Metropolitan Municipality, Beaufort West Local Municipality and Nama Khoi Local Municipality.

WRC report no. 3005/1/21

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THREATS OF EXTREME WEATHER EVENTS – IMPROVING THE RESILIENCE OF QWAQWA TO THE MULTIPLE RISKS OF CLIMATE CHANGE

To improve the resilience against climate change impacts and to develop efficient coping strategies, new approaches that integrate the assessment of exposure and vulnerability on the one hand, and offer efficient coping strategies on the other, are needed. However, such adaptation strategies must be based on appropriate and reliable downscaled information and include communication technologies with early warning and decision support systems for the population and decision makers concerned. The overarching aim of this project was to understand how the cumulative impacts of successive extreme weather events may affect the exposure and resilience of local communities in QwaQwa and how these impacts may be ameliorated through risk reduction planning.

WRC report no. 3091/1/23 and 3091/2/23

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HYDROLOGICAL MODELLING OF CLIMATE CHANGE IMPACTS FOR DEVELOPMENT OF ADAPTATION STRATEGIES: THE CASE OF LUVUVHU RIVER CATCHMENT, LIMPOPO, SOUTH AFRICA

The Limpopo basin is a semi-arid region of South Africa where rainfall patterns are highly variable, unpredictable and unreliable. One of the major challenges with climate change is its impact on water resources and extreme hydrological events. Extreme events such as droughts and floods, significantly affect important sectors such as agriculture, energy, water resources, among others. There is a need to determine the effects of climate change on water resources to predict the potential impacts on agriculture and domestic/municipal water use. Adaptive responses that reduce vulnerability to current, as well as future climate variability and change, are critical in the context of South Africa's urgent socio-economic developmental needs and

threatened ecosystem services.
WRC report no. 2771/1/20
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CLIMATE CHANGE IMPACTS ON THE SAFETY OF CONCRETE ARCH DAMS IN SOUTH AFRICA

The reality of climate change can no longer be ignored as evidenced by observed temperature increases. In South Africa the temperature increase is projected to reach more than 3°C by 2050. Existing concrete arch dams were not designed anticipating climate change. Therefore, the temperature rise coupled with possible dry or wet weather will progressively lead to the deterioration of the structural integrity of concrete dams. This study has shown that concrete arch dams are likely to be overstressed in future leading to cracking and this may compromise their structural integrity.
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ENVIRONMENTAL MIGRANTS – THE FORGOTTEN REFUGEES AFFECTED BY SLOW-ONSET AND RAPID-ONSET EVENTS IN TWO CASE STUDY AREAS IN THE LIMPOPO RIVER BASIN, SOUTHERN AFRICA

Southern Africa is projected to continue to experience rising temperatures, often resulting in reduced rainfall or drought, which renders communities more vulnerable and therefore increases the likelihood of further displacement and migration across the region. This research aimed to address the dearth of empirical, case study-specific data on the migration, environment and climate change nexus in the southern African region in several ways. The project focused on two countries in southern Africa – South Africa and Mozambique.
WRC report no. 2768/1/20
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IMPACTS OF DROUGHT INDUCED WATER SHORTAGES IN SOUTH AFRICA: ECONOMIC ANALYSIS

Drought is a disastrous natural phenomenon that has significant impact on socio-economic, agricultural, and environmental spheres. The purpose of the document is to: (1) review past studies on the economic impacts of drought in South Africa by economic sectors; (2) outline the approaches used assess the impacts of policy interventions and shocks (including those for assessing the direct, indirect and induced effects of droughts); (3) provide the methodology used to assess the economic impacts of drought in this report; and finally, (4) provide the results and discussions.

WRC report no. 2604/1/18

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TOWARDS GENDER-SENSITIVE STRATEGIES FOR RESPONDING TO CHALLENGES POSED BY CLIMATE-RELATED IMPACTS

Gender specialists contend the gendered nature of climate change discourses. For them, too much attention has been paid to the geophysical, and to the measurement of climate change impacts, without much attention to aspects of quality of life. For this reason, this study shone the torch on the qualitative aspects of human well-being associated with climate change. In so doing, the study was gendered – this means that the project team looked at both male and female responses and considered whether, and in what ways, women's experiences differ from those of men, and secondly, the team looked at the subjective, the qualitative and thus the feminine.

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PLANNING FOR ADAPTATION: APPLYING SCIENTIFIC CLIMATE CHANGE PROJECTIONS TO LOCAL SOCIAL REALITIES

This project bridged the gap between science and society to support community-based adaptation. Hydrologists and climate modellers worked with NGO practitioners to develop, downscale and "translate" scientific projections, based on livelihood and vulnerability information created jointly with pilot communities. NGOs ran community workshops that were specifically tailored around building awareness of climate change and the need for community-based adaptation; exchanging knowledge with communities, including presenting the downscaled climate model projections for their areas; and supporting communities to develop local action plans.

WRC report no. 2152/1/15

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IMPROVEMENT OF EARLY PREPAREDNESS AND EARLY WARNING SYSTEMS FOR EXTREME CLIMATIC EVENTS – FLOOD WARNINGS

This project endeavoured to enhance the early warning system against flash floods in South Africa, which is based on the South African Flash Flood Guidance (SAFFG) system. The SAFFG system models on an hourly basis the likely hydrological response of small river basins to rainfall as estimated in near real time by information obtained from SAWS weather radar systems and the Meteosat weather satellite.

WRC report no. 2068/1/15

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CLIMATE VARIABILITY, CLIMATE CHANGE AND WATER RESOURCE STRATEGIES FOR SMALL MUNICIPALITIES

Water is a limiting resource for development in South Africa and a change in water supply could have major implications in most sectors of the economy. Factors that contribute to vulnerability in water systems in southern Africa include seasonal and inter-annual variations in rainfall, which are amplified by high run-off production and evaporation rates. The majority of climate models suggest a decrease in rainfall over the western part of southern Africa in the coming decades. Based on these projections, the most severe impacts are likely to occur in this region, where small towns and subsistence farmers are most vulnerable. This study investigates the adaptive capacity of small towns and communities in the Northern Cape province to climate variability, specifically drought.

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INFORMING THE RESPONSES OF WATER SERVICE DELIVERY INSTITUTIONS TO CLIMATE AND DEVELOPMENT CHANGES: A CASE STUDY IN THE AMATOLE REGION, EASTERN CAPE

This project aimed to quantify changes associated with near future (2046-2065) climate change and socio-economic development, with inclusion of the uncertainty linked to these changes, in order to develop a decision support system that incorporates these uncertainties. The focus of the project was on the water supply area of two moderate size water boards, in particular, the Amatole system (for the Amatola Water Board area) and the Modder and Caledon River systems (for the Bloem Water Board area).

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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

The task of meeting water access targets for all communities in South Africa is complicated by the general lack of services which continue to dominate the current planning and development agenda. Responsible authorities and institutions are slow and hesitant to include climate change, mitigation and adaptation in their agendas as they battle to deal with the current water access crisis as just one of many other immediate challenges. It is against this background that the study sought to investigate the circumstances which surround water access in communities before dealing with issues of climate change and climate change adaptation in water access.

WRC report no. 1963/1/14

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DEVELOPMENT OF DEFENSIBLE REGIONAL CLIMATE CHANGE PROJECTIONS FOR ADAPTATION AND POLICY

This report addresses issues underlying the critical question "How do I assess the regional climate change information for my sector / location / decision / policy?" This is a nuanced issue, and within this context this report explores the multiplicity of approaches for developing robust regional understanding of climate change.

WRC report no. 2061/1/14

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