The physical and social dimensions of the WEF nexus: interdependencies in the Rufiji River Basin, Tanzania.

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2021

Overview

- Research project ‘UMFULA’
  - ‘Future Climate For Africa’
- Rufiji River Basin
  - Problem-framing
  - Stress testing development pathways; WEF-E
  - Political economy……
- Conclusions

UMFULA

FUTURE CLIMATE FOR AFRICA

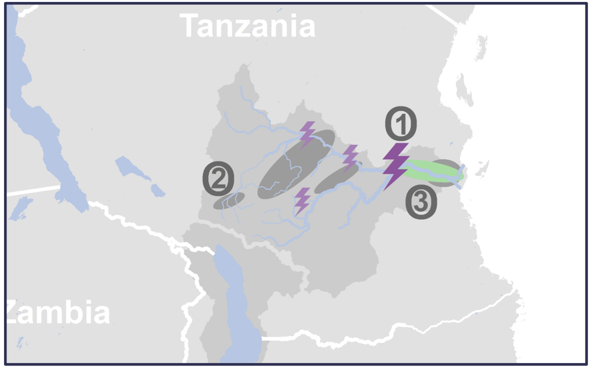

Image source; http://aquate.com/

Climate change - Rufiji River Basin case study…. high stakes decisions?

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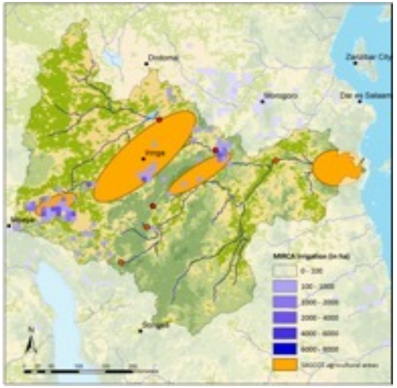
Climate risk to major infrastructure

Siderius, C. et al. (2021) Climate variability impacts water-energy-food infrastructure performance in Eastern Africa. *One Earth* 4, 1-13.

Rufiji River Basin development plans



Irrigation expansion

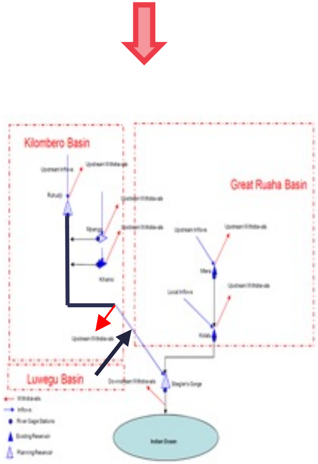
+

Hydropower dams

+

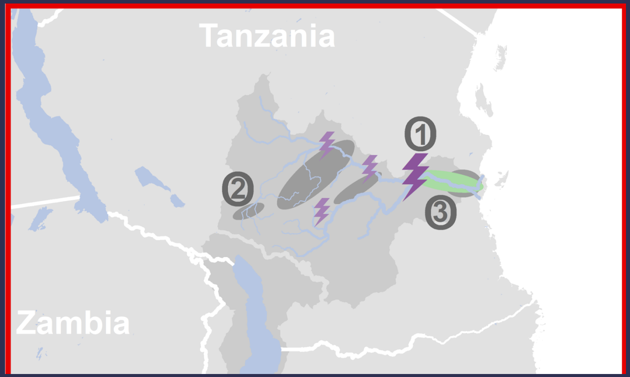
Wetlands and environmental flows

+ Climate risk



Modelling system

To what extent will climate change compromise development objectives?



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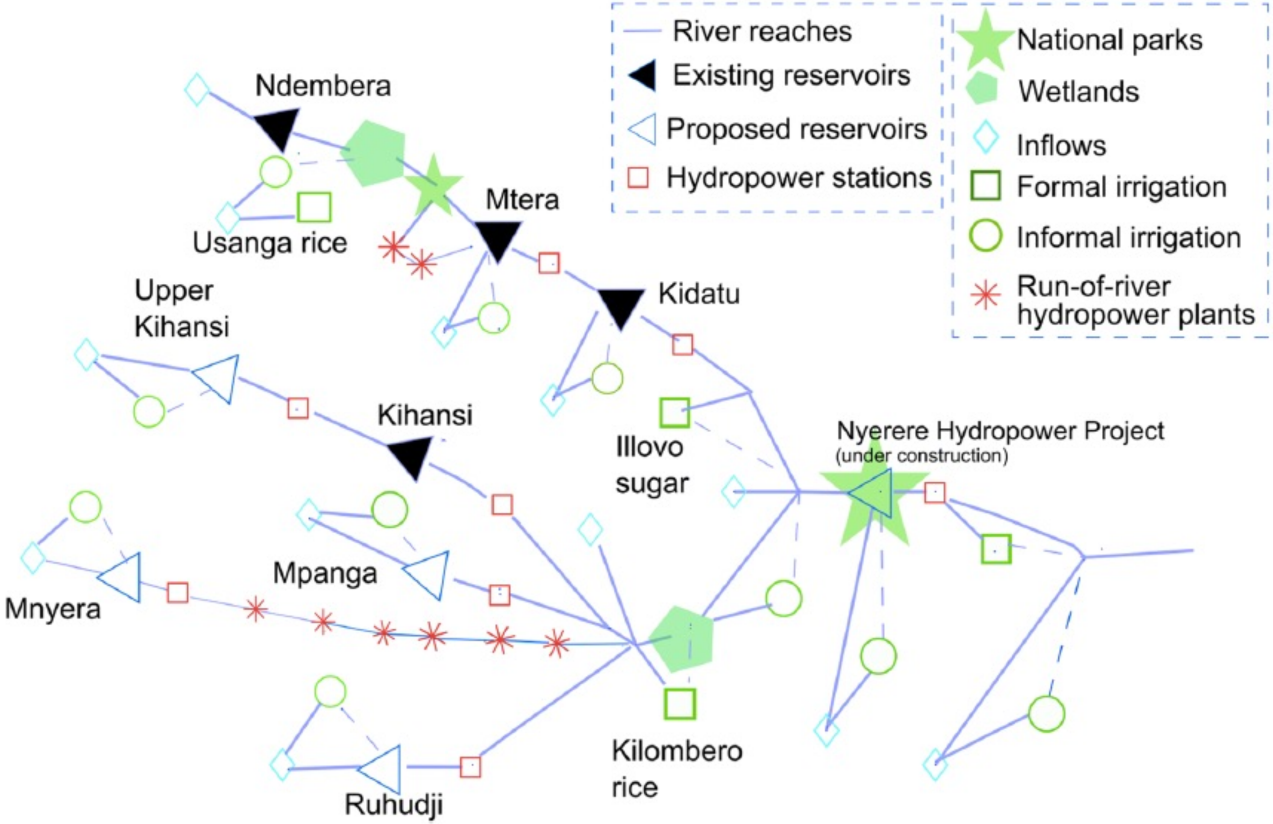
Geressu, R. et al. (2020) Assessing river basin development given water-energy-food-environment interdependencies. Earth's Future, 7.

Water resources simulation model

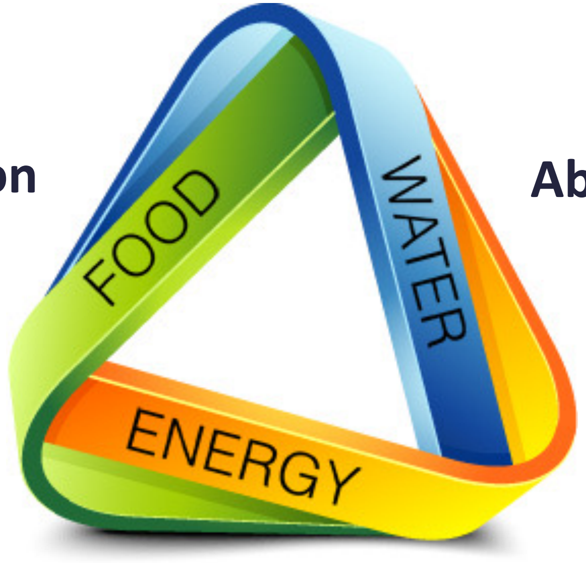
Includes:

- existing (4) and all planned dams (7)
- 2 wetlands
- 2 national parks
- Formal (4) and informal irrigation offtakes (9)



Development plans – trade-offs and co-benefits across the Water-Energy-Food-Environment sectors

Irrigation expansion up to 400,000ha



Abstractions up to 6.2BCM

New hydropower plants JNHPP

Image source; http://aquate.com/

Identify most important concerns of managers / stakeholders

Performance indicators

Irrigation
reliability of meeting
irrigation water demand

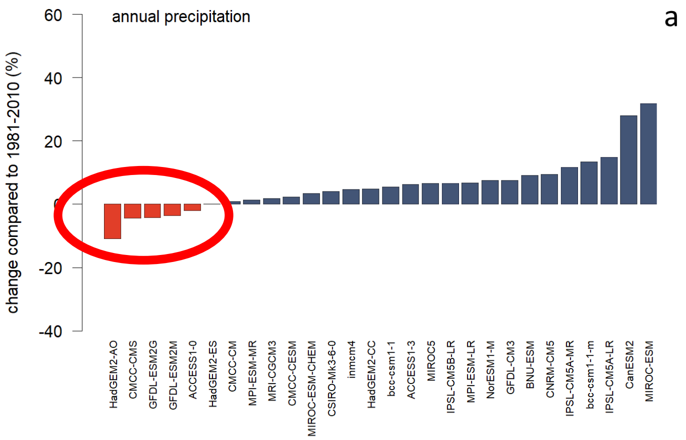
Ecosystem services
peak flow frequency
downstream of JNHPP
flow disruption metric

Hydropower production
reliability of annual and monthly
total annual production

Image source; http://aquate.com/

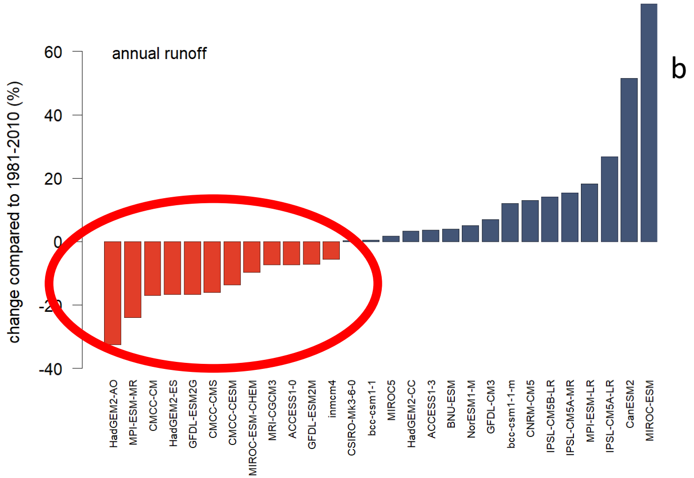
Wet and dry projections…

% change in future rainfall



Runoff enhances risk of drying

% change in future runoff

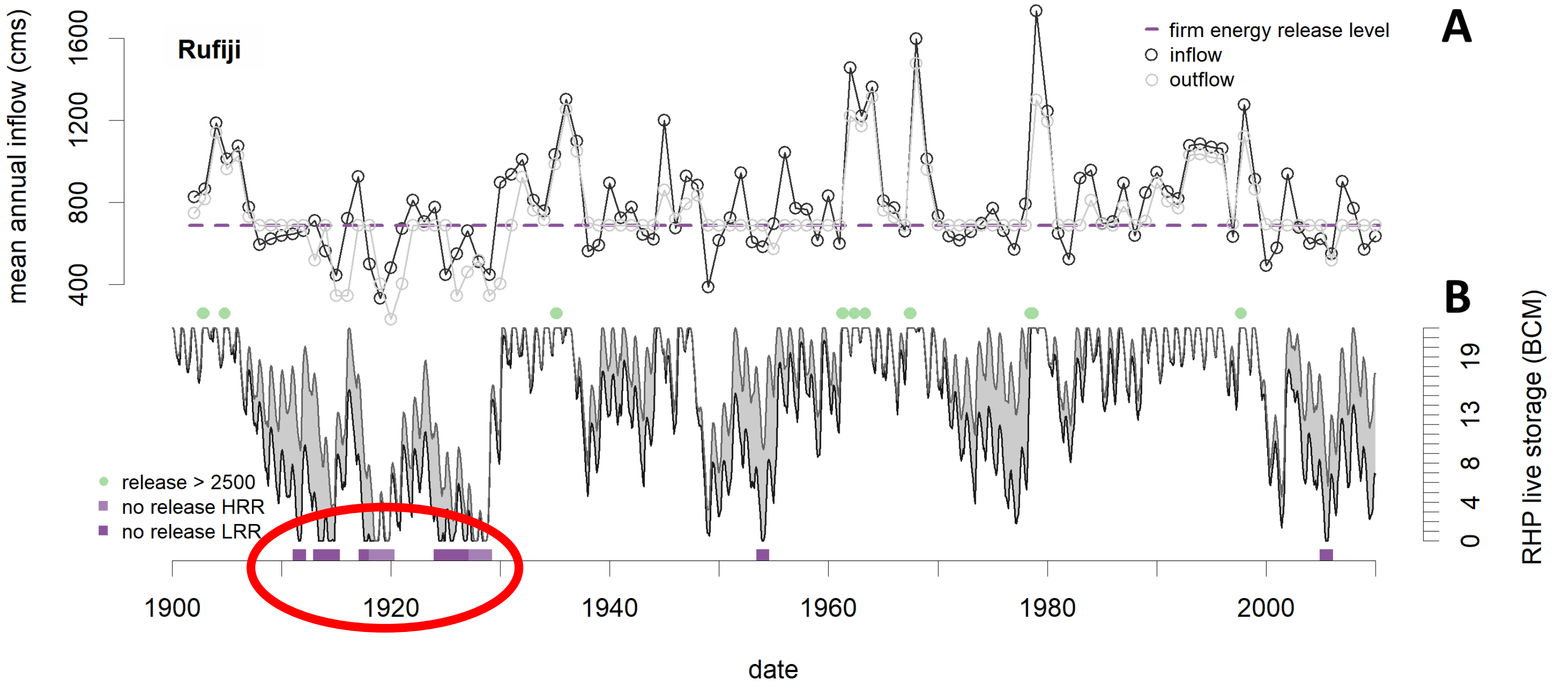


Rainfall – 5 dry models out of 28
Runoff – 12 dry models

Impacts of historical variability

What if JNHPP had been built in 1900?

Siderius, C. et al. (2021) Climate variability impacts water-energy-food infrastructure performance in Eastern Africa. *One Earth* 4, 1-13.

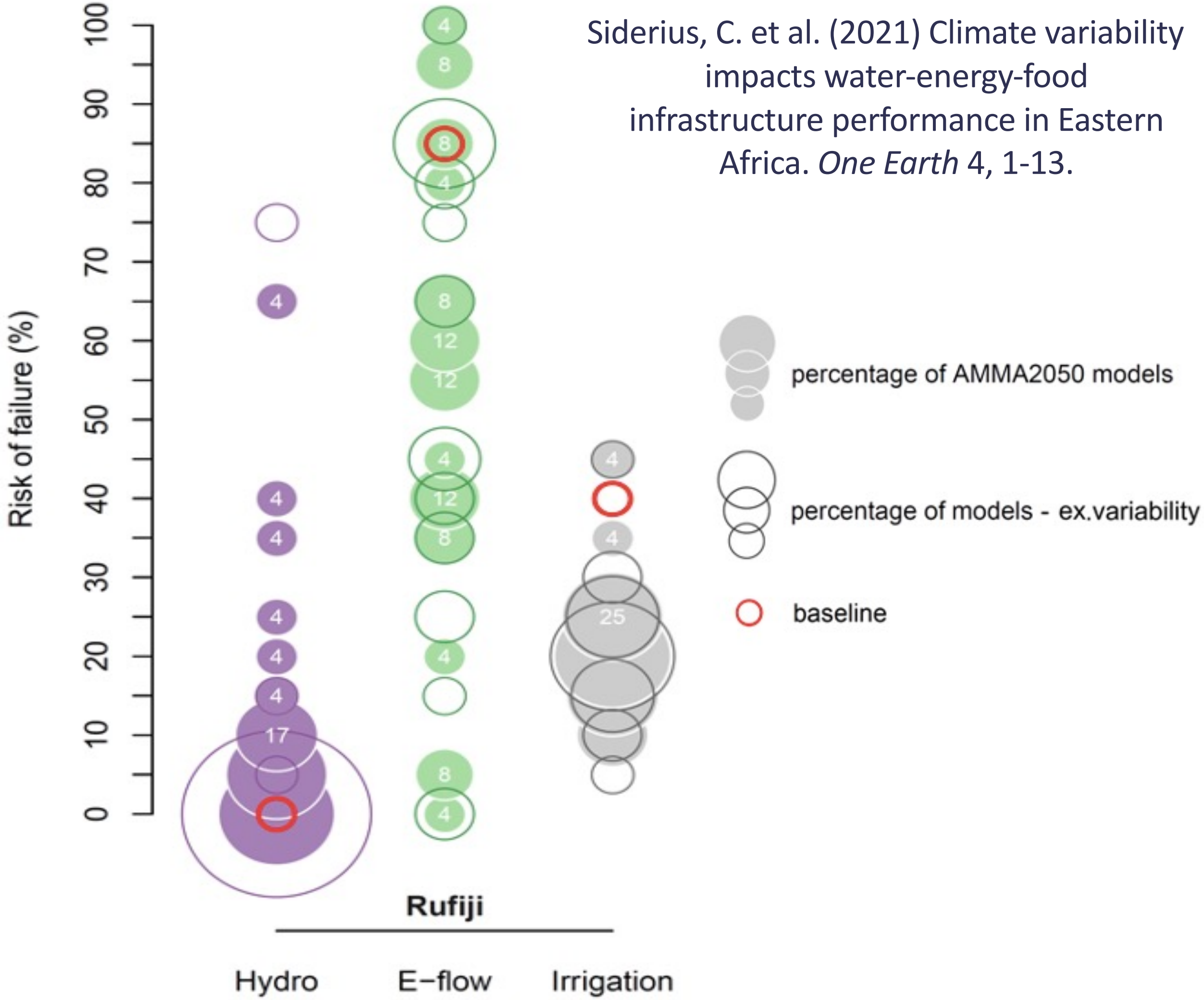


Reservoir buffers dry years

But - multi-year droughts stress system

Failure rates (%) to meet performance objectives under 24 GCM scenarios

- Three performance indicators
- Stress test under range of climate projections + JNHPP + irrigation
- Positive and negative impacts – different between indicators

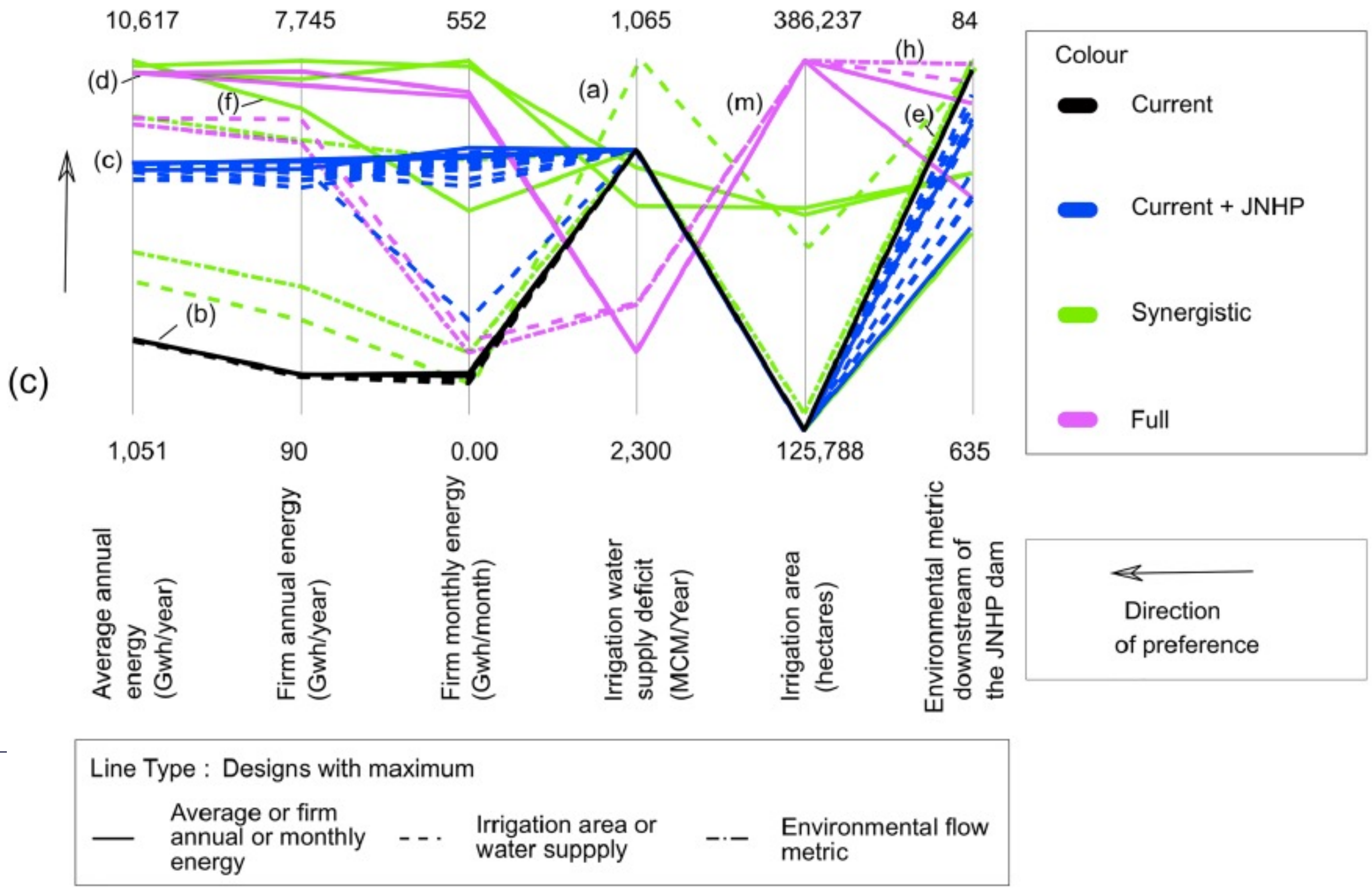


Siderius, C. et al. (2021) Climate variability impacts water-energy-food infrastructure performance in Eastern Africa. *One Earth* 4, 1-13.

Multi-objective optimization – Rufiji Basin

Geressu, R. et al. (2020) Assessing river basin development given water-energy-food-environment interdependencies. Earth's Future, 7.

- Infrastructure options
- Multi-year drought risk
- Contingency plans



The role of governance / political economy

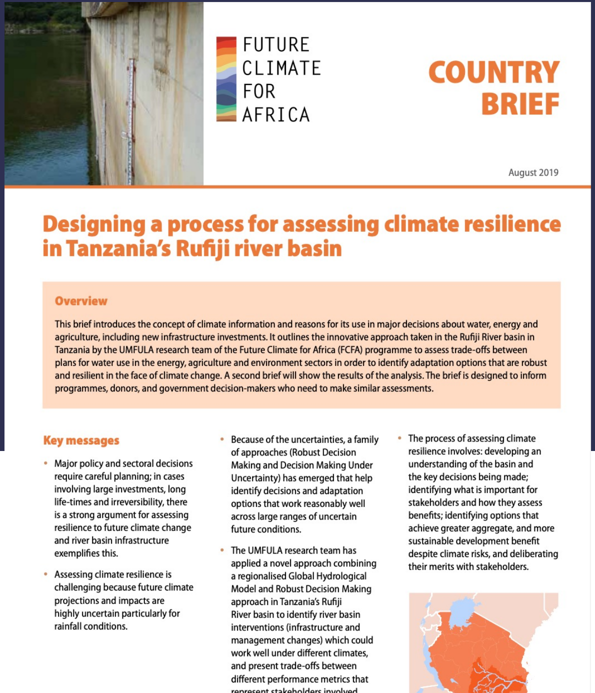
1. *Sufficient water but multi-year drought and trade-offs need consideration*
2. *Management / governance crucial (effectiveness and capacity of delivery systems)*
3. *Political economy factors underpin decisions and outcomes (big decisions, ministerial responsibilities)*

Rufiji Basin work;

Siderius, C. et al. (2021) Climate variability impacts water-energy-food infrastructure performance in Eastern Africa. *One Earth* 4, 1-13.

Geressu, R. et al. (2020) Assessing river basin development given water-energy-food-environment interdependencies. Earth's Future, 7.

Siderius, C., et al. (2021) High stakes decisions under uncertainty…. in Conway, D. and Vincent, K. (eds) Climate Risk in Africa: Adaptation and Resilience. Palgrave, Macmillan.


FUTURE CLIMATE FOR AFRICA

COUNTRY BRIEF

August 2019

Designing a process for assessing climate resilience in Tanzania's Rufiji river basin

Overview

This brief introduces the concept of climate information and reasons for its use in major decisions about water, energy and agriculture, including new infrastructure investments. It outlines the innovative approach taken in the Rufiji River basin in Tanzania by the UMFULA research team of the Future Climate for Africa (FCFA) programme to assess trade-offs between plans for water use in the energy, agriculture and environment sectors in order to identify adaptation options that are robust and resilient in the face of climate change. A second brief will show the results of the analysis. The brief is designed to inform programmes, donors, and government decision-makers who need to make similar assessments.

Key messages

- Major policy and sectoral decisions require careful planning; in cases involving large investments, long life-times and irreversibility, there is a strong argument for assessing resilience to future climate change and river basin infrastructure exemplifies this.
- Assessing climate resilience is challenging because future climate projections and impacts are highly uncertain particularly for rainfall conditions.
- Because of the uncertainties, a family of approaches (Robust Decision Making and Decision Making Under Uncertainty) has emerged that help identify decisions and adaptation options that work reasonably well across large ranges of uncertain future conditions.
- The UMFULA research team has applied a novel approach combining a regionalised Global Hydrological Model and Robust Decision Making approach in Tanzania's Rufiji River basin to identify river basin interventions (infrastructure and management changes) which could work well under different climates, and present trade-offs between different performance metrics that
- The process of assessing climate resilience involves: developing an understanding of the basin and the key decisions being made; identifying what is important for stakeholders and how they assess benefits; identifying options that achieve greater aggregate, and more sustainable development benefit despite climate risks, and deliberating their merits with stakeholders.

Thank you

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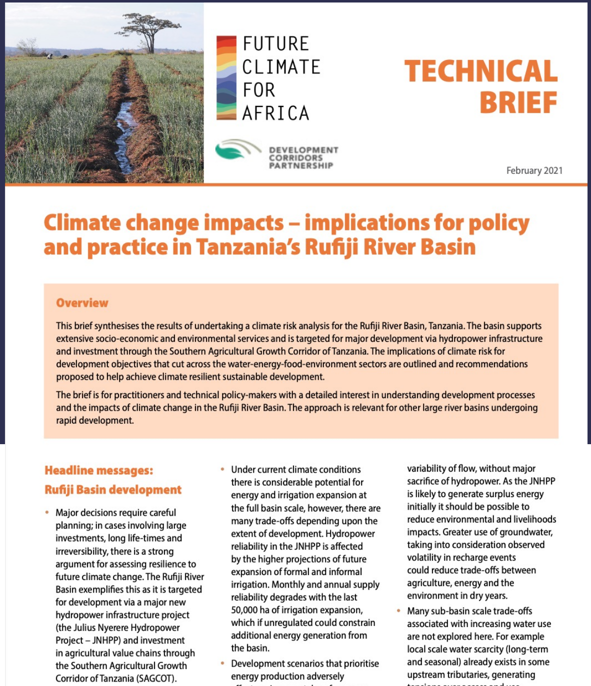
FUTURE CLIMATE FOR AFRICA

DEVELOPMENT CORRIDORS PARTNERSHIP

TECHNICAL BRIEF

February 2021

Climate change impacts – implications for policy and practice in Tanzania's Rufiji River Basin

Overview

This brief synthesises the results of undertaking a climate risk analysis for the Rufiji River Basin, Tanzania. The basin supports extensive socio-economic and environmental services and is targeted for major development via hydropower infrastructure and investment through the Southern Agricultural Growth Corridor of Tanzania. The implications of climate risk for development objectives that cut across the water-energy-food-environment sectors are outlined and recommendations proposed to help achieve climate resilient sustainable development.

The brief is for practitioners and technical policy-makers with a detailed interest in understanding development processes and the impacts of climate change in the Rufiji River Basin. The approach is relevant for other large river basins undergoing rapid development.

Headline messages: Rufiji Basin development

- Major decisions require careful planning; in cases involving large investments, long life-times and irreversibility, there is a strong argument for assessing resilience to future climate change. The Rufiji River Basin exemplifies this as it is targeted for development via a major new hydropower infrastructure project (the Julius Nyerere Hydropower Project – JNHPP) and investment in agricultural value chains through the Southern Agricultural Growth Corridor of Tanzania (SAGCOT).
- Under current climate conditions there is considerable potential for energy and irrigation expansion at the full basin scale, however, there are many trade-offs depending upon the extent of development. Hydropower reliability in the JNHPP is affected by the higher projections of future expansion of formal and informal irrigation. Monthly and annual supply reliability degrades with the last 50,000 ha of irrigation expansion, which if unregulated could constrain additional energy generation from the basin.
- Development scenarios that prioritise energy production adversely

variability of flow, without major sacrifice of hydropower. As the JNHPP is likely to generate surplus energy initially it should be possible to reduce environmental and livelihoods impacts. Greater use of groundwater, taking into consideration observed volatility in recharge events could reduce trade-offs between agriculture, energy and the environment in dry years.

- Many sub-basin scale trade-offs associated with increasing water use are not explored here. For example local scale water scarcity (long-term and seasonal) already exists in some upstream tributaries, generating