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The WRC operates in terms of the Water Research Act (Act 34 of 1971) and its mandate is to support water research and development as well as the building of a sustainable water research capacity in South Africa.

TECHNICAL BRIEF

Climate change

A WRC funded research project has been completed on the evaluation of the sensitivity of socio-economic activities to climate change in climatically divergent South African catchments

In light of projected amplification of the effects of climate variability and climate change on hydrological responses, it is important to increase the ability to respond to change. Adaptation and hence adaptive capacity calls for the ability of responsiveness as well as a continual uptake of new information into decision making processes in order to evaluate the negative effects and potential benefits from climate change.

The three volumes produced through the project

1. An Evaluation of the Sensitivity of Socio-Economic Activities to Climate Change in Climatically Divergent South African Catchments

This volume entails:

- A conceptual framework for mainstreaming climate change into decision-making processes;
- Techniques for the assessment of climate change impacts on estuaries;
- Techniques for assessing impacts of wetlands on hydrological responses under varying climatic conditions;
- Modelling hydrological responses to land use and climate change impacts and their interactions;
- Modelling impacts of scenarios of climate change on runoff responses;
- Concepts of hazards, vulnerability, risk and uncertainty to be considered in adaptive water management under climate change;
- Climate cange and vulnerability;
- An implementable water accounting framework for South Africa, including aspects of climate change and a conceptual framework for decision-making processes.

2. A 2011 Perspective on Climate Change and the South African Water Sector

A summary of key findings of this part of the project yielded the following:

The first is that there is no doubt that climate change poses new challenges to water resource managers in South Africa; with certain areas, especially to the east of the country, projected to get wetter while areas of concern were identified to the southwest of the country, the west coast and, to a lesser extent, the extreme north of South Africa. Results also show that patterns of change across South Africa are often projected to differ between future "average year" conditions vs. future 1-in-10-year wet or 1-in-10-year dry conditions.

Another finding was that the transitional zone between the winter and summer rainfall area in the western interior of South Africa appears to be an area of high sensitivity and of inconsistent change, with the highest ratios of change frequently occurring there.

In general, the results showed an increase in the year-to-year variability of hydrological responses into the future, often a quite substantial increase, especially when inter-annual variability was expressed in absolute terms by the standard deviation. The increase in variability also tended to be higher into the more distant future than between the intermediate future and present.

Patterns of change into the future of certain hydrological variables are not always smooth across South Africa. Often strong gradients of change over very short distances were shown from the analyses, sometimes

even changing from increases to decreases over short distances.

Some components of the hydrological system were found to be more sensitive to climate change than others, sometimes displaying a doubling or more, or a halving or more, of change into the future.

3. **Handbook on Adaptive Management Strategies and Options for the Water Sectors in South Africa under Climate Change.**

This Handbook sets out to create an awareness of potential impacts of climate change, and of the role that everyone should play in the water sector. It aims to introduce a potential pathway and process which empowers the water sector and individuals within it to act in the face of climate change by adapting timeously and adequately. It sets out the importance of climate change in the South African water sector (e.g. already subjected to a high risk climate; changes in rainfall are amplified by hydrological responses; many fragile water dependent ecosystems exist; climate change is superimposed onto already stressed catchments; the many poor are particularly vulnerable to the vagaries of climate and any changes in climate; water related infrastructure has a typical design life well into the era of increasing climate change impacts; water quality has deteriorated and with higher temperatures most chemical reactions will speed up markedly; and climate change can play out very differently at the local level, implying that adaptation also becomes a local issue) – all factors which create vulnerability across many sectors in South Africa.

The book also follows an outline of a framework which has been designed and which is based on the core principles of adaptation, integrated water resource management and social learning. The framework and its adaptive practices could create momentum to pro-actively counteract negative impacts of climate change and derive benefit from positive impacts, thereby reducing vulnerability specifically in the poverty stricken communities of our society. Consequently, it has to assure appropriate ways of dealing with future impacts of climate change, while simultaneously avoiding mal-adaptation, and it should not rely on automatisms of decision takers, i.e. taking decisions just because they have been informed or believe they know the answers. The Handbook concludes by presenting a detailed case study of an adaptation design, using rainwater harvesting under climate change as the example.

On important concepts that thread through the three reports

In the three reports making up the products of this research project concepts such as adaptation, adaptive capacity, risk, vulnerability, uncertainty, governance, frameworks and mainstreaming climate change are frequently used.

Implications on adaptation and adaptive capacity

Addressing strategies to adapt specifically to climate change often appears as an additional burden to water managers. However, the development of adaptation strategies may offer opportunities for reducing vulnerability in many sectors in addition to the water sector, including agriculture, poverty and health, as well as on other changes as yet not fully understood. Important to note, however, that potential impacts of climate change on water resources are still highly uncertain, implying that adaptive capacity is a very important skill to be acquired.

On adaptive management

Adaptation and hence, adaptive capacity, call for the ability of responsiveness as well as a continual uptake of new information into decision-making processes in order to evaluate the negative effects and potential benefits from climate change.

Consequently, a transition into a pro-active, adaptive management approach is imperative. It calls for a highly integrated management concept at catchment level, based on sound understanding of the interdependence of different key factors such as economic and human needs, environmental requirements and management capacity under climate change conditions. IWRM's responsiveness allows the incorporation of features of adaptive management, thereby increasing adaptive capacity.

More specifically in meeting the challenges of climate change are three key attributes of IWRM, ***viz***. integration of sectors that impact on water resources, effective institutions and organisations to manage trade-offs and its nature as an ongoing and, thus, responsive process.

On mainstreaming climate change

Worldwide the implications of climate variability and climate change have not yet always been fully considered in existing water policy and decision-making frameworks. Certainly, to

date South Africa's water managers often consider climate change impacts as less pressing in comparison to other problems they are facing, such as land use changes, inefficient irrigation practices, footprints of past policies, overabstraction, surface and groundwater pollution and wetlands mismanagement. While some have sought to address climate change adaptation as a new set of issues within the water sector, there is a very strong case instead for 'mainstreaming' climate change adaptation issues into current water sector practices. Mainstreaming in this context implies embedding it within current water resources planning and decision making processes rather than introducing a parallel or supplementary process.

On climate and land use change on freshwater inflows into estuaries

Of the many aquatic systems impacted upon by climate change, estuaries are amongst the most sensitive as a consequence of their location at the lower end of the terrestrial hydrological system. In South Africa, climate change is projected to have different regional effects which, in turn, could impact on the various components making up the terrestrial hydrological system.

On climate and climate change impacts on wetlands responses

Wetlands are considered hydrological sensitive ecotones that provide numerous good and services. The ***ACRU*** model's Wetland Routine was used to simulate impacts of wetlands on catchment hydrological responses in the physiographically and climatically highly diverse Thukela catchment of 29 036 km^2. The impact of wetlands on flood attenuation and streamflow regulation was found to be relatively small when assessing mean ***annual*** streamflows generated from a 50-year historical climate dataset, with decreases postulated to be the result of increased total evaporation from subcatchments with wetlands.

Future actions

There is a need to roll out and implement these research outcomes.

Further reading:
To obtain the reports: *An Evaluation of the Sensitivity of Socio-Economic Activities to Climate Change in Climatically Divergent South African Catchments (***WRC Report No. 1843/1/12***); A 2011 Perspective on Climate Change and the South African Water Sector (***WRC Report No. TT 518/12)** and *A Handbook on Adaptive Management Strategies and Options for the Water Sectors in South Africa under Climate Change (***WRC Report No. 1843/2/12**), contact Publications at Tel: (012) 330-0340; Fax: (012) 331-2565; Email: orders@wrc.org.za or Visit: www.wrc.org.za to download a free copy.