

New research aims to identify those at extreme risk of climate change impacts



While climate change research has identified several 'hotspots' in South Africa where biodiversity and natural resources are particularly vulnerable to climatic deviations, it is not to say the communities in these areas are equally vulnerable or that those in potentially less impacted areas are not as vulnerable. This is according to research by the Centre for Water Resources Research (CWRR) at the University of KwaZulu-Natal (UKZN). Article compiled by Lani van Vuuren.

As global research increasingly points to the significant potential consequences climate change could have on South Africa, attention is turning not only to mitigating potential climate change, but also adapting

to possible impacts. As part of an effective adaptation plan there is a need to identify those communities who are most vulnerable to possible climate change, says environmental hydrologist, Sabine Stuart-Hill, of the CWRR. She was speaking at the 16th National Hydrology Symposium, held in Pretoria, late last year. "This is irrespective of their adaptive ability and the overall resilience of society, the environment and the economy."

Poor communities are usually assumed to be the most vulnerable members of society as they neither have the relevant knowledge nor the finances to cope and depend on a few resources. Nonetheless, it cannot and should not be assumed that regions experiencing high levels of climate change will also be the most vulnerable, or that high levels of poverty equal high vulnerability, noted Stuart-Hill.

INVESTIGATING VULNERABILITY

As part of a larger Water Research Commission-funded project, Stuart-Hill and her team investigated how research could assist in identifying vulnerable communities, which should be primary targets for adaptation strategies. The project aimed to, firstly, identify which communities are most sensitive to climate change due to their socio-economic status; secondly, investigate how able those communities are to respond to the risks imposed on them; and thirdly, define what the risks are that these communities are most exposed to.

Vulnerability communities were assessed according to three main components, namely adaptability (or response capacity), sensitivity (resource dependency) and exposure

(or risks) to stressors or hazards.

'Adaptability' refers to the response capacity of a community. Stuart-Hill explained it as the communities' ability to make informed decisions about the risk climate change imposes on them and their ability to use this information to protect themselves against the threats, or react and recover from the effects of the threats.

In turn, 'sensitivity' to impacts is characterised by the communities' dependency on the resources around them. "Those people who are directly dependent on resources around them are more likely to be affected by any changes in the availability and distribution of those resources," said Stuart-Hill.

Lastly, 'exposure' can be characterised as the probability of a physical impact being imposed on a community. This may be in relation to the physical location of people, for example, those living next to a river where they are at greater risk to increased runoff and flooding. "By analysing the distribution of these three characteristics, we can identify which communities are most vulnerable to climate change and focus adaptation plans on these communities."

TWO OPPOSING CATCHMENTS

Two divergent catchments were selected to test the project team's methodology: the Mgeni catchment, in KwaZulu-Natal, where a projected increase in annual rainfall is predicted due to climate change; and the Berg catchment, in the Western Cape, where decreases in annual rainfall are predicted. The Mgeni catchment includes two major cities, Pietermaritzburg and Durban, while the Berg catchment includes Cape Town. Both catchments comprise a mixture of land uses, including urban settlement (formal and informal), rural areas, subsistence and commercial farming as well as various open spaces to degraded areas.

In addition, in both catchments high density settlements characterise urban settlement patterns, implying that a large number of people, living in a relatively small area, are vulnerable to climate change impacts. "Urban migration may have a negative effect on people's ability to adapt to climate change as they experience disruptions in social structure and lose traditional practices," explained Stuart-Hill. "This presents a challenge to city managers and decision-makers to help protect a large number of highly vulnerable people."

Furthermore, the research showed that often the communities least able to adapt were also those most sensitive and exposed to climate change, partly also due to patterns of urban migration, legacies of past legislation and the urban structure of society.

It was found that each catchment has areas of more or less vulnerable communities. Those with low-economic status based on their income, education and housing type were found to be most vulnerable to climate change in both catchments. Stuart-Hill explained that the adaptability of communities with lower education and income levels are compromised due to their inability to make informed decisions, or the inability to protect themselves from

the effects of climate change.

Families in traditional or informal households are at greater risk due to flooding as the buildings materials and structure lack the structural integrity to withstand the pressures of flood water. This of particular concern in the Mgeni catchment, where large projected changes in three-day flood events are predicted, especially in the interior around Pietermaritzburg, where a large number of informal houses are still to be found.

Communities in the Mgeni catchment were found to be more reliant on open sources of water than communities in the Berg catchment (it must be noted, however, that data from Census 2001 were used in the study, and that the situation might have changed in the meantime). While streamflow is projected to increase in the Mgeni catchment as a result of projected climate change, this streamflow may become more variable. In the Berg catchment, the problem is rather of too little water as annual streamflow is projected to decrease between 10% and 20%, resulting in less water being available in rivers and dams.

Using open water also has various social and health issues, such as risk to waterborne diseases. In Mgeni catchment, many communities have



Guy Stubbs/Africa Media Online

A recently concluded project by the WRC assessed the vulnerability of South African communities to climate change.

Poor communities living in dense settlements are particularly vulnerable to extreme weather events, such as floods.



Lori Wasechuk/Africa Media Online

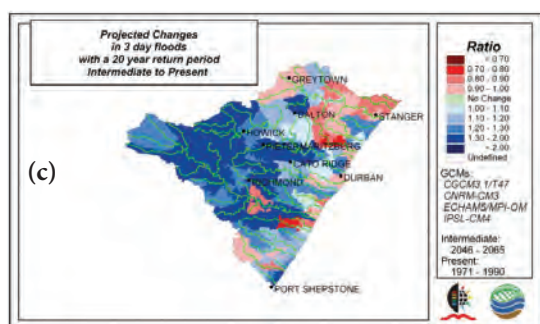
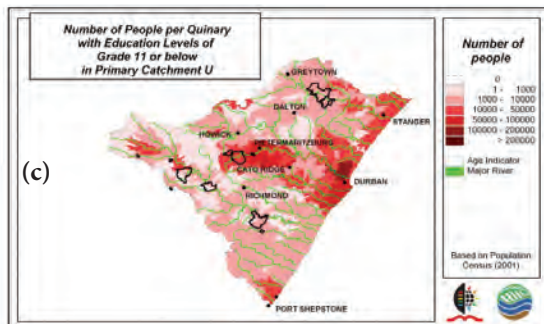
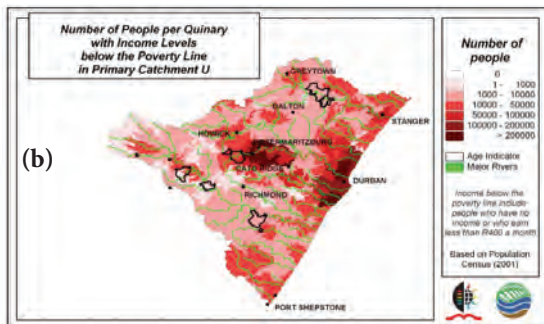
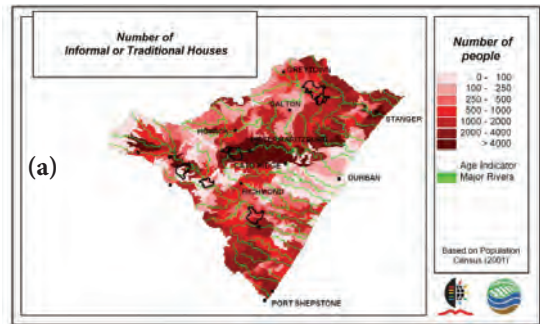
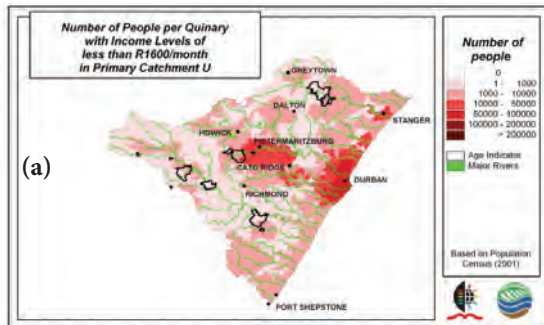
a major river running through them, leaving them vulnerable to risks of flooding.

“The need to reduce the number of people relying on open water sources is imperative in both

catchments as these people are using an unsafe water source and are at risk to changes in water quality and quantity,” said Stuart-Hill. While rainwater tanks and groundwater extraction may be viable alternative

water sources in Mgeni catchment, the latter may not be a viable option even to those already making use of boreholes in the Berg catchment, as a decrease in recharge of groundwater is predicted due to climate change.

Overall, the results showed far higher levels of vulnerability in the Mgeni than the Berg catchment. This is based mainly on low income and education levels as well as high population densities in the Mgeni catchment. However, each catchment presents a different set of challenges to municipal managers and different adaptation plans will be required. Especially in the Mgeni catchment challenges will arise from a rather disperse picture of vulnerable communities with divergent characteristics. The research has also underlined the importance of basic levels of service, not only to improve



Right, (a)- (c): Education in the Mgeni River catchment. Lower education levels indicate greater vulnerability.

Far right, (a)- (c): Number of informal or traditional structure households which are at greater risk of damage due to flooding in the Mgeni catchment.

DESCRIPTION OF ADAPTABILITY, SENSITIVITY AND RISK AS INDICATORS OF VULNERABILITY

VARIABLE	DESCRIPTION	DATA SOURCE	IMPACT
Adaptability			
Age	< 15 or > 69 years Or 15 – 69 years	Population Census	
Education	Grade 11 or Lower	Population Census	Lack of knowledge to make informed decision. Reduced employment options, reduces ability to move to safer environment
Income	Below the poverty line (< R400 / month) Low Income (< R1 600 / month)	Population Census	Reduced ability to take precautionary action against threats or to recover from impact. Lack of resources to move to safer environment
Sensitivity			
Open water	Dams, pools, stagnant water, rivers & streams	Quinary Catchments	Streamflow
Rainfall Tank	Water harvested from rainfall	Quinary Catchments	Rainfall
Borehole	Water pumped from a borehole	Quinary Catchments	Groundwater recharge
Irrigation	Water collected from streamflow for the purpose of irrigating commercial and subsistence agriculture	Quinary Catchments	Changes in irrigation demands, changes in streamflow and changes in evaporation
Risk			
Proximity to rivers	Risk of flooding	Quinary Catchments	Peak Discharge

people’s daily lives but to make them less vulnerable to the onslaughts of climate change.

By identifying which communities are vulnerable to climate change researchers can provide planners with

a starting point on where to focus specific adaptation options and offer insight into which adaptation strategies are most viable for each location.

Concluded Stuart-Hill: “By improving our understanding of

the different dimensions of vulnerability earlier action can be taken. This will greatly enhance the safety of our society, environment and economy to the potential onslaught of climate change.”

Below, (a)- (c): Number of informal or traditional structure households which are at greater risk of damage due to flooding in the Berg catchment.

WRC PROJECT HELPS WATER SECTOR COPE WITH CLIMATE CHANGE

With projected impacts on drought, flooding, evaporation, storm surges, melting ice caps and sea-level rise, the hydrological cycle is one component of the Earth’s system that will possibly be most affected by climate change. Many of the impacts of climate change, including its effects on climate variability, will manifest themselves on the availability of, and demand on, water resources.

In South Africa, where water resources are already scarce and unequally available across the country, climate change has been identified as one of South Africa’s most significant threats on its path towards sustainable development and a more equitable society. Juxtaposed with this are land use changes which often amplify flow variability as a result of management practices. Furthermore, there remain disparities in water availability and access to water for many of the country’s people. These could well be amplified by climate change.

Therefore, taking current knowledge to a new level, updating it and making it more relevant as well as usable for water managers in their decision-making processes, was the major goal of a recently concluded, multi-year WRC project. The project was led by the School of Bioresources Engineering and Environmental Hydrology at the University of KwaZulu-Natal.

One of the outcomes of the project has been a Handbook on *Adaptive Management Strategies and Options for the Water Sector in South Africa under Climate Change (WRC Report No. 1843/2/12)*. The practical aid is aimed at mainstreaming climate change issues into decision making. The handbook 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.

To order the handbook, contact Publications at Tel: (012) 330-0340; Fax: (012) 331-2565 or Email: orders@wrc.org.za. The handbook can also be downloaded free of charge from the WRC’s website: www.wrc.org.za

