THE INEXTRICABLE LINK: CLIMATE CHANGE AND OUR WATER RESOURCE

Droughts... floods... toxic algal blooms...
Growing water scarcity, an increase in the population, the degradation of shared freshwater ecosystems and competing demands for shrinking natural resources have the potential for creating bilateral and multilateral conflicts in the Southern African Development Community (SADC) region. This is according to Dr Gift Manase, a CSIR water resource economist and expert on economic dimensions of climate change.

CLIMATE CHANGE MODELLING exercises consistently indicate that many of the world’s major river basins may experience more severe droughts and floods in future. Southern Africa is particularly vulnerable to extreme variability, given its high dependence on rain-fed agriculture and water resources for livelihoods; limited knowledge on climate change; limited resources for adaptation; and lack of institutions and capacity to regulate river and stream flow.

The majority of the population in the SADC region (over 70%) depends on agriculture; mainly rain-fed agriculture. Therefore, understanding the impacts of climate change on water resources is of paramount importance in the SADC region.

“Although uncertainties still pertain to the exact future impact of climate change on water resources, SADC countries should start integrating climate change in water sector and national strategies,” comments Manase.

Whatever strategies are adopted for optimising water usage, the successful development of these depends on reliable meteorological and hydrological information. In many instances, application of hydrological models on a basin-wide scale is restricted by data density. Reliable impact assessments and near-term predictions depend on a robust database. Flood propagation and thus flood warning capacity, for example, depend on the density of measuring points.

CSIR INPUT

The CSIR has undertaken research funded by the Danish Water Forum (DWF) to identify key research institutions in SADC that are conducting research on the impact of climate change on water resources. The aim is to create a regional network on climate change, human health, water and food security as a platform for knowledge and information sharing.

“We adopted a multi-pronged approach, which included web-searches, telephone and personal interviews, email discussions, literature reviews and participation at regional climate change and water workshops,” says Manase.

In the CSIR study, research projects or publications in SADC were classified into four main research themes, namely vulnerability; impact assessments; adaptation and mitigation. The thrust in the region at the moment seems to be on better understanding the potential impacts of climate change on water resources and there is substantial work conducted to simulate and develop scenarios, especially in South Africa.

In 2005, 1 380 scientists were conducting research on climate change in Africa, of whom only 3% did research on climate change and water resources. There is a stark unequal geographical distribution of scientists, with South Africa having five times or more scientists than any other SADC country. This further emphasises the need for networking and sharing knowledge and experiences. An analysis of the academic background of the researchers identified in this study shows that the majority are hydrologists (65%) followed by social scientists (30%) and only a few (5%) are economists.

Much of the research on climate change and water is conducted by academic institutions. There is a fundamental need to ensure that information generated by scientists in academic institutions is conveyed to policymakers and practitioners so that real-time decisions are made.

This work culminated in the formation in February 2009, of a South-South-North SADC Climate Research Network supported by the three Danish networks; the DWF, the Danish Development Research Network and the Danish Research Network for International Health. More information about the network can be found on www.ddrn.dk

Manase suggests that incentives for this new network should include:

• Building capacity, especially of young researchers by providing them with opportunities to publish. It is suggested that the new network partners with existing journals and publishes a special issue on climate change for SADC.
• Providing information on funding opportunities.
• The network should be a one-stop-shop for information on climate change, health, water and food security. – Hilda van Rooyen

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Expectations are that the whole country will get hotter, particularly inland. This will result in greater evaporative losses from dams, more evaporation from the landscape and a greater risk of algal blooms. Blue-green algae, also called cyanobacteria, are more likely to bloom in warmer water and the toxic and clogging effects of these blooms could have a serious effect on drinking water supply and irrigated agriculture.

We already have maps at a national scale of some of the predicted water resource impacts of climate change (Schulze et al, 2005). Figure 1 shows where rainfall will increase (blue) – in Lesotho and parts of North West and the Eastern Cape Drakensberg – and decrease (pink-red) in most of the rest of the country. Work by the South African Weather Bureau shows that we are already seeing decreases and increases in long-term rainfall trends, which correlate well to these predicted changes (Kruger, 2006).

The nature of rainfall is also expected to change, and we will see an increase in extreme events such as droughts and floods. This will require better disaster management and may have unexpected consequences for available water resources. Sediment erosion may increase and dams are likely to silt up more quickly. Groundwater recharge in semi-arid areas is driven by extreme rainfall events, so if these become more frequent, groundwater recharge may increase.

However, we may also see threshold effects with some resources. The rate of groundwater recharge declines exponentially below 500 mm per annum rainfall, so a slight decrease in rainfall could mean a more dramatic decrease in groundwater recharge and less water available in wells and boreholes. These poorly understood non-linear feedbacks in the climate-water system are called ‘tipping points’ because they can result in dramatic, irreversible changes.

One of the key adaptation strategies for many municipalities will involve better, drought resistant water storage. Currently, South Africa has fairly low levels of per capita storage and we have typically relied on large and medium scale surface water dams. These dams are going to become more vulnerable to losses from evaporation, siltation and contamination from algal blooms and water suppliers will need to diversify their water storage strategies. Most water stored naturally in catch-
ments is stored in aquifers underground; therefore groundwater can provide an important buffer against more uncertain rainfall in the future. Figure 2 shows how the amount of groundwater stored in aquifers varies around the country.

The CSIR has also pioneered artificial recharge to groundwater, using aquifers as seasonal stores. This has worked well in the Cape where we have developed recharge basins in Atlantis with the City of Cape Town. Excess storm water from the winter rainy season is captured, treated and infiltrated into the coastal aquifer near the town. The Department of Water and Environment Affairs is now encouraging municipalities to set up managed recharge schemes as part of their long-term integrated water resource planning.

Adaptation to climate change will require an improved understanding of our water balance, water demand management and strengthening engineering and community-based capacity to respond to new water supply challenges.

References


Figure 2: Groundwater storage millions of m$^3$/km$^2$ (DWAF, GRA 2005)

THE SOUTH AFRICAN RISK AND VULNERABILITY ATLAS

The atlas is aimed at equipping decision-makers with information on the impact and risk associated with global change in the region. It will provide easily understood global change sensitivity and vulnerability information at regional, national, provincial and municipal levels. The atlas will provide an electronic geographical information system and will involve local researchers from various disciplines to continuously update the content with new research. It will capture data related to aspects such as groundwater, surface water, forests, biodiversity, human health, crops, demographies, economics and social dimensions.

The SARVA project is funded by the Department of Science and Technology and is project managed by the CSIR, with key content and technological inputs from South African institutions and research groups.