CLIMATE CHANGE ADAPTATION
DISASTER RISK REDUCTION AND MANAGEMENT

Adaptation Scenarios Factsheet Series, Factsheet 3 of 7

THE LONG-TERM ADAPTATION SCENARIOS FLAGSHIP RESEARCH PROGRAMME (LTAS) FOR SOUTH AFRICA

The LTAS (April 2012 – June 2014) aims to respond to the South African National Climate Change Response White Paper (2011) by undertaking climate change adaptation research and scenario planning for South Africa and the Southern African sub-region.

The **Adaptation Scenarios Factsheet Series** has been developed to communicate key messages emerging from LTAS Phase 2 (June 2013 – June 2014) to policy- and decision-makers, researchers, practitioners and civil society. The Factsheet Series complements the LTAS Phase 2 technical reports. For further details on this factsheet, see the LTAS Phase 2 full technical report entitled *Climate Change Adaptation: Perspectives for Disaster Risk Reduction and Management in South Africa – Provisional Modelling of Drought, Flood and Sea-Level Rise Impacts and a Description of Adaptation Response.*

1. Introduction

The possibility of increased disaster risk is considered to be one of the most concerning and potentially costly impacts of future climate change in South Africa, and globally. Understanding these risks and identifying key areas of concern is critical for developing suitable and sustainable adaptation policies and scenarios.

2. Climate change impacts of relevance to Disaster Risk Reduction and Management

A consistent message from the analysis of drought-related risks in South Africa over the medium- and long-term is for increased water supply limitations in the Western Cape and potential for increased water resources availability to Gauteng and the Vaal system. In general, the results suggest that the current well-developed and integrated water supply system in South Africa provides resilience to a wide range of climate variability and climate change uncertainty. Analysis of future flood risk shows consistent increases across most parts of the country, but particularly in KwaZulu-Natal, the Eastern Cape, Limpopo and the southern Cape. Numerous structures (bridges, dams and powerlines) are projected to be at ‘high’ to ‘very high’ risk from flooding by 2050 (see Box 1).

Analysis of the potential climate change impacts on increased sediment yields from a selection of 95 dam catchments across the country shows that there are significant impacts for some individual dams. Adaptation responses utilising effective land management and ecosystem-based approaches are therefore indicated as having high potential effectiveness for reducing sediment impacts as well as increased flood risks in these catchments. Nationally, however, results show only limited impact as a result of increasing flood frequencies, with future changes in land cover and land use potentially of greater significance.

Analysis of sea-level rise shows that potential impacts at the local scale could be significant, particularly for coastal metropolitan areas such as Cape Town, Durban and Port Elizabeth. Of particular concern is the potential impact on the coastal tourism sector. Ports are considered to be less vulnerable as they would be relatively easy (yet costly) to upgrade, although future research should focus on small harbours and coastal communities with more limited resources for adaptation. On a national scale, the potential economic impacts are likely to be relatively small given that South Africa does not have large areas of low-lying land, or development on large deltas.

BOX 1: STRUCTURES WITH PROJECTED ‘HIGH’ TO ‘VERY HIGH’ FLOOD RISK INCREASES BY 2050

- Almost 1,700 bridges (30%) on the South African National Roads Agency (SANRAL) database are projected to potentially experience High to Very High flood risk increases by mid-century.
- More than 900 dams (19%) on the Department of Water Affairs (DWA) Dam Safety database are projected to potentially experience High to Very High flood risk increases by mid-century.
- Almost 900 powerline crossings (29%) on the SA Explorer GIS database are projected to potentially experience High to Very High flood risk increases by mid-century.

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- The total number of threatened infrastructure components is projected to potentially increase towards the end of the century, but according to a different mix as that which existed at 2050. These 'flip-flop' characteristics – risks diminishing or increasing towards the end of the century – potentially pose a severe dilemma for climate change adaptation planning, with disaster risk reduction initiatives having to attempt to stay synchronised with these patterns in different parts of the country.

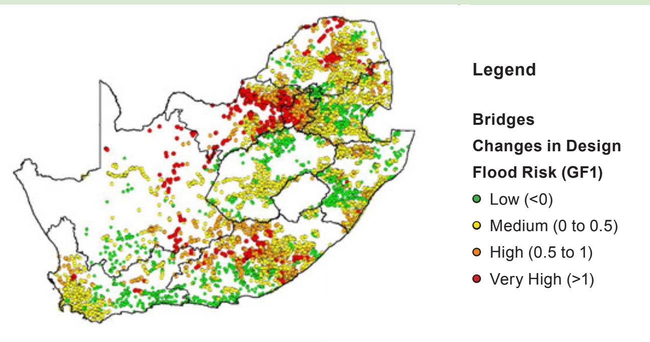

Figure 1: Relative risk for bridges for the climate model with the greatest general impact up to 2100.

3. Climate change adaptation responses

Recommended adaptation responses for South Africa under future climates are summarised below. Adaptation responses specific to droughts, floods, sediment yields and sea-level rise are provided in Boxes 2 – 5. The general responses below show a number of cross-cutting issues for adapting to increasing droughts, floods and sediment loads that are applicable across a range of climate futures and therefore represent no regret options that should be implemented. These include:

- Continuous monitoring and drought/flood early warning systems.
- Improvements land care, catchment management and water sensitive urban design.
- Enforcement of current zoning practices to reduce the number of people in flood-risk areas.
- Routine maintenance and correct operation of existing infrastructure, particularly related to dams.
- Integrated design and planning that take climate risks and change uncertainty into account.
- Improvements in safety nets and diversification of livelihoods for particularly vulnerable groups.

Under a drying future (either nationally or in specific regions of the country) adaptation should include a review of the resilience of existing water supply systems with a particular focus on improved integration and diversification of the current stand-alone water resources systems. Future food security and food sovereignty also require an increased integration and diversification at a national and regional (SADC-wide) scale, and should be considered as potential adaptation options.

Under a wetting future, adaption options should include a review of current flood risk and design standards, changes to urban flood retention and flood mitigation works, a focus on water sensitive design of municipal infrastructure and changes to the operating rules of large dams with an increased flood control role. The later requires consideration of the trade-off with increasing drought risks.

For sea-level rise the most appropriate adaptation option is managed retreat through the demarcation and enforcement of coastal set-back lines that incorporate future sea-level rise. In certain situations, hard engineering solutions could be considered, but care must be taken that these solutions do not simply move the problem onto somewhere else where the impacts may be just as significant, if not more substantial.

BOX 2: SPECIFIC ADAPTATION RESPONSES TO THE IMPACTS OF DROUGHT

Adaptation responses for drought should be focused on long-term systemic and structural changes, rather than short-term physical or engineering solutions. Such changes require the use of a standardised set of climate models and a standardised approach for incorporating climate change (and other uncertainties) into the existing water resources planning methods for individual systems across the country. These studies could then decide on appropriate physical adaptation options such as increased storage capacity or additional inter-basin transfer schemes within each system. Continued monitoring, seasonal forecasting and drought early warning systems are critical for drought adaptation and require further development, research and maintenance.

In addition, improved drought planning, including drought-resistant seed varieties, food stock piles, and support for farmers and rural households, is required so that these measures can be put in place in advance of forecasted impending disasters. A range of other drought risk reduction measures are also important. These include restoration of critical ecological systems such as restoring of natural systems, removal of invasive alien plants, rehabilitation of wetlands; as well as consideration for improved water use efficiency, alternative sources of water and improved storage capacity.

BOX 3: SPECIFIC ADAPTATION RESPONSES TO THE IMPACTS OF FLOODS

Adaptation options for reducing future flood risk should be holistic and require institutional changes, as well as both soft and hard engineering solutions. Catchment management, improved land care practices as part of ecosystem-based adaptation approaches and enforcement of zoning regulations are critical adaptation options for increased flood risk. They are, however, also components of best practice and represent no regret options that should be immediately implemented across the country and would be necessary, irrespective of the direction of future climate change impacts.

Adaption options for floods also include changes to design standards. These include regulatory requirements for water sensitive urban design and increased on-site stormwater retention and flood mitigation measures. On a national scale, a review of current design standards for key infrastructure, including bridges, dams, and flood lines, for sustainable urban design and the placement of critical infrastructure such as powerlines, treatment plants and sub-stations, is required. Such changes are a long-term adaptation measure, and should be complemented by improved maintenance of existing infrastructure. The latter is a more immediate requirement.

BOX 4: SPECIFIC ADAPTATION RESPONSES TO THE IMPACTS OF INCREASED SEDIMENT YIELDS

The adaptation focus for reducing potential sediment impacts should be on improved land care and catchment management as part of ecosystem-based adaptation approaches. This includes appropriate farming and forestry practices, rehabilitation of dongas, rehabilitation and re-vegetation of degraded lands, the enforcement of buffer strips, set-back lines and rehabilitation of wetlands and natural floodplains. 'Hard' engineering solutions, such as sand by-pass systems, additional treatment capacity or dredging of reservoirs are possible, but are generally more expensive and less reliable than improved catchment management practices, which aim to mitigate the risk at source. Furthermore, routine maintenance of water resources infrastructure, including dams and treatment plants, is critical and considered to be a no regret option to reduce the impact of increased sediment loads.

BOX 5: SPECIFIC ADAPTATION RESPONSES TO THE IMPACTS OF SEA-LEVEL RISE

Some of the most effective sea-level rise adaptation options involve systemic interventions that reduce exposure to multiple risks, including sea-level rise. Options in this category are typically classified as no (or low) regret in that they deliver multiple benefits. Such options include not reclaiming further land from the sea, preventing further degradation of coastal wetlands and estuaries, protecting dune cordons, integrating sea-level rise scenarios into future planning decisions, incorporating sea-level rise risks in disaster management strategies, maintaining coastal stormwater infrastructure and decentralising strategic services infrastructure.

Additional targeted interventions aimed at managing specific risks are also required. Identifying vulnerability, communicating risk, implementing coastal set-back lines, early warning systems and insurance market corrections are all considered as potential social and institutional adaptation responses for reducing sea-level risk and vulnerability in South Africa. Furthermore, infrastructure (seawalls, groynes, detached breakwaters and revetments) and biological interventions (ecosystem-based adaptation) are required. Biological options are typically cheaper and more labour intensive than infrastructural options, and pose less risk of adverse consequences.

4. Policy and research recommendations

There are significant spatial variations in the potential impacts as well as the adaptation options under different climate models across the country. Therefore, the following research and policy actions are recommended:

- Detailed local and regional studies are critically required, using where appropriate, the initial analysis undertaken in LTAS Phase 2 to inform the development of appropriate risks and responses.
- Consideration should be given as to whether specific flood operating rules (e.g. draw-down of dams prior to the onset of the flood season) should be implemented in particular regions of the country.
- The value of ecosystem-based adaptation measures has been highlighted across all aspects of disaster risk reduction (droughts, floods, sediment and sea-level rise). These approaches therefore represent critical no regret and multi-objective adaptation responses that should be investigated further.
- Potential flooding impacts need to be considered at a local level, including detailed hydrological and hydraulic analysis to investigate the specific risk and adaptation options for individual critical infrastructure, ecosystems and human settlements, as required.
- It may be necessary to consider reviewing existing design standards. The responsibility for a review of these design standards should be designated to the relevant authority.
- As a result of the potential impact on regional economies and national food security, a more detailed analysis of potential drought impacts on the agricultural sector is required, as well as consideration of appropriate potential adaptation options, including more regional (SADC-wide) integration.
- The latest available regional climate models need to be downscaled for additional flood, drought and sediment impact analyses.
- The sensitivity of changes in flood risks and sediment yields to human or climate induced changes in land cover, and the potential for climate change to further drive these changes, needs further investigation.
- Detailed analysis, including finer scale modelling, of the specific risks associated with climate change impacts on disasters and in specific areas of the country from a wider range of climate models is required.
- Detailed regional analysis to assess drought risks at a finer spatial scale, particularly focusing on the vulnerable stand-alone systems where the potential for increased integration and diversification of resources should be investigated as a potential adaptation option.
- The risks of extreme drought due to increased natural climate variability, such as related to shorter El Nino cycles, needs to be investigated further.
- Detailed research to investigate the impact of climate change directly on land cover and sensitivity for erosion and soil loss is required across the country.

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