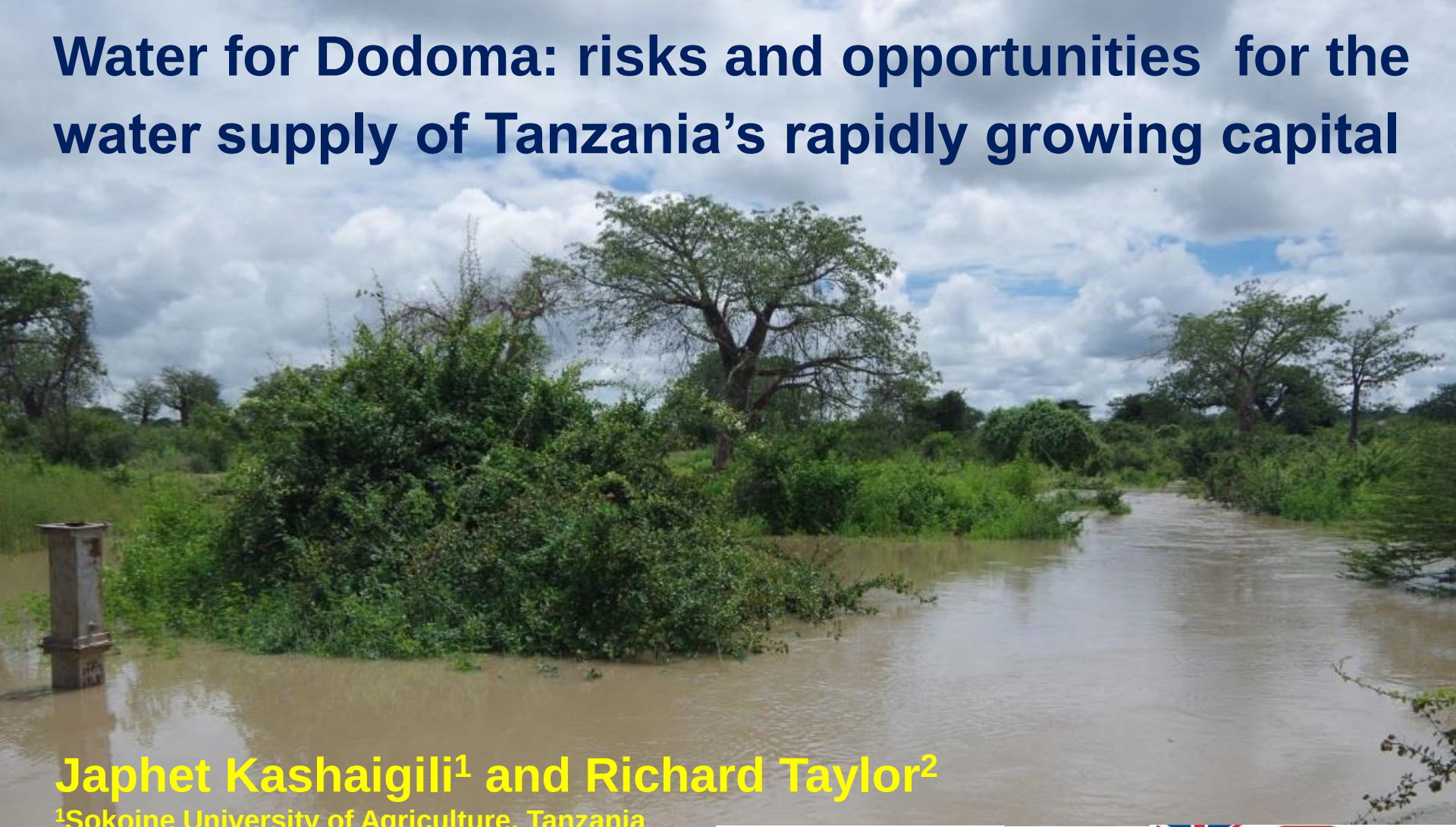
Water for Dodoma: risks and opportunities for the water supply of Tanzania's rapidly growing capital



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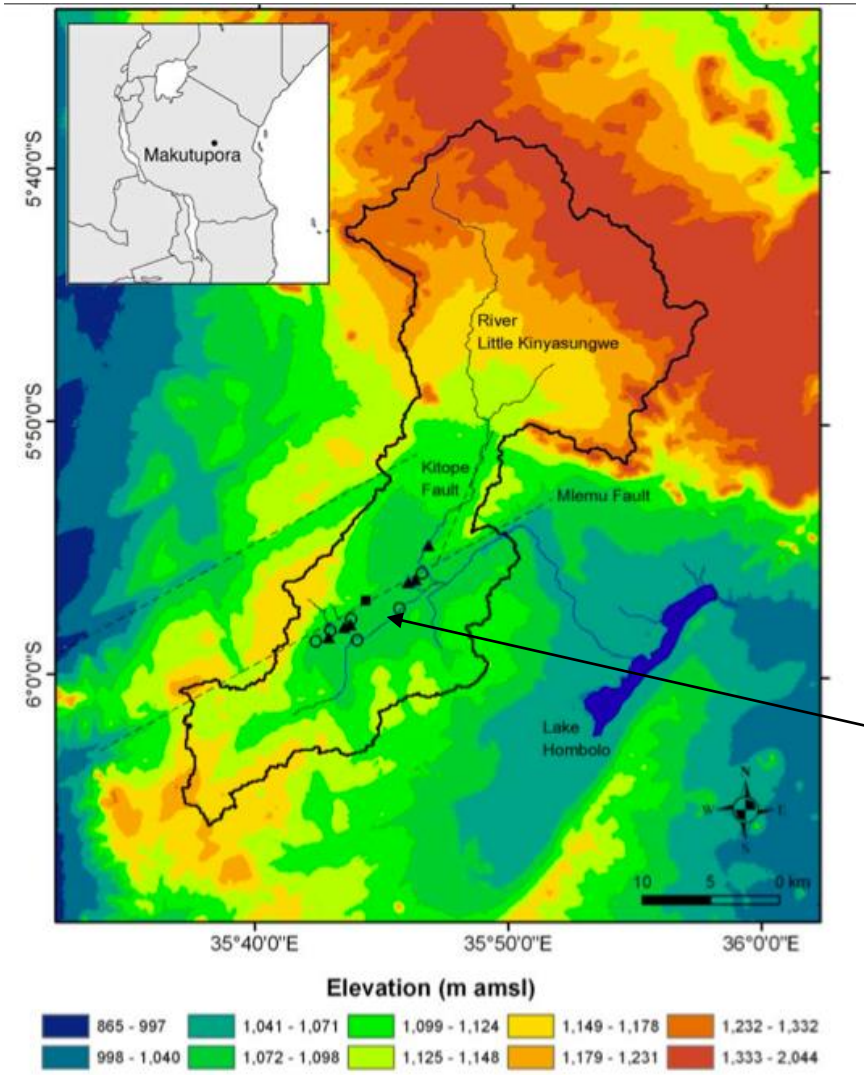
AfWA2020 (Kampala), 24 Feb 2020
UPGro Seminar: From where does your water come?

Makutapora Wellfield

- supplies >50 000 m^3 of safe water daily to the capital city of Dodoma in central, semi-arid Tanzania



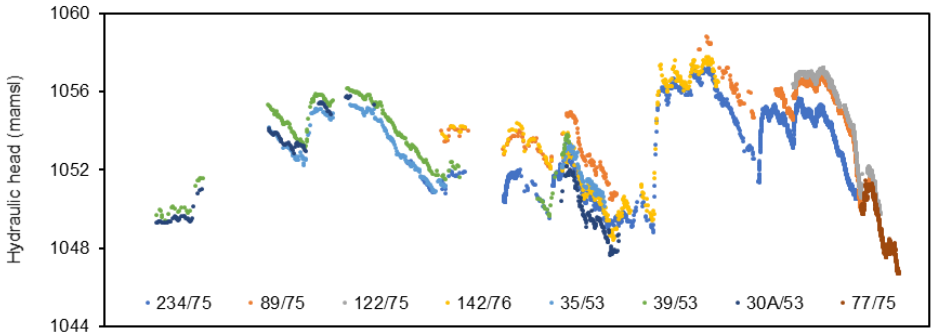
- high well yields aligned to faults in weathered basement aquifer system

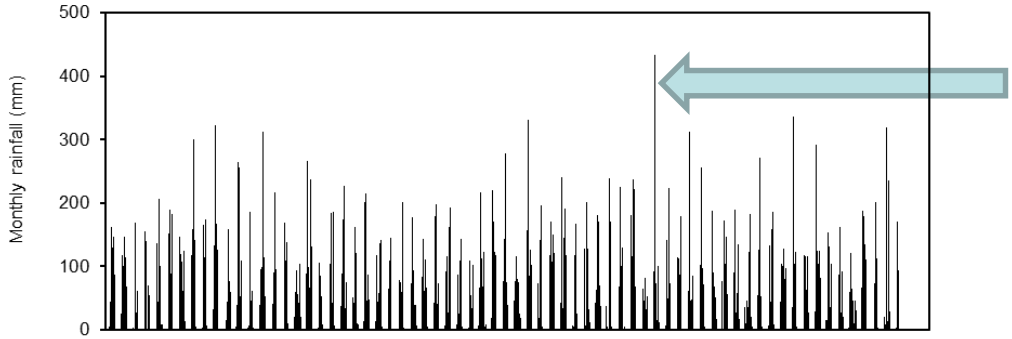
Makutapora Wellfield

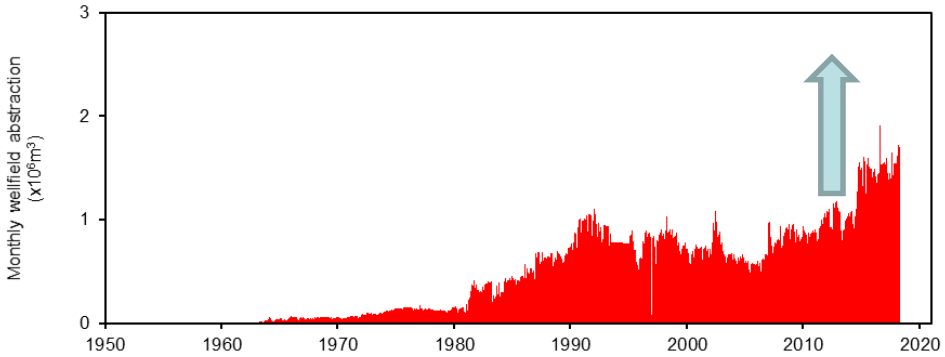
The Makutapora Record

GroFutures

- multi-decadal record of groundwater levels reveals episodic replenishment and rising abstraction rates







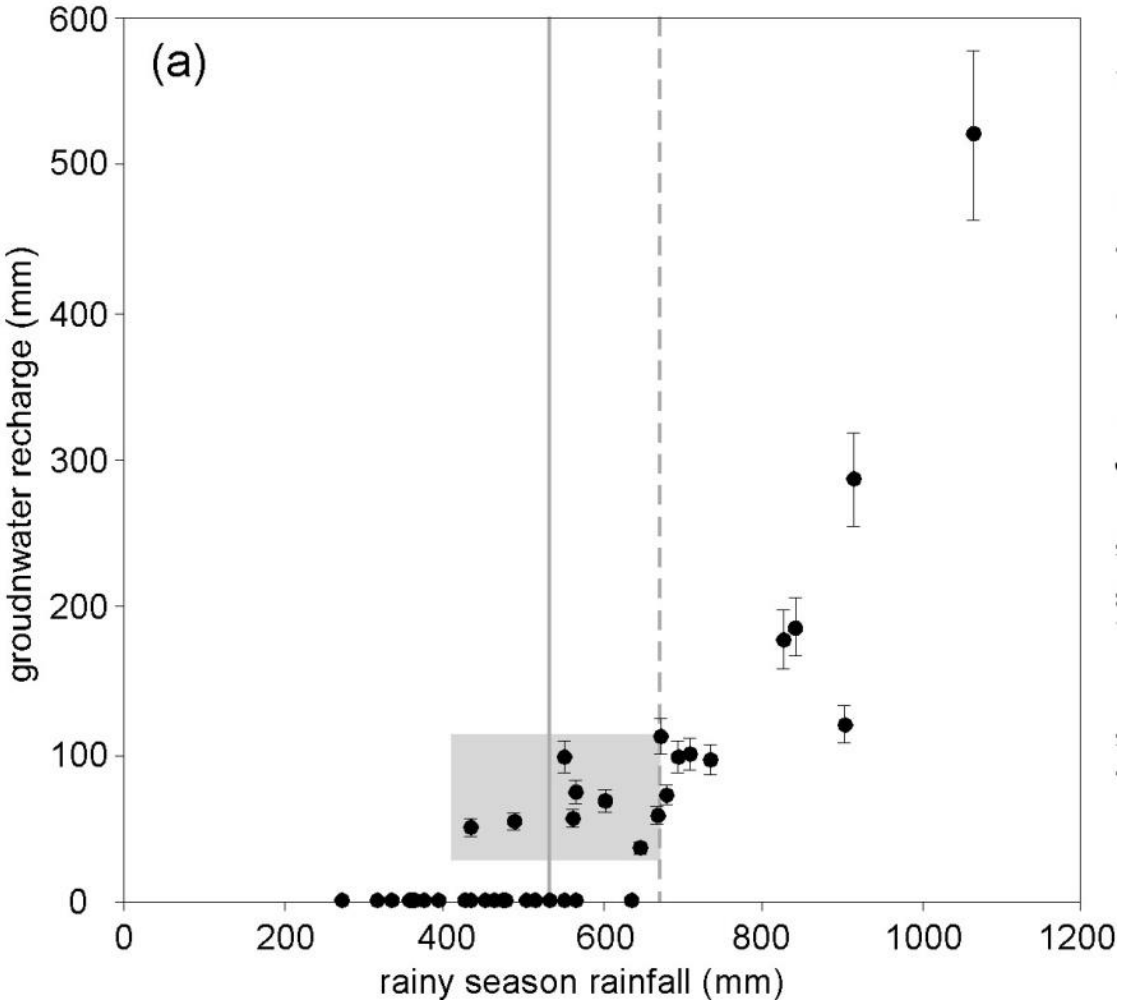
exceptional rainfall of 1997/1998 El Niño

~50% increase in pumping (May 2015)

recharge and extreme rainfall

- recharge results disproportionately from extreme seasonal rainfall

- substantial recharge occurs episodically, just 2 to 3 seasons each decade

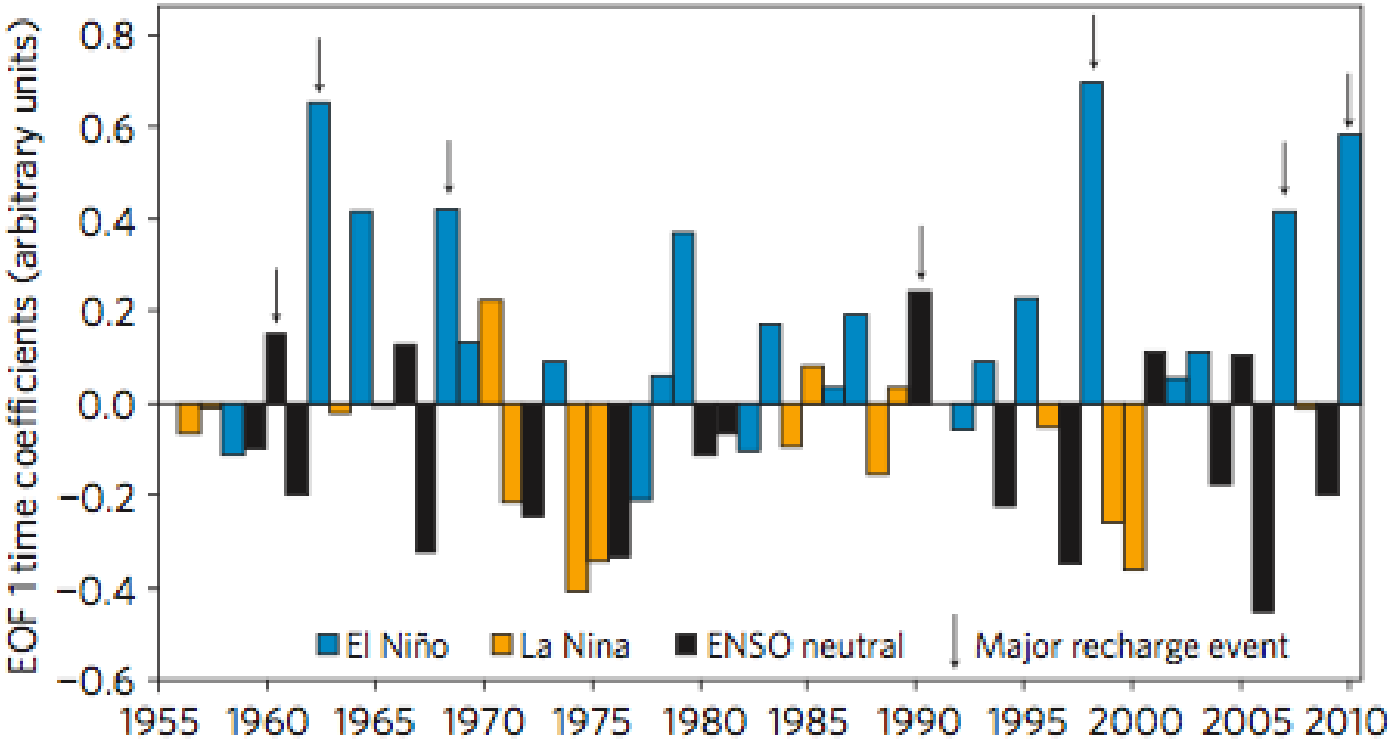


mean R = 0.47 m·decade^{-1} (1955-2010)

Taylor et al. (2013) Nature Climate Change 3: 374-378.

episodic recharge and El Niño events

- variations in seasonal rainfall categorised by large-scale influences (El Niño, La Niña, neutral)



- rainy seasons producing substantial recharge (arrows) associated with El Niño events

Taylor et al. (2013) Nature Climate Change 3: 374-378.

Intensification of rainfall under climate change

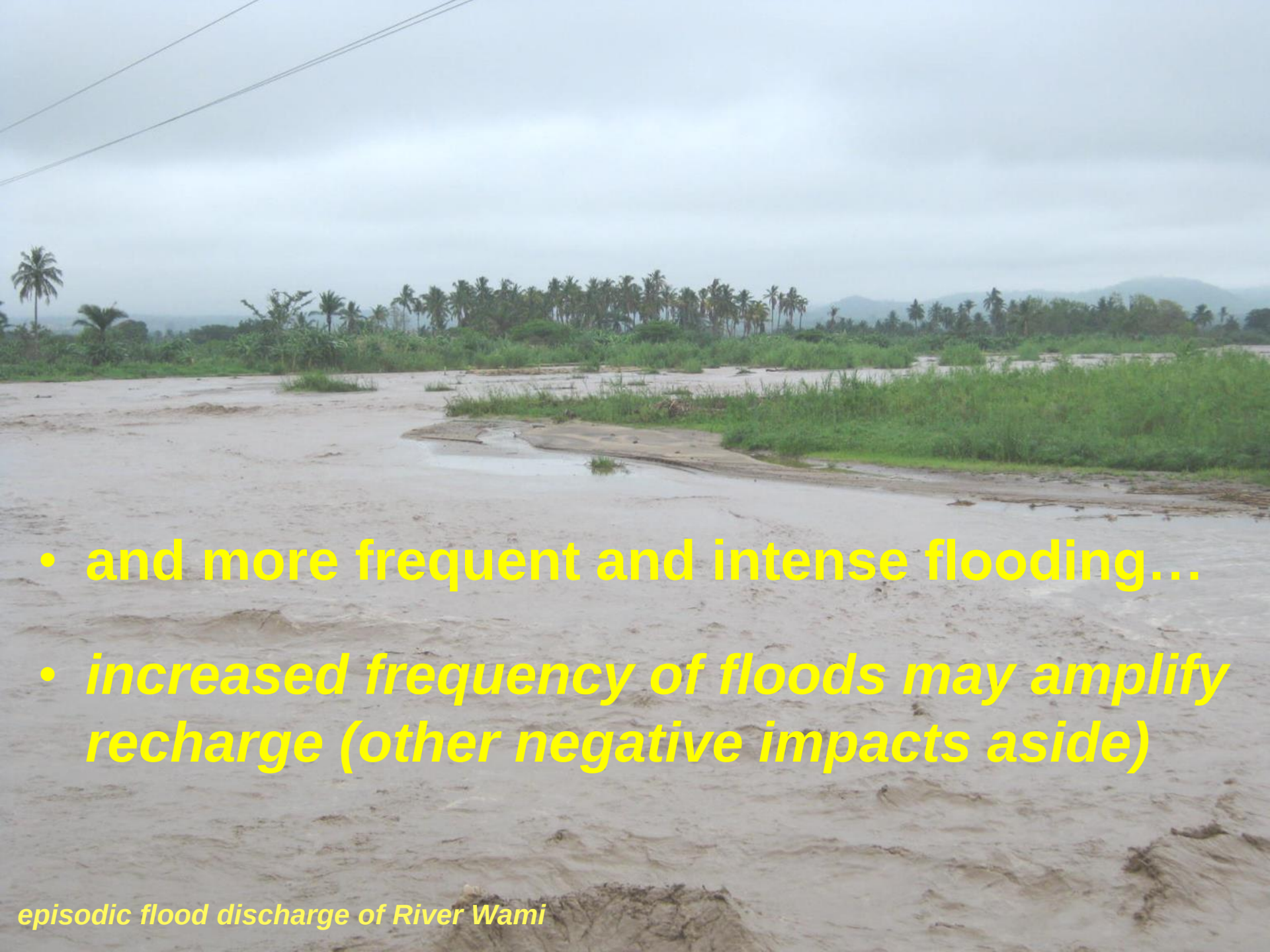
- **global warming intensifies rainfall resulting in <u>fewer</u>, low/medium rainfalls and <u>more frequent</u> very heavy rainfalls - "extreme events"**

Rainstorm in Namibia

Allan *et al.* (2010) *Environ. Res. Lett.*, 5: 025205.
Min *et al.*, 2011. *Nature,* 470: 378-381.

- leading to more frequent and longer droughts

sand river in central Tanzania



- **and more frequent and intense flooding…**
- ***increased frequency of floods may amplify recharge (other negative impacts aside)***

episodic flood discharge of River Wami

- **wellfield recharge primarily arises via leakage from ephemeral streamflow**

Opportunities

- heavy seasonal rainfall is predictable (El Niño) and primary process of wellfield replenishment (focused recharge) informed by field research and modelling
- this knowledge raises the possibility of anticipating major recharge events (during El Niño years) and exploring ways of enhancing replenishment through Managed Aquifer Recharge (MAR) – GoT to evaluate the feasibility of MAR
- injection wells have been used successfully in Windhoek (Namibia) to amplify groundwater recharge from floodwater discharges (Murray et al., 2018)

Risks

- increased abstraction to supply Tanzania's rapidly growing capital could lead to groundwater depletion
- alternative water supply options including inter-basin water transfers are expected to incur very high costs
- challenge of effectively governing self-supply options (private drilling) in Dodoma may also lead to groundwater depletion and degradation
- implementation of MAR to enhance wellfield replenishment carries potential risks of interfering with natural recharge processes.

Looking forward

- Makutapora Wellfield represents an invaluable source of safe water to the capital city of Dodoma
- wellfield features one of the longest monitoring records in Africa - expansion in monitoring beyond areas of pumpage is required to provide an early warning system for risk of groundwater depletion
- MAR strategies need to consider fully natural recharge processes to prevent undesired outcomes such as clogging of recharge pathways, contamination
- example of the Makutapora Wellfield in a dryland environment highlights important, often overlooked connections between surface waters and groundwater

Thanks for listening!

artesian borehole, Singida