REACH
Improving water security for the poor

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Extreme rainfall and the Turkwel Gorge Dam in Kenya: Understanding risks and management priorities

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Introduction

Lakes along the Great African Rift System from Ethiopia to Tanzania are at their highest levels in decades. The rising water poses multiple hazards including contamination, landslides, and flooding affecting millions of lives.

In northwest Kenya, the Turkwel Gorge Dam has reached a historical high, filling to over 92%, with predictions it could overflow at some point in November 2020. Any overflow from the dam could cause flooding along the Turkwel River, threatening a number of settlements including the Turkana County capital – Lodwar town. The chief executive of the Water Resources Authority, Mohammed Shurie, warns that the flooding could affect close to 300,000 people. This is in addition to the 20,000 families already affected by the flooding of Lake Turkana. Understanding the causes of the historic water levels provides an opportunity to improve management responses as well as build climate resilience in the future.

The Turkwel river basin (Figure 1) contributes to Kenya's national and local economy through energy and agricultural production. The river supplies water to several competing demands including hydroelectric production at the Turkwel Gorge Dam, small scale irrigation, industry, pastoral communities and livestock, Lodwar municipality and ecosystem along the channel.

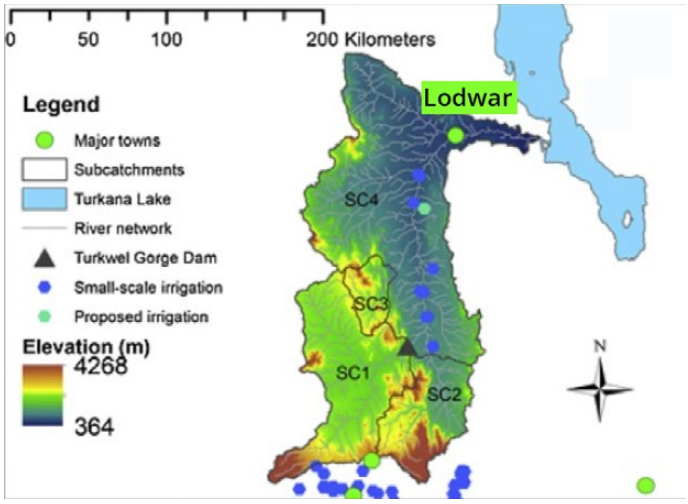

Figure 1: The Turkwel river drains to Lake Turkana, has a total drainage area of 23,740 km2. The triangle indicates location of Turkwel Gorge dam (source: Hirpa et al. 2018)

Key points

The potential crisis is a consequence of a sustained period of high rainfall over the last few years (Figure 2) and particularly since October 2019. 2018 and 2019 were the 2nd and 4th wettest years in the last 40 years, while 2020 is on course to be the wettest. The wet conditions of the last year are in contrast to drought conditions and very low reservoir levels during the March-May rainy season in 2019. Managing dam reservoir levels is especially difficult under these volatile conditions.

The extreme rainfall of the last year is due to a combination of climatic factors, which we do not fully understand. This is especially the case for the traditionally drier months of the year from June to September. Ongoing research examining these physical processes suggests that unusually high temperatures in the Indian Ocean may play a part, along with outflows of very humid air from the Congo Basin. Dam operation guidelines developed in the 1980s are unlikely to have fully considered the possibility of changing climate conditions, and rapid transitions between low and extremely high rainfall.

With climate change increasing the likelihood of extreme conditions, management decisions conditioned on past rainfall dynamics are not a good guide for future stresses. There is considerable disagreement between the models regarding future rainfall changes. This underlines the inherent uncertainty in the climate model projections in the basin. However, decision makers should expect more events outside the range of observed experience.

If the dam spills with significant flooding this will create damage in flood-prone areas. In Lodwar town, most of

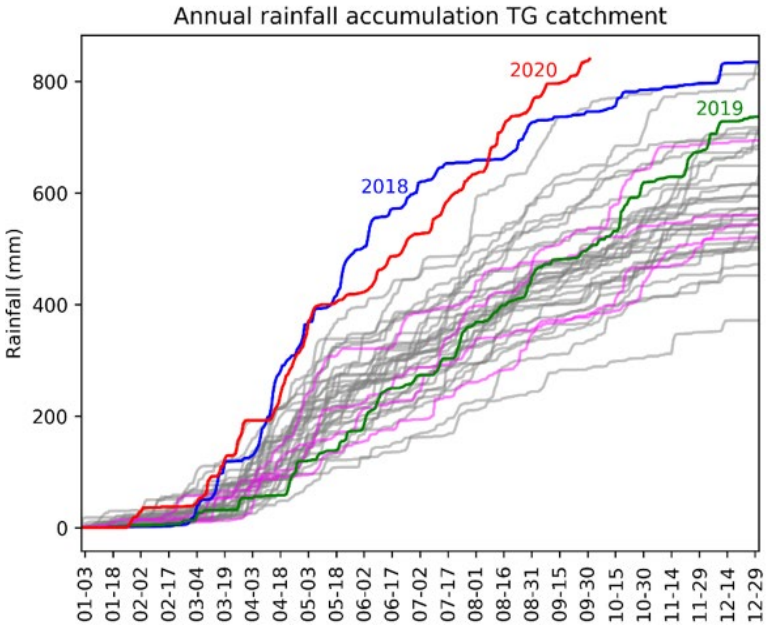

Figure 2: Annual rainfall accumulations for the last 40 years in Turkwel Catchment. Each line shows one year, pink lines are for 2014-2017. Data sourced from CHIRPS

the boreholes supplying the people and businesses are located by the river falling in harm's way. Urban expansion has drifted into zones which are likely to be flooded. The livelihoods of many people in the catchment are closely tied to access to grazing or small-scale farming by the river banks.

Floodwater from the dam is also likely to be turbid, affecting drinking water quality. This is due to the accumulation of silt and clay. Lodwar has no alternative water supplies and limited treatment capacity.

Areas of action

Rainfall hazards in the 1980s during dam construction are substantially different from today, with altered climatic conditions and a fresh set of social challenges. To reduce damages and to improve water security we propose three areas for action.

Information gaps need to be addressed

- *The Turkwel catchment has insufficient rainfall monitoring*. The majority of rainfall in the catchment falls in the upper zones of Mount Elgon where no observed rainfall data exist. There is one station at the foothill of Mount Elgon, the next one being located in Lodwar town, a further 300km away. It is difficult for dam managers to manage uncertainty without credible and timely data translated appropriately for their work.
- *Better meteorological data can also improve the accuracy of short-term weather forecasts*. These are critical for responsive dam management. A robust environmental monitoring plan with stakeholder consensus and public scrutiny will improve water security, if there is political leadership and effective coordination. These are non-trivial conditions.
- *Better information and mapping of key recharge zones would help guard against threats from urban or agricultural expansion and climate change*. In the semi-arid zones downstream of the dam, groundwater is the critical water resource and a buffer to low rainfall during droughts. Increasing evidence shows extreme rainfall events are associated with high groundwater recharge in many parts of Kenya and Africa[1].

Improving institutional capacity

- *Institutions need to have the capacity and accountability to manage multiple and often competing needs for irrigation, hydropower, environmental flows, livestock and domestic water needs.* Information alone will not lead to better decisions.
- *Communicating and sharing climate data with the many uncertainties is a critical step in improving water security*. This communication might be particularly important with respect to seasonal rainfall forecasts, which successfully predicted the above average rainfall of the last year. With the dam now full, the set of management decisions is potentially more complex and dangerous than when the dam was close to empty a year ago.

Mapping flood risks and understanding tradeoffs

- *Mapping areas with heightened flood risk can help to prioritise management interventions*[2]. Flood risk maps would identify vulnerable people and guide future planning so predictable damage is avoided. Often the most vulnerable and least well-informed are at the greatest risk.

References

[1] Cuthbert, M. O., Taylor, R.G., Kukuric, N. (2019). Observed controls on resilience of groundwater to climate variability in sub-Saharan Africa. Nature, 572, 230-234.

[2] Hirpa, F.A., Dyer, E., Hope, R., Olago, D.O., Dadson, S.J. (2018). Finding sustainable water futures in data-sparse regions under climate change: Insights from the Turkwel River basin, Kenya. Journal of Hydrology: Regional Studies, 19, 124-135.

Contacts and acknowledgements

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