Policy Brief

"CLIMATE VARIABILITY AND CHANGE IN THE ZAMBEZI RIVER BASIN – INTERVENTIONS AND POLICY OPTIONS"

EXECUTIVE SUMMARY

Projected climate change, landuse change, economic development, and population changes are expected to have far reaching consequences in the Zambezi River Basin. The combined effect of climate change and prioritising irrigation demand in the upstream catchments could compromise hydropower output.

INTRODUCTION

Changes in climate including inter-annual variability are already threatening the Zambezi River system and the investments and livelihoods that depend on it. Temperature, precipitation and evaporation are highly variable from one year to another resulting in negative impacts on availability of water in the Basin for various consumptive and non-consumptive uses including hydropower generation, irrigation, navigation, fisheries, wildlife and the environment. Between 1901 and 2014 area average annual temperature in the basin has warmed by about 0.8°C and is projected to warm up by between 0.5 to 1.5°C by the 2050s depending on greenhouse gas emission scenarios.

The Zambezi River Basin's has an unstable rainfall regime where annual rainfall ranges from 400 to 1000 mm. Although historical rainfall shows no definite trend, droughts and floods have been characteristic features of the basin's climate. Between 1980 and 2017, eight severe droughts and three floods ravaged the Zambezi River Basin. This variability on inter-annual, decadal and multi-decadal time scales, as experienced in the past, is expected to continue to be the dominant influence on future rainfall in the basin. Most climate models agree that there will be a general decline in precipitation in the Zambezi River Basin, with average precipitation decline ranging from three to twelve percent by the 2050s depending on greenhouse gas emission scenario. Under the high greenhouse has emission scenario, climate models project a decline in average annual precipitation by as much as twenty percent by the 2050s.

Key messages

- *Zambezi hydropower output could decline by 10–20% under a drying and hotter climate.*
- *Basin infrastructure and development plans must consider potential impacts of climate change.*
- *The risks to regional electricity systems highlight the need for strong cooperative governance arrangements to manage shared water resources in the region.*
- *Resilience thinking should be promoted in managing the Zambezi River Basin*

Runoff is sensitive to changes in both rainfall and evapo-transipiration. In future, potential evapotranspiration is projected to increase by four to 20% across the basin because of warmer temperatures and the fact that large reservoirs evaporate more water than natural rivers (already more than 11% of the Zambezi's mean annual flow is lost to evaporation from dams). Future runoff is projected to decrease by about 4 to 20% by 2020, ten to twenty percent in the 2050s and 16 to 23% by the 2080s depending on emission scenario. Increasing evapotranspiration may also further reduce runoff.

Under a global warming level of 1.5 and 2.0°c the most severe effects of global warming will be related to the increased frequency of occurrence and severity of extreme events, particularly droughts and floods.

VULNERABILITIES

What are the possible impacts of climate change including variability?

The Intergovernmental Panel on Climate Change (IPCC) has rated the Zambezi as the river basin most vulnerable to future impacts of climate change among eleven major basins in Africa because of warmer temperatures and a decrease in rainfall. Most of the impacts of climate change in the Zambezi River Basin are expected to be negative.

- All Zambezi River Basin countries will experience a significant reduction in average annual stream flow. Multiple studies estimate that the Zambezi runoff will decrease by 10 to 20% by 2050s.

- Under a hotter and drier Zambezi River Basin, climate change has the potential to affect hydropower operations with the possibility of reduction in hydropower potential by about eighteen to twenty percent in 2050s and twenty 8 to 31% in the 2080s. Because some hydropower could be displaced by coal, regional greenhouse gas emissions could increase by the equivalent of a large coal-fired power station which is a threat to the attainment of the Paris Agreement emission targets.

- Higher temperatures and reduced rainfall are projected to increase demand for irrigation water and reduce rainfed crop yields by up to 50% percent for some countries by the 2050s thereby threatening livelihoods and food security.

KEY POLICY ISSUES RELATED TO CLIMATE CHANGE IN THE ZAMBEZI RIVER BASIN

Cognisant of the history of economically devastating climate extremes that are droughts and floods which are predicted to increase in frequency and intensity, current and proposed development programmes, strategies, plans, projects and policies in the Zambezi Basin have significantly intergrated climate change into the respective designs and operations. Proposed hydropower projects such as the Batoka, the Strategic Plan for the Zambezi Watercourse (ZSP) and livelihood projects being implemented under the auspices of the Climate Resilient Infrastructure Development Facility (CRIDF) are such examples. However risks associated with such developments in light of the inadequacy of data and information for project designs remain issues for policy makers to focus on.

Large scale hydropower and irrigation developments in the Zambezi Basin have been identified in the MSIOA and the ZSP. These could have pronounced socio-economic and environmental implications for downstream livelihoods and sustainable conservation of biodiversity. The ecological goods and services provided by the Zambezi Basin ecosystems are not being properly valued in the planning for such large scale developments.

Ensuring energy and water security in the Zambezi River basin under future climate change conditions will require new ways of river basin development. The frequent occurrence of extreme floods will threaten the stability and safe operation of large dams. If dams are "under-designed" for larger floods, millions of people living in the basin would be at risk.

Transboundary management of shared water resources has always been a challenge in the basin partly because riparian countries have multiple and competing interests; limited mechanisms for cooperative action between nations that share the basin; institutional, legal, economic and human resource constraints and poor data collection, poor communication and inadequate training.

Adaptation to changing water demand and to climate change impacts through for example expansion of water storage and irrigation facilities may reduce flow to downstream countries, especially if the design does not incorporate the likelihood of changing river flows with climate variability and future climate change. This is already an issue of concern in Mozambique.

LESSONS LEARNT

Institutional arrangements for managing transboundary water resources are important for building adaptive capacity in the face of climate change including variability. The revised SADC Protocol on Shared Watercourses; IWRM Strategy for the Zambezi (2008) and the Zambezi Watercourse Commission (ZAMCOM) Agreement of 2004, whose objective is: "To promote the equitable and sustainable utilization of the water resources of the Zambezi Watercourse as well as the efficient management and sustainable development thereof" are good examples of institutional arrangements that promote cooperative basin management.

Benefits to cooperation include: basin-wide environmental management, improvements in water quality and maintenance of biodiversity, hydropower, irrigation, flood and drought management, navigation, reduced risk of conflict between riparian states, increased food and energy security, integration of regional infrastructure, markets and trade.

RECOMMENDATIONS

In view of the threat paused by climate change including variability, making the Zambezi River Basin Riparian states sustainable, resilient and less vulnerable to climate change is an important policy goal. Proactive management for resilience to floods, water scarcity and drought will be critical for the basin. When water becomes limiting, the social-economic-ecological system in the basin must adapt rapidly if key elements (for example, communities, hydropower generation, food security, biodiversity) are to be maintained.

The policy goal can be achieved by advancing the following:

i. Building resilience to climate related stress in the basin through building adaptive, absorptive and transformative capacity (for example, through developing monitoring schemes with feedback loops to management, setting in place appropriate decision-making processes, building capital stocks, fostering learning, innovation, maintaining diversity and redundancy, and ensuring that some "slack" remains in key components of the system) than of managing for a specific outcome or goal.

   Pro-active management will be most effective if it occurs via politically acceptable and participatory processes, if it uses the best possible science, and takes a holistic perspective that seeks to incorporate social, ecological, and economic elements in problem definition and solution.

ii. Given the large uncertainty regarding basin climate change projections and possible impacts, river basin management plans should incorporate management strategies that deliver benefits regardless of the climate outlook. Robust and adaptive river basin management measures should be low-regret or reversible, incorporate safety margins and mindful of the actions being taken by other river basins to mitigate or adapt to climate change.

iii. Projections and scenarios based on climate models should be used for improving river basin management planning. Uncertainty in models should not be used as a justification for no action. Instead river basin managers should use a range of scenarios for river basin management planning to accommodate uncertainty and subject these to sensitivity testing.

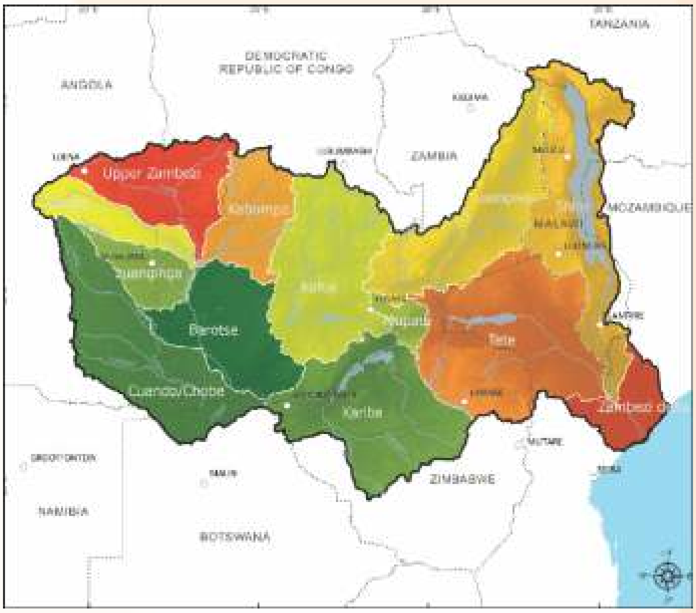
iv. Programmes of planned measures of river basin management should undergo a climate screening. This check should involve a sensitivity analysis of the proposed measures to evaluate longterm effectiveness and cost-efficiency under changing climate conditions. Ideally preferred measures will have multiple benefits including for example, flood risk management, drought management and nature conservation.

v. More institutional dialogue and communication is needed across sectors and countries in the Zambezi River Basin for effective climate change response. For example, the energy people need to talk to water and agriculture people. There is some level of dialogue across most sectors, but the energy sector tends to be less connected to any of the others. There is need to bridge that gap.

vi. To protect the critical resources in the Zambezi River Basin, stakeholders must therefore continually evaluate and report on the risks and impacts of climate change and identify appropriate adaptation and mitigation strategies by utilizing the best available science.

CONCLUSION

The significance of climate variability, change and extremes will continually challenge decision making in the Zambezi River Basin. Other changes occurring in the basin such as changing water-use patterns, development of large infrastructure schemes and changing socio-economic development levels of riparian states also challenge the institutional capacity of current cooperative management mechanisms. Sustainability, both for socio-economic investments and the environment will be clearly dependant on resilience and the capacity to manage weather and climatic extremes. The challenge for policy, decision makers and River Basin Organisations is to be highly adaptive and manage the basin in ways that recognize and support the building and maintenance of resilience for the benefit of the basin and its people.



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