Flood management in Namibia: Hydrological linkage between the Kunene River and the Cuvelai Drainage System:

Cuvelai-Etosha Basin

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Namibian Climate

- Arid to semi arid country
- Seasonal and highly variable climate
- Hydro – meteorological extremes

Flooding and Droughts are “normal” in Namibia
NAMIBIA CLIMATE IS INFLUENCED BY;

Geographical latitude (tropic of Capricorn passes Namibia)

- sub-tropical climate

Cold Benguela current creates permanent low pressure zone in front of coast and prevents direct influx of moisture

- dry climate

Seasonal movement of Inter Tropical Convergence Zone (ITCZ) creates low pressure in interior that draws in moisture from east and north

- seasonal climate
  annual cycle of dry and wet seasons
  (rainy season from October to April)
Flood Forecasting and Early Warning

Sources of information:

• Weather and rainfall forecasts and observations:
  – NMS, INAMET, ZMD, SAWS, SARCOF

• Remote sensing/internet – eumetsat, NASA

• Riverflows:
  – Telemetry stations: satellite, cellular network
  – Local observers – Hydrology & NamWater staff
  – Hydrology field teams
  – DWA Zambia, DNA Angola, DWA Botswana, DWA South Africa

• Satellite images:
  – NASA, DLR (Germany)
Seasonal predictions

NINO3 SST ANOMALLY PLUME

SST - Is the Sea Surface Temperature over zone 3.4 in the Equatorial Pacific Ocean. The SST values and graph show the Southern Oscillation (SO) “anomaly” (deviation from normal).

- “Warming > El NINO”, and if its “Cooling > LA NINA”

A positive value and trend are indicative of “El Niño conditions”, more likely to give below-normal rainfall (droughts) in the months to follow.

A negative value and trend are indicative for “La Niña conditions”, more likely to give above-normal rainfall (and floods) in the months to follow.
Area prone to floods
Namibia Water Basins

For easy management of water at local level, the Country is divided into 13 water management bodies (Basins).
Map of Cuvelai River Basin
Cuvelai-Etosha Basin

- Transboundary River basin
- Total Area: 159,620 km²
- Area - Angola: 52,158 km² (32.68%)
- Area - Namibia: 107,462 km² (67.32%)
- Maximum altitude: 1,477 m
- Mean annual rainfall (Angola: 900 mm and Namibia 550mm)
Flood history for the Cuvelai

- Torrential rains
  - The northern areas of the country
- Upstream catchments/headwaters in neighboring countries (Angola)
- Causing severe disruption to properties and loss of lives
Impacts

- Damage to infrastructures
- Poor sanitary condition
- Pollution & contamination
- Displacement of families, education
- Communication breakdown
- Emotional disturbance
- Difficult to deliver essential supplies - accessibility
Why increased flood impact?

- Climate change / variability?
- Location of affected areas
- Heavy rain – locally + upstream
- Poor Infrastructural development, design and maintenance
- Uncontrolled land use
- Lack of proper storm water drainage infra-structures
- Lack of enforcement
- Absence of water harvesting infrastructures (Dams)?
Challenges

- Lack Regional or urban flood management plan
- Financial constrains
- High poverty level
- High unemployment rate
- Lack of affordable formal urban housing
- Floods easily forgotten when takes long before they happen.
Study Area

- The triangular area between the perennial Kavango and Kunene Rivers is drained by the Cuvelai, a unique ephemeral and deltaic drainage system.
Assumptions

- For decades, episodes of seasonal flooding in the ephemeral Cuvelai drainage System has been variously linked to the flooding of the Kunene River.
Assumptions

- Although the first known ground surveys in the 1920s and 1930s ruled out such an assumption, this association continues to echo in the literatures to the present.
Methodology

For improved hydrological modelling on the western Cuvelai Sub-Catchment, we employed the newly released digital surface model from the Advanced Land Observing Satellite (ALOS), complimented by satellite image analysis and ground-truthing exercises during the dry and rainy seasons.
Results & discussion

• Results confirms a hydrological link between the two catchments, which facilitates transient resource fluxes, particularly aquatic life, between the two fluvial systems.
• However, this linkage does not involve the flooding of the Kunene River overtopping its banks. Instead, there are at least four major sites along the Kunene River where the Kunene and Cuvelai channels are directly connected or lie side by side without a pronounced topographic barrier.
Results & Discussion cont..

• On the events of heavy rainfall, these streams suddenly form a contiguous body of water, with filled depressions in the watershed zone flowing on either side of the water divide.

• In two instances, the water divide cuts across contiguous channels flowing in opposite directions. Corroborative results for this linkage emerged from fish migrating upstream of the Kunene tributaries draining from the indistinct watershed zone. In reaching the watershed, characterized by flat terrain and depressions, fish escape into the Cuvelai drainage system and migrate downstream in record numbers.
Conclusion

• Namibia climatic condition is highly variable.
• Flood and drought are normal for Namibia given it’s climatic conditions.
• Results confirm a hydrological link between the Kunene and Cuvelai River system.
• However, this linkage does not involve the flooding of the Kunene River overtopping its banks.
• Corroborative results for this linkage emerged from fish migrating upstream of the Kunene tributaries draining from the indistinct watershed zone. In reaching the watershed, characterized by flat terrain and depressions, fish escape into the Cuvelai drainage system and migrate downstream in record numbers. The implications of this fleeting hydrological link are critical for both the hydrological modelling and transboundary flood management.
• Further investigations may include the role of neo-tectonic and impact of human activities on this critical hydrological linkage between the two catchments.
Thank you!
Asante sana!
Obrigado!